Invertebrate Biodiversity and Photo Catalogue from the 2018 Northern and Striped Shrimp Stock Assessment Survey in Davis Strait, Hudson Strait, and Northern Labrador Coast

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2020

Canadian Technical Report of
Fisheries and Aquatic Sciences 3351

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Canadian Technical Report of Fisheries and Aquatic Sciences

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Cat. No. Fs97-6/3351E-PDF ISBN 978-0-660-33582-7 ISSN 1488-5379

Correct citation for this publication:

Lacasse, O., Roy, V., Nozères, C., Deslauriers, D., and Walkusz, W. 2020. Invertebrate Biodiversity and Photo Catalogue from the 2018 Northern and Striped Shrimp Stock Assessment Survey in Davis Strait, Hudson Strait, and Northern Labrador Coast. Can. Tech. Rep. Fish. Aquat. Sci. 3351: iv + 163 p.

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ABSTRACT

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This report is intended to give information on the bycatch of primarily benthic marine invertebrate species from a collaborative survey carried out in 2018 by the Northern Shrimp Research Foundation (NSRF) and Fisheries and Oceans Canada (DFO) Central and Arctic Region in Davis Strait, Hudson Strait, Ungava Bay and along the Northern Labrador Coast. An analysis of captures and photos taken from 121 stations revealed the presence of 296 taxa representing 12 phyla, including 78 taxa of arthropods and 54 taxa of echinoderms. The normalized biomass of bycatch was 221 kg in Davis Strait, primarily composed of sponges (130 kg), and 160 kg in Hudson Strait, primarily composed of arthropods (119 kg). This work is complementary to other recent photo catalogues from neighboring areas and increases our knowledge of the invertebrate diversity in this region, adding to the existing body of work from the Eastern Canadian Arctic.

RÉSUMÉ

Lacasse, O., Roy, V., Nozères, C., Deslauriers, D., et Walkusz, W. 2020. Invertebrate Biodiversity and Photo Catalogue from the 2018 Northern and Striped Shrimp Stock Assessment Survey in Davis Strait, Hudson Strait, and Northern Labrador Coast. Rapp. tech. can. sci. halieut. aquat. 3351 : iv + 163 p.

Ce rapport vise à donner de l'information sur les prises accessoires des espèces d'invertébrés marins principalement benthiques provenant d'un relevé collaboratif effectué en 2018 par la fondation pour la recherche sur la crevette nordique (Northern Shrimp Research Foundation – NSRF) et la région centrale et arctique de Pêches et Océans Canada (MPO) dans les détroits de Davis et d'Hudson, la baie d'Ungava et le long de la côte du nord du Labrador. L'analyse des prises et photos effectuées à 121 stations a révélé la présence de 296 taxons représentant 12 phylums, incluant 78 taxons d'arthropodes et 54 taxons d'échinodermes. La biomasse normalisée des prises accessoires était de 221 kg dans le détroit de Davis et était principalement composée d'éponges (130 kg), alors qu'elle était de 160 kg dans le détroit d'Hudson et était principalement composée d'arthropodes (119 kg). Ce travail est complémentaire à d'autres photo catalogues pour des régions avoisinantes et contribue à augmenter les connaissances sur la biodiversité des invertébrés dans la région de l'Est de l'Arctique canadien.

INTRODUCTION

The stock status of the commercially harvested shrimp *Pandalus borealis* (Northern Shrimp) and *Pandalus montagui* (Striped Shrimp) along the Northern Labrador Coast (Labrador Sea) and in the Eastern Canadian Arctic (Davis Strait, Hudson Strait) has been assessed annually since 2005. For this purpose, a bottom trawl survey is conducted by the Northern Shrimp Research Foundation (NSRF) in a joint industry-government effort between NSRF and Fisheries and Oceans Canada (DFO), where DFO provides NSRF with sampling design and performs the analyses of the data collected (DFO 2009a). The main goal of the survey is to provide fishery-independent information on shrimp distribution, sex and maturity status, and length frequencies which are used to calculate indices of total abundance, fishable biomass and spawning stock biomass for the two shrimp species (DFO 2018). In addition, the survey provides information on the distribution, abundance and biomass of the bycatch of fish and invertebrate species collected in the trawl. Up until 2018, the identification of the invertebrate bycatch was done by the NSRF science team, however, several taxonomic groups were only identified to a general level (*e.g.,* phylum, order, or family).

Traditionally, the catch data with taxa names, weights and counts were recorded in databases and apart from freezing a specimen for later examination, identification done at sea was not validated. However, the recent use of digital images to document catches and their compilation in reports and guides has helped improve identification by survey personnel, and enabled faster data processing by reducing the number of specimens collected for later examination by specialists (Nozères et al. 2010, 2014). The improvement of the identification done at sea enables the occurrence data from this survey, and future ones, to complement other regular groundfish/shellfish and multispecies surveys in the Atlantic-Arctic marine area in providing information on invertebrate biodiversity (Jørgensen et al. 2017). Hence, for these reasons, a DFO biologist (Olivia Lacasse) took part in the 2018 NSRF survey to record the invertebrate biodiversity at the lowest possible taxonomic level.

The scope of the work in 2018 was divided into three objectives: a) to acquire detailed data on diversity and spatial distribution of invertebrates in the areas covered by the survey, b) to collect samples of *P. borealis* and *P. montagui* for use in bio-indicator research, and c) to sample fish stomachs for diet analysis (shrimp predators). This document covers the first objective related to benthic biodiversity.

MATERIALS AND METHODS

Study Area

The study area is divided into three Shrimp Fishing Areas (SFA 2, 3 and 4; Figure 1a) included within Northwest Atlantic Fisheries Organization Divisions (NAFO) 0B and 2 (Figure 1b). These SFAs can be divided into two major areas having specific surface water circulation patterns: Davis Strait (SFA 2) and Northern Labrador Sea (SFA 4) (Figure 2a), and Hudson Strait and Ungava Bay (SFA 3) (Figure 2b).

Davis Strait (300 km wide and 1000 m deep, on average) is located at the south end of Baffin Bay where it connects to the Labrador Sea and Hudson Strait (Figure 2a). The Baffin Island Current (BIC) flows southward along Canada's shelf and slope through Davis Strait and the Northern Labrador Sea (Hamilton and Wu 2013). The BIC is created by the input of cold and fresh Arctic water making its way to Baffin Bay through Nares Strait, Jones Sound and Lancaster Sound (Tang et al. 2004; Cuny et al. 2005; Curry et al. 2011). The BIC follows the east coast of Baffin Island, enters the western half of Davis Strait and feeds the Labrador Current (Hamilton and Wu 2013). The West Greenland Current is also a tributary to the water that flows south through Davis Strait and the Labrador Sea.

Hudson Strait is a channel linking Hudson Bay and Foxe Basin to the Northern Labrador Sea and Davis Strait (Harvey et al. 1997). Ungava Bay is located on the southern boundary of Hudson Strait and both are influenced by freshwater runoff into Ungava Bay, low salinity water from Hudson Bay and Foxe Basin, and high salinity oceanic water from the Labrador Sea (Drinkwater 1986, 1990). Drinkwater (1990) describes the residual circulation pattern in Hudson Strait to be dominated by three features: (1) a strong nearshore coastal current flowing southward along the Quebec shores that exits the Strait north of Cape Chidley, (2) a weaker, broader current flowing northwestward on the Baffin Island side of the Strait, and (3) a strong southward cross-channel flow in the eastern half of the Strait (Figure 2b).

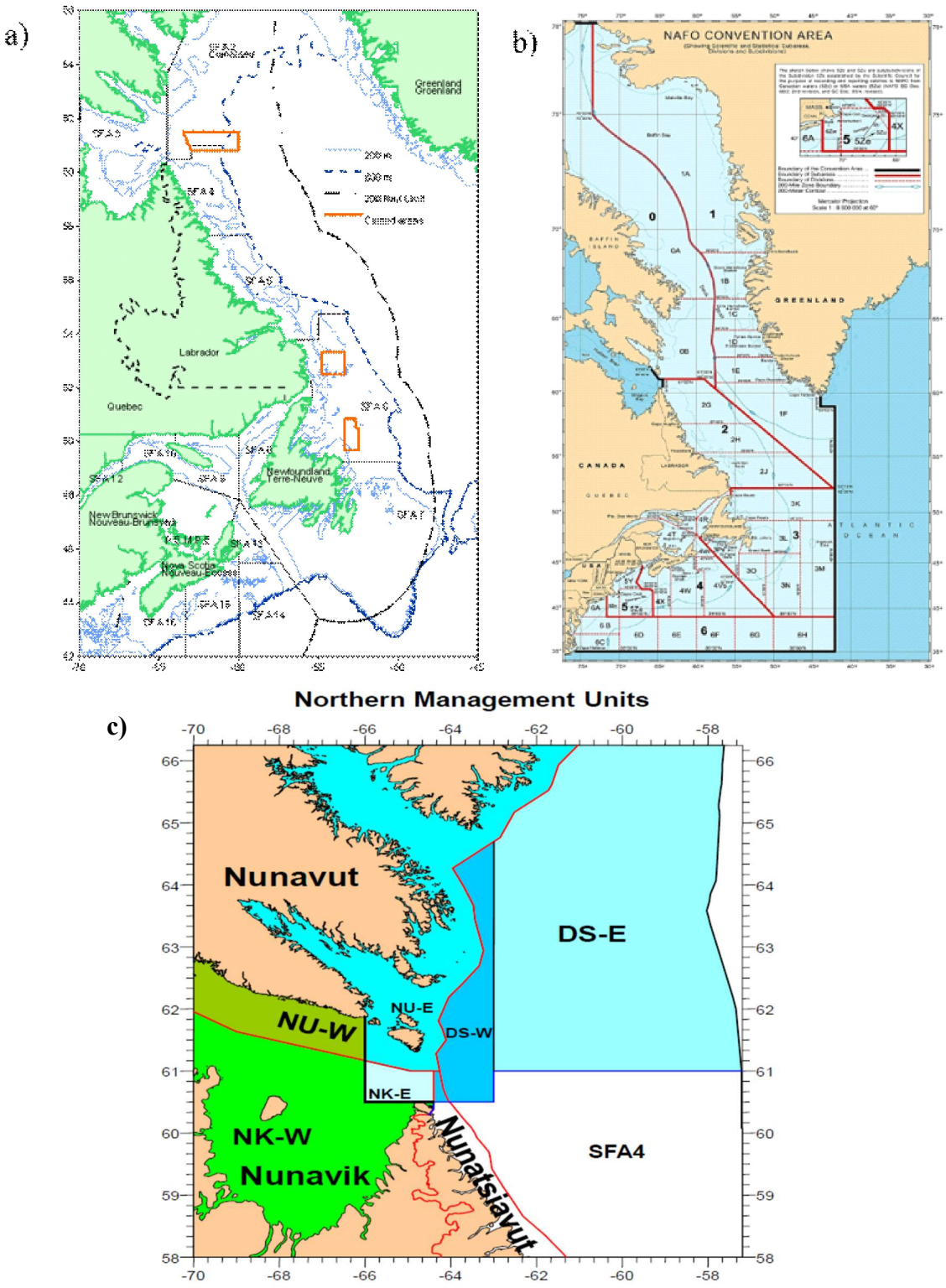
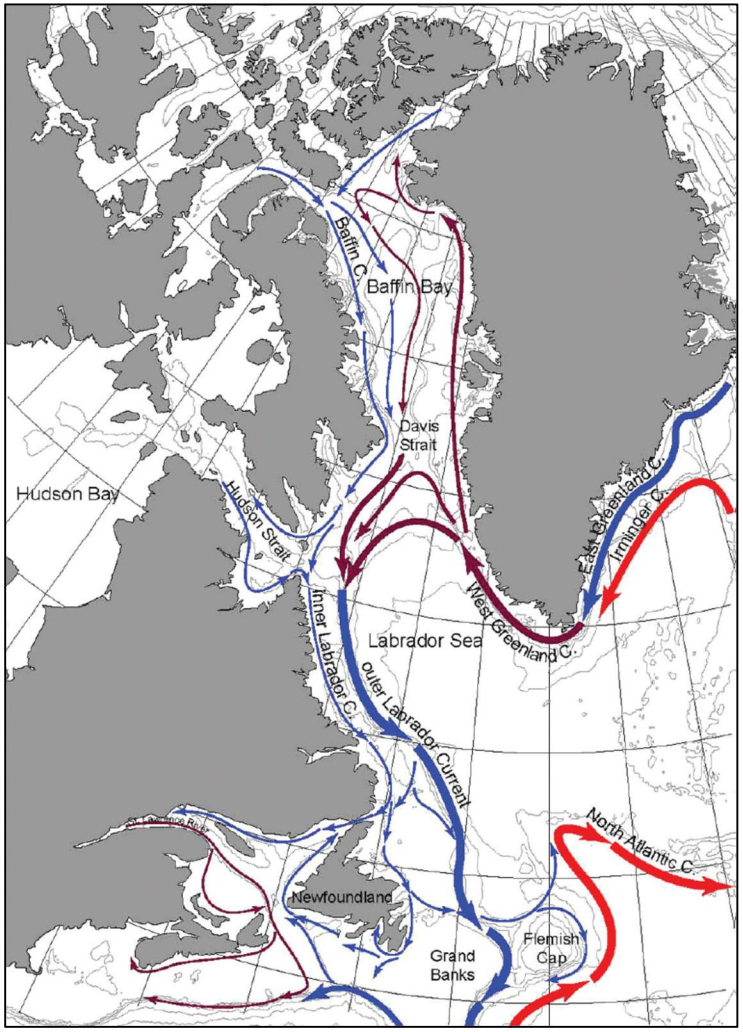


Figure 1. a) Northern and Striped Shrimp Fishing Areas – SFAs (DFO 2015), b) Northwest Atlantic Fisheries Organization (NAFO) areas (NAFO 2019), and c) Eastern (in green) and Western (in blue) Northern and Striped Shrimp Assessment Zones (DFO 2019).

a)



b)

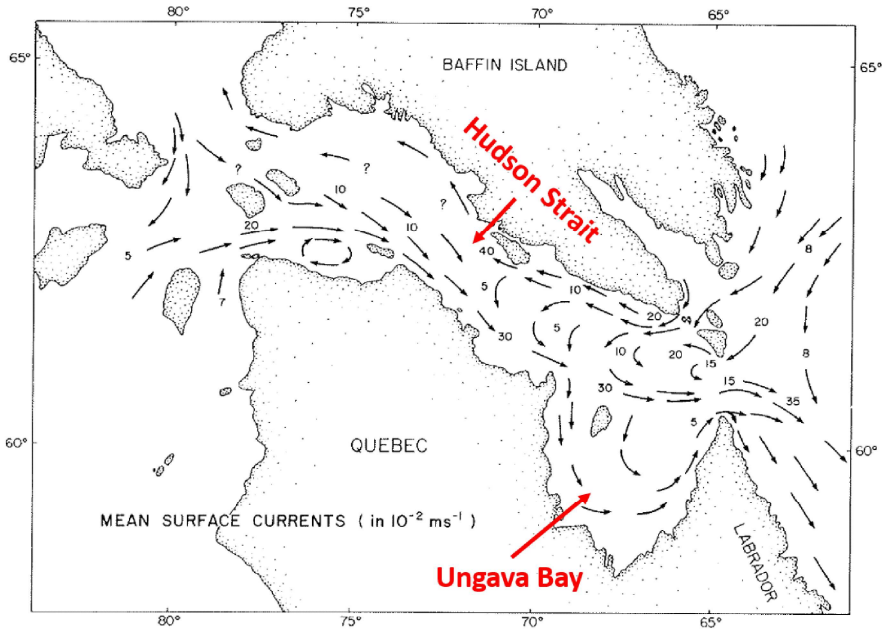


Figure 2. Surface water circulation patterns for a) Northwest Atlantic, coloured by current type: blue = cold, purple = temperate, red = warm (Solignac et al. 2011), and b) Hudson Strait and Ungava Bay during summer (Drinkwater 1990).

Invertebrate Biodiversity Sampling

The 2018 NSRF survey was carried out between July 21st and September 4th by the F/V *Aqviq*. The 2018 survey covered SFAs 2, 3 and, 4 (Figure 1). For the purpose of the DFO shrimp assessments, SFA 3 is analogous to the Western Assessment Zone, while SFA 2 is analogous to the Eastern Assessment Zone (DFO 2018). Each area was divided by depth strata (100–199 m, 201–300 m, 301–400 m, 401–500 m and 501–750 m). The stations were assigned using a buffered, depth-stratified, random survey design. Two types of sampling gears were used during this survey: a standard Campelen trawl (SCT) and a modified Campelen trawl (MCT), both with an average horizontal opening of 17 m and a 12.7 mm mesh line in the cod end. The difference between the two gears resides in the diameter of the rock hopper wheels: the MCT has bigger wheels to reduce incidence of net damage when trawling rocky areas. Historically, the SCT was used for the survey done on the Labrador coast (SFA 4) by DFO-Newfoundland and Labrador Region while the MCT was used by DFO-Central and Arctic Region to cover the arctic SFAs 2 and 3. During the 2018 NSRF survey, a total of 75 stations were sampled using the SCT and 248 stations were sampled with the MCT. Sampling trawl depth ranged between 100 and 750 m and the duration of a tow was standardized to 15 minutes at a speed of 3 knots. Sets deemed successful were hauled on deck to be sorted and processed morphologically. The year 2018 marks the first time that a DFO biologist was part of the NSRF survey. The work done by this biologist was independent from the routine work done by the NSRF team, who have been recording bycatch found in their subsamples since 2005.

The bycatch protocol of the present study is different than the one used by the NSRF team. The NSRF protocol targets *P. borealis* and *P. montagui* populations, with a 5 kg subsample of each trawlset catch used to characterize both *Pandalus* populations and associated bycatch. Testing and implementing new procedures for sampling bycatch (with logistics, time and space requirement as constraining factors) resulted in a change of the sampling method (Methods 1 and 2) and an increase in scientific rigor and greater detail in identification during the survey:

> **Method 1.** The DFO biologist haphazardly collected invertebrates from the bycatch on the sorting belt, to be counted and identified to the lowest taxonomic level possible. A total of 22 stations (out of 108 biodiversity stations) were sampled using this method.
>
> **Method 2.** For each station pre-selected (selected to ensure that the minimum number of stations per depth, strata and SFA was attained) by the DFO biologist, when there was more than one basket of the catch collected by the NSRF team, they would haphazardly set aside one basket (up to a maximum weight of 25 kg) of the mixed catch (small fish, *Pandalus* shrimp, all other invertebrates). For each basket, the fish and *Pandalus* shrimp were removed and the remainder was sorted, identified when possible to the lowest taxonomic

level possible, counted and weighed by taxon. A total of 86 stations (out of 108 biodiversity stations) were sampled using this method.

Method 1 was used for all stations in SFA 4 (with the exception of two stations) and for the first three stations in SFA 3. Method 2 was used for two stations in SFA 4 and for the remaining stations in SFA 2 and SFA 3 (Table 1).

Table 1. Number (n) of stations in the three shrimp fishing areas (SFA) completed during the 2018 NSRF survey in each depth stratum (All catches), along with the number of stations for which catch was photographed (Catch with photos) and for which bycatch was further characterized for biodiversity (Catch weighed) using either method 1 or 2.

Shrimp Fishing Area	Depth stratum (m)	Number of Stations				
		All catches	Catch with photos	Catch weighed	Bycatch Method 1	Bycatch Method 2
Davis Strait (SFA 2)	100–199	9	6	5	0	5
	200–299	52	15	12	0	12
	300–399	57	21	20	0	20
	400–499	21	13	13	0	13
	500–750	19	13	12	0	12
Sub-total		158	68	62	0	62
Hudson Strait and Ungava Bay (SFA 3)	100–199	22	5	3	0	3
	200–299	36	9	6	0	6
	300–399	15	6	6	1	5
	400–499	8	5	5	1	4
	500–750	9	6	5	1	4
Sub-total		90	31	25	3	22
Labrador coast (SFA 4)	100–199	28	6	6	6	0
	200–299	32	6	5	5	0
	300–399	7	3	3	3	0
	400–499	5	4	4	4	0
	500–750	3	3	3	1	2
Sub-total		75	22	21	19	2
TOTAL		323	121	108	22	86

The reasons for changing from method 1 to 2 include: (1) less subjectivity during sampling, (2) consideration of smallest invertebrates that could be overlooked when using method 1, (3) semi-standardization of sampling method for stations done during the day and the night, and (4) faster workflow for the NSRF crew. For both methods, data on abundance (number of individuals, with the exception of brittle stars and colonial taxa that were not counted individually but in physical

clusters when possible) and bulk weight (g) of all individuals from the same taxon were recorded in a MS Access catch database developed by DFO Central and Arctic Region. It is important to note that, for a given station, the total weight entered in the database represents the weight of the whole catch and the subsample weight refers to the sum of the weights of the invertebrates recorded in the database at each station. For some stations, *P. borealis* and *P. montagui* weight was recorded in the database but it was not used for this study. The weights of the baskets were not systematically recorded before sorting, so the average weight of each basket was obtained by dividing the weight of the whole catch by the number of baskets for that catch. Therefore, the bycatch biomasses presented herein are considered to be approximate. In addition to benthic invertebrates, pelagic crustaceans, molluscs and cnidarians were also recorded and photographed to represent the total diversity of bycatch seen during the NSRF survey.

Creation of a photo catalogue

For every station that had a basket set aside to be analyzed (method 2), photos were taken of the entire sorted catch next to a visible label and ruler. When time did not allow for the analysis of the entire bycatch (*i.e.*, to sort, count and weigh the invertebrates), the content of the basket was spread onto the sorting belt and photos were taken to represent the catch. The photos were then used in the taxonomic diversity analysis.

The photos of bycatch were taken with a 12 MP waterproof point-and-shoot compact camera with a flash diffuser (Olympus TG-5). Individual specimens were photographed on a white or black background with a white survey label, and a scaled label (5 cm scale) when possible. At the end of each day, the photos were transferred to a computer directly from the camera into an Adobe Photoshop Lightroom 6 catalog. The photos were then tagged with keywords for station number, SFA and depth stratum. Following the survey, all the photos in the Lightroom catalogue were reviewed by Claude Nozères, Olivia Lacasse and by other experts for specific groups (see Acknowledgements) to identify taxa to their lowest taxonomic level possible. When a taxon was identified, it was tagged with keywords using its taxonomic name. The valid taxonomic names were obtained from the World Register of Marine Species (http://www.marinespecies.org). In addition, photos of the whole catch were taken by one of the ship crew members at 313 stations (not all the 323 stations were photographed) when they were transferred on the conveyor belt (totalling ~ 2,500 photos). The content of these photos is not covered in the present document but available as a visual reference of the species assemblage at each station. All the photos taken during this survey are stored at Maurice Lamontagne Institute in Mont-Joli, Quebec.

Identification of Invertebrates

Taxa were identified to the lowest taxonomic level possible onboard with the use of a photo catalogue from Northwest Atlantic areas (Nozères et al. 2014) and identification guides from Northwest Atlantic areas and Atlantic-Arctic areas such as Grainger (1966) and Pawson (1977) for Echinodermata; Savard and Nozères (2012), Pohle (1988, 1990), Zakharov et al. (2018) and Sars (1895) for Arthropoda; Kenchington et al. (2015) and Sebens (1998) for Cnidaria; Frandsen and Zumholz (2004), Bernard (1979) and Alexeyev (2003) for Mollusca; and Kenchington et al. (2015) and Dinn and Leys (2018) for sponge morphotypes. Hence, whenever an invertebrate was difficult to identify, it was photographed, tagged with a unique identifier (sequential number), collected and immediately frozen at -20 °C. Frozen specimens of pycnogonids, gastropods and bivalves were identified in the laboratory by Virginie Roy with the use of identification guides such as Abbott (1954) and Bouvier (1923). Sponge species identification often requires spicule examination and genetic analysis for confirmation (Dinn and Leys 2018). Unfortunately, time and ressources did not allow us to do as Dinn and Leys (2018) recommended and sponges were identified with the help of identification guides mentioned above. Deoxyribonucleic acid (DNA) barcoding analysis was done on a few selected specimens at the Laboratory of Genomics at Maurice Lamontagne Institute (Mont-Joli, QC). Finally, the occurrence data will be uploaded to the Ocean Biogeography Information System (https://obis.org).

Taxonomic Richness and Biomass Data Analyses

Station locations (geographic coordinates and depth), taxonomic names (when possible), and catch weights (kg) were extracted from the catch database, along with the taxonomic names (when available) from the photo catalogue. Although the biodiversity sampling method differed between SFA 4 and SFAs 2 and 3, all three areas were evaluated for their taxonomic richness (number of taxa per phylum), while biomass analysis was only performed for SFA 2 and SFA 3. Species accumulation curve analysis were done with the Vegan R package on the number of unique taxa recorded at each station for each SFAs. All three SFAs were divided into two depth categories: 100–199 m and ≥ 200 m, where the 200 m isobath corresponds to the shelf break in the study area. The station biomass for each recorded taxon was scaled up to station total catch biomass by multiplying the weight of the taxon by the total weight of catch divided by weight of the subsample).

RESULTS

A total of 121 station catches were photographed and used in the analysis for the taxonomic richness while 108 stations were successfully sampled for bycatch biodiversity and used for the invertebrate bycatch biomass analysis (Table 1, Figure 3). The vast majority of invertebrates sampled during the survey were benthic invertebrates.

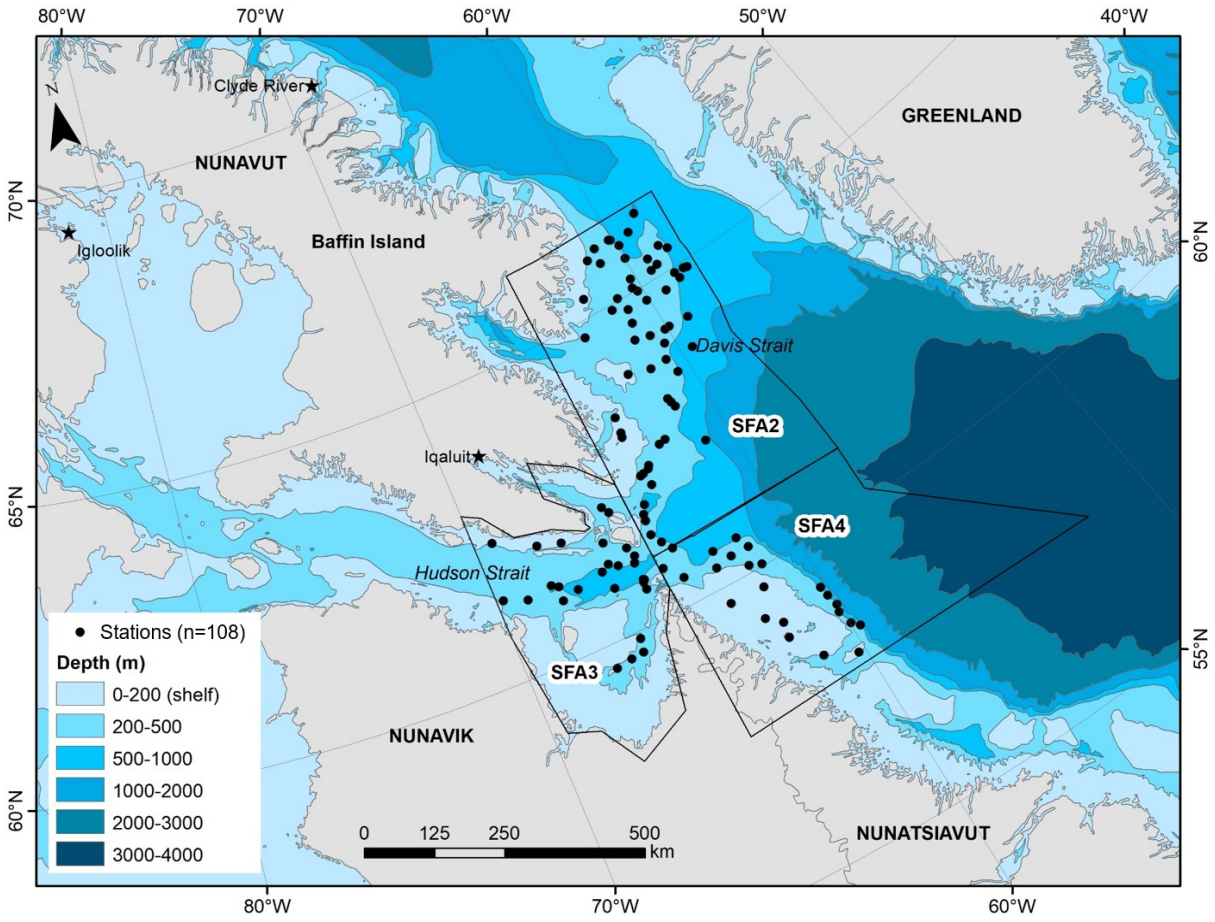


Figure 3: Stations (n = 108) sampled for invertebrate bycatch biodiversity in SFAs 2, 3, and 4 during the 2018 NSRF annual survey.

Creation of a photo catalogue

The Adobe Lightroom catalogue for the 2018 survey contains 6,485 photos, ranging from views of the whole bycatch at a given station to macro details of individual organisms. After a thorough review of all the photos, approximately 10% (621 photos) were selected, based on the quality of the image and the representativity of the specimen, to be used in this photo catalogue (Appendix 1). It is important to note that this photo catalogue is not an identification guide and that the photos are there to visually present what was found during this survey.

Invertebrate Taxonomic Richness

Throughout the study area, a total of 12 phyla were identified in the invertebrate bycatch: 12 phyla in SFA 4, 11 in SFA 3 and 10 in SFA 2 (Table 2). A total of 296 invertebrate taxa were identified across the study area: 232 taxa were identified to species level and 35 to genus level, while 10 taxa could only be identified to family level, six to order (Actiniaria, Amphipoda, Euphausiacea, Nudibranchia Ophiurida and Zoantharia), eight to class (Ascidiacea, Asteroidea, Gastropoda, Holothuroidea, Hydrozoa, Polychaeta, Pycnogonida and Scyohozoa) and five to phylum (Bryozoa, Cnidaria, Nemertea, Porifera and Sipuncula) (Table 3). In comparison, NSRF recorded between 2014 and 2018 an average of 36 invertebrate taxa (in five phyla) in the bycatch database with about only nine taxa recorded to species level. Despite all the documentation available, some species, in particular of Actiniaria, Amphipoda, Cnidaria, Mollusca, Porifera, and Pycnogonida, were still difficult to identify onboard and required the use of a stereomicroscope (not available onboard) to observe small, distinctive characteristics and further examination by specialists. Table 3 gives a detailed list of all the taxa encountered throughout the entire study area along with the occurrence of each taxa by zone (number of stations a taxon is present in a zone). It is important to note that even though *P. borealis* and *P. montagui* are shown in Appendix 1, they were removed from data analysis since they are not considered part of the bycatch.

Table 2. Summary of invertebrate bycatch taxonomic diversity in the three Shrimp Fishing Areas (SFA) for two depth intervals (100–199 m, ≥200 m) as covered by the 2018 NSRF survey, with the number of: trawl stations (and stations added to the catch database), stations during sunrise (SR), daytime (D), sunset (SS) and night (N); phyla and taxa (and species) in the invertebrate bycatch; and total catch biomasses (with estimated invertebrate bycatch biomass). N/A = invertebrate biomass catch data not available.

Shrimp Fishing Area (depth range)	Number of							Total Catch Biomass (Contribution of Invertebrate Bycatch)
	Stations (added to database)	Stations trawled at				Invertebrate Bycatch Phyla	Invertebrate Bycatch Taxa (species)	
		SR	D	SS	N			
SFA 2 (100–199 m)	6 (5)		6			10	87 (66)	31 (14) kg
SFA 2 (≥ 200 m)	62 (57)	7	40	1	14	10	204 (151)	1,337 (207) kg
SFA 3 (100–199 m)	5 (3)	1	4			11	110 (82)	26 (11) kg
SFA 3 (≥ 200 m)	26 (22)		16	3	7	11	172 (131)	2,166 (262) kg
SFA 4 (100–199 m)	6 (6)		6			10	82 (65)	493 (N/A) kg
SFA 4 (≥ 200 m)	16 (15)	3	9	2	2	12	158 (121)	2,682 (N/A) kg

The highest taxonomic richness (number of taxa per area) for invertebrate bycatch was found in SFA 2 with a total of 226 taxa, while SFAs 3 and 4 had 189 and 176 taxa, respectively. The species accumulation curves (Figure 4) show in general that more stations from these areas are required to adequately estimate taxa richness, excepting SFA 2 ≥ 200 m for which the curve was nearly asymptotic (Figure 4b). In all three SFAs, the phylum Arthropoda had the highest taxonomic richness with 54 different taxa in SFA 2 (22 taxa in 100–199 m; 47 in ≥ 200 m), 47 in SFA 3 (29 in 100–199 m and 42 in ≥ 200 m) and 44 in SFA 4 (22 in 100–199 m and 34 in ≥ 200 m). The phylum ranking second in taxonomic richness was Echinodermata with 48 different taxa in SFA 2 (25 taxa in 100–199 m and 42 in ≥ 200 m), 34 in SFA 3 (22 in 100–199 m and 33 in ≥ 200 m) and 31 in SFA 4 (18 in 100–199 m and 29 in ≥ 200 m) (Figure 5). In order to facilitate the reading of Figures 5 and 6, phyla that were less represented [*i.e.*, Annelida, Brachiopoda, Bryozoa, Cephaloryncha, Chordata (excluding fishes and other vertebrates), Nemertea, and Sipuncula] were grouped together in the category "Other". A detailed list of all the taxa and their frequency of occurrence in the study area can be found in Table 3. Note that some taxa listed in this table are not shown in Appendix 1 because no photographic record was available. The most frequently observed (more than 50% of the stations) arthropod taxa across the study area were the shrimp *Lebbeus polaris,* the amphipod *Epimeria loricata,* and the pelagic krill *Meganyctiphanes norvegica*. While the most frequently observed echinoderm taxa were the sea urchin *Strongylocentrotus* sp., the brittle stars *Ophiopholis aculeata, Ophiura sarsii,* and *Ophiacantha* sp.*,* and the sea star *Henricia* sp. The photo catalogue also presents 12 visually different rostrum types (*i.e.,* shapes) for *Lebbeus polaris* (Appendix 1).

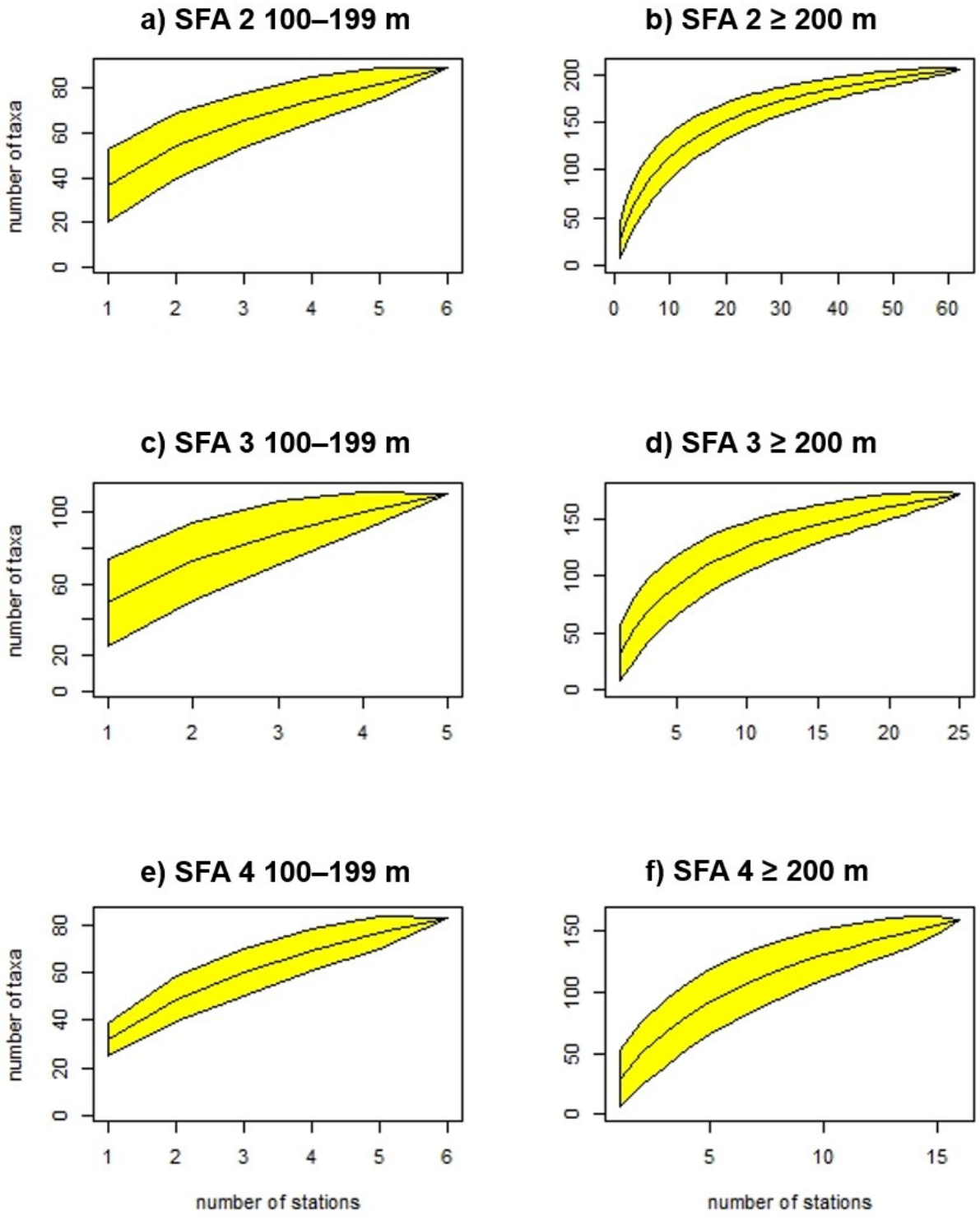


Figure 4. Species accumulation curves (yellow = 95% confidence intervals) for stations in SFAs 2, 3, and 4 at depths between 100–199 m (a, c, e) and ≥ 200 m (b, d, f).

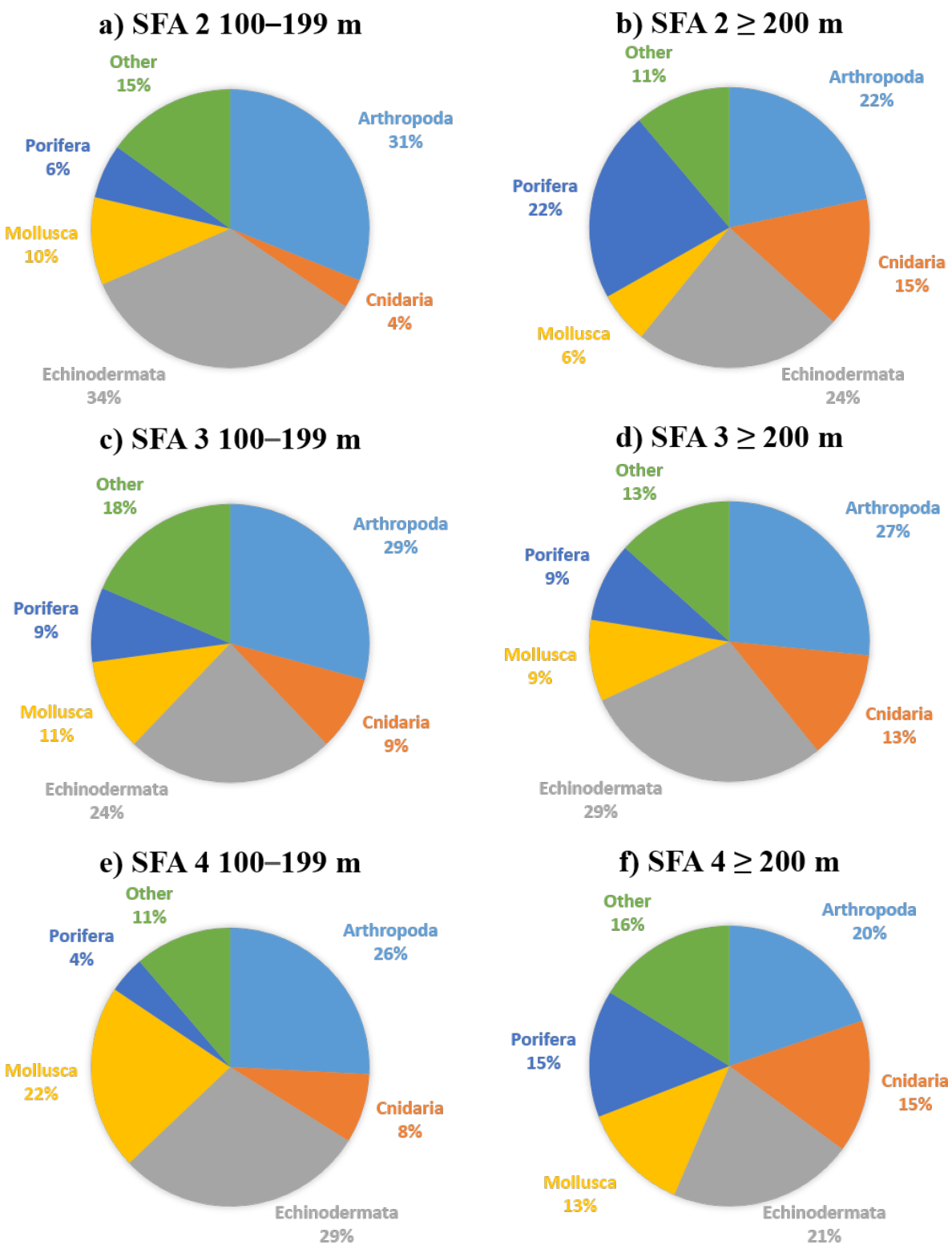


Figure 5. Percentage of taxa by phylum based on invertebrate bycatch taxonomic richness for SFAs 2, 3 and 4 at depths between 100–199 m (a, c, e), and ≥ 200 m (b, d, f).

Table 3. Frequency of occurrence of invertebrate bycatch taxa from the 2018 NSRF survey for each Shrimp Fishing Area (SFA), divided by depth strata (100–199 m and ≥ 200 m), and total number of stations examined for taxonomic diversity (n).

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Annelida	*Brada granulosa*	0	0	0	3	0	0
	Brada inhabilis	3	0	0	5	1	0
	Echiurus echiurus	0	4	0	0	0	0
	Euphrosine borealis	0	4	2	9	0	2
	Laetmonice filicornis	0	4	0	0	0	5
	Nephtys sp.	1	7	0	0	0	0
	Notostomum laeve	0	0	1	0	0	0
	Onuphidae	0	0	1	8	0	0
	Phyllodocidae : cf. *Phyllodoce groenlandica*	1	0	0	0	0	0
	Polychaeta	2	6	4	5	2	1
	Polynoidae	3	18	4	12	2	9
Arthropoda	*Acanthephyra pelagica*	0	1	0	0	0	0
	Acanthonotozoma cf. *serratum*	1	0	0	0	0	0
	Acanthonotozoma cristatum	3	0	1	0	0	0
	Acanthostepheia malmgreni	0	0	1	3	0	0
	Aega psora	0	13	0	0	0	4
	Aegiochus ventrosa	0	0	0	1	0	3
	Ampelisca cf. *eschrichtii*	0	0	3	3	0	0
	Amphipoda	0	0	0	0	0	1
	Anonyx sp.	3	10	5	8	1	5
	Arcoscalpellum michelottianum	0	0	0	0	0	1
	Arcturus baffini	3	6	1	11	0	1
	Argis dentata	1	0	4	6	5	2
	Astacilla granulata	0	0	0	0	1	0
	Atlantopandalus propinqvus	0	6	0	0	0	1
	Balanus balanus	0	0	0	0	2	0

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Arthropoda	*Boreomysis* sp.	0	18	3	9	0	3
	Boreonymphon abyssorum	2	2	0	0	0	0
	Boreonymphon ossiansarsi	0	0	1	0	0	0
	Calocaris templemani	0	1	0	0	0	0
	Cleippides quadricuspis	0	4	0	0	0	0
	Cleippides tricuspis	0	0	0	0	1	0
	Colossendeis angusta	0	1	0	0	0	0
	Colossendeis proboscidea	1	1	1	1	0	0
	Epimeria (Epimeria) loricata	0	28	0	5	0	2
	Eualus belcheri	0	2	2	7	6	6
	Eualus gaimardii	0	1	0	0	1	0
	Eualus macilentus	0	0	0	2	4	3
	Euphausiacae	0	0	1	0	0	0
	Eusergestes arcticus	0	4	0	5	0	3
	Eusirus cuspidatus	0	3	4	6	0	1
	Eusirus holmii	0	7	0	7	0	0
	Gammaracanthus loricatus	1	0	0	0	0	0
	Gennadas elegans	0	2	0	0	0	0
	Gnathophausia zoea	0	2	0	0	0	0
	Hyas alutaceus	0	0	1	0	2	1
	Hyperia galba	0	0	0	1	0	0
	Lebbeus groenlandicus	1	0	2	5	2	1
	Lebbeus polaris	4	33	4	18	1	5
	Lithodes maja	0	3	0	1	0	8
	Meganyctiphanes norvegica	1	39	1	11	0	4
	Melitidae	0	3	0	0	0	0
	Monoculodes cf. *latimanus*	0	0	0	2	0	0
	Munida tenuimana	0	0	0	0	0	3

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Arthropoda	*Munidopsis curvirostra*	0	5	0	0	0	0
	Munnopsis typica	1	1	0	2	0	0
	Mysis sp.	0	0	0	2	0	0
	Nymphon hirtipes	4	4	1	5	0	0
	Nymphon longitarse	0	0	0	0	1	0
	Nymphon serratum	0	0	1	1	0	0
	Nymphon stroemi	0	1	0	0	0	1
	Pagurus sp.	0	1	0	1	5	5
	Pagurus pubescens	0	0	0	2	0	2
	Paramphithoe hystrix	5	7	4	10	0	1
	Pardalisca abyssi	0	2	0	0	0	0
	Paroediceros lynceus	0	0	1	1	2	0
	Pasiphaea multidentata	0	5	0	0	0	2
	Pasiphaea tarda	0	5	0	0	0	4
	Pasiphaeidae	1	0	0	0	0	0
	Pleustes (Pleustes) panoplus	0	1	0	1	0	0
	Pontophilus norvegicus	0	18	0	0	1	1
	Pseudopallene brevicollis	0	1	1	0	0	0
	Pycnogonida	3	20	5	19	0	1
	Rhachotropis aculeata	5	10	5	4	1	1
	Sabinea hystrix	0	3	0	0	0	0
	Sabinea sarsii	0	1	0	0	0	1
	Sabinea septemcarinata	6	7	4	2	3	2
	Sclerocrangon boreas	4	0	3	6	1	0
	Sclerocrangon ferox	0	13	0	2	0	0
	Socarnes vahlii	0	1	0	1	0	0
	Spirontocaris spinus	4	3	5	8	5	4
	Stegocephalus ampulla	0	6	0	12	0	2
	Stegocephalus inflatus	6	9	1	6	1	3
	Stegocephalus similis	0	0	0	6	0	0

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Arthropoda	*Synidotea marmorata*	0	0	0	0	1	0
	Themisto compressa	0	3	0	0	0	1
	Themisto libellula	0	3	3	8	1	0
	Tole spinosa	4	1	2	3	0	0
	Weltnerium nymphocola	0	0	0	1	0	0
Brachiopoda	*Hemithiris psittacea*	3	1	3	4	0	0
	Terebratulina septentrionalis	0	4	0	0	0	3
Bryozoa	cf. *Alcyonidium pachydermatum*	1	0	1	2	3	3
	Bryozoa	2	11	2	3	2	5
	cf. *Cystisella saccata*	1	1	2	2	0	1
	cf. *Diplosolen intricarium*	0	6	1	2	0	0
	cf. *Hornera lichenoides*	1	28	2	5	0	5
	cf. *Leieschara coarctata*	0	4	1	1	0	1
	cf. *Microporina articulata*	0	0	0	3	0	0
	cf. *Reteporella* sp.	1	9	0	0	0	8
	Securiflustra securifrons	0	3	3	7	4	8
Cephalorhyncha	*Priapulus caudatus*	0	0	0	0	0	1
Chordata	*Ascidia* sp.	0	4	2	2	0	2
	Ascidiacea	1	4	0	1	2	1
	Boltenia ovifera	0	0	1	0	0	0
	Styelidae	5	10	5	15	1	6
	Dendrodoa aggregata	1	0	2	1	0	0
	Didemnidae	0	27	1	0	0	3
	Eudistoma vitreum	4	6	2	9	1	2
	Styela rustica	0	0	1	0	0	0
Cnidaria	*Acanella arbuscula*	0	14	0	0	0	3
	Actinauge cristata	0	13	0	2	0	1
	Actiniaria	0	14	3	9	0	4
	Actinostola callosa	0	10	0	12	0	1
	Anthoptilum grandiflorum	0	0	0	0	0	1

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Cnidaria	*Atolla wyvillei*	0	7	0	0	0	2
	Aurelia aurita	0	3	0	0	0	0
	Bolocera tuediae	0	3	0	1	0	5
	Ceratocaulon wandeli	0	2	0	0	0	0
	Cnidaria	0	1	0	0	0	1
	Corallimorphus profundus	0	2	0	0	0	0
	Cyanea capillata	0	2	0	0	0	0
	Drifa glomerata	4	12	3	7	6	6
	Duva florida	0	15	1	4	1	5
	Epizoanthus cf. *erdmanni*	0	3	0	0	0	0
	Flabellum (Ulocyathus) alabastrum	0	5	0	0	0	1
	Gersemia rubiformis	1	7	4	11	4	6
	Halcampa sp.	0	0	0	1	0	0
	Halipteris finmarchica	0	7	0	0	0	0
	Heteropolypus sp.	0	4	0	0	0	0
	Hormathia nodosa	0	1	0	1	0	2
	Hormathiidae	0	10	1	9	0	5
	Hydrozoa	1	16	2	17	0	9
	Lafoeidae	0	7	0	3	0	0
	Liponema multicorne	0	2	0	0	0	0
	Metridium sp.	0	0	0	1	0	0
	Nephtheidae	0	1	0	2	0	2
	Paramuricea sp.	0	3	1	0	0	0
	Periphylla periphylla	0	16	0	1	0	5
	Primnoa resedaeformis	0	4	0	0	0	0
	Pseudodrifa sp.	0	4	0	0	0	1
	Pseudodrifa racemosa	0	0	1	2	1	0
	Ptychodactis patula	0	2	0	0	0	0
	Scyphozoa [P]	0	2	0	0	0	0

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Cnidaria	*Stephanauge nexilis*	0	4	0	0	0	0
	Stomphia coccinea	1	3	1	3	3	2
	Thuiaria thuja	0	7	4	15	0	5
	Umbellula encrinus	0	6	0	0	0	0
	Urticina felina	0	1	0	0	0	2
	Zoantharia	0	6	0	1	0	0
Echinodermata	Asteroidea	1	0	0	2	0	0
	Brisaster fragilis	0	4	0	0	0	0
	Ceramaster granularis	0	5	0	0	1	2
	Crossaster sp.	0	3	1	2	1	2
	Crossaster papposus	4	7	5	16	4	3
	Crossaster squamatus	2	7	1	7	0	2
	Ctenodiscus crispatus	0	1	0	6	1	2
	Cucumaria frondosa	1	0	3	3	0	1
	Gorgonocephalus sp.	3	5	0	5	2	6
	Gorgonocephalus arcticus	2	2	4	13	2	0
	Gorgonocephalus eucnemis	1	9	2	13	2	3
	Heliometra glacialis	6	14	4	11	6	4
	Henricia sp.	3	36	5	15	2	9
	Hippasteria phrygiana	0	6	0	4	0	6
	Holothuroidea	0	1	2	6	2	3
	Hymenaster pellucidus	2	7	0	0	0	0
	Icasterias panopla	0	13	0	0	0	0
	Leptasterias sp.	1	3	0	2	1	2
	Leptasterias (Hexasterias) polaris	0	0	1	1	0	0
	Leptasterias groenlandica	1	0	1	0	0	0
	Leptychaster arcticus	0	6	0	0	0	2
	Lophaster furcifer	2	6	1	6	0	1
	Molpadia sp.	0	1	0	0	0	0
	Novodinia americana	0	3	0	0	0	1

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Echinodermata	*Ocnus glacialis*	0	1	0	0	0	0
	Ophiacantha sp.	3	26	4	22	5	1
	Ophiactis abyssicola	0	9	0	1	0	1
	Ophiocten sericeum	1	0	0	0	0	0
	Ophiomusa lymani	0	6	0	0	0	0
	Ophiopholis aculeata	6	25	5	19	5	11
	Ophiopleura borealis	0	0	0	2	0	0
	Ophiopus arcticus	0	1	0	3	0	0
	Ophioscolex glacialis	0	13	0	0	0	2
	Ophiura robusta	4	7	3	8	3	4
	Ophiura sarsii	6	21	5	16	6	8
	Ophiurida	2	4	0	0	0	0
	Phormosoma placenta	0	1	0	0	0	1
	Poliometra prolixa	4	10	0	2	0	0
	Pontaster tenuispinus	0	7	0	0	0	0
	Poraniomorpha sp.	0	4	0	0	0	0
	Pseudarchaster parelii	0	8	0	0	0	0
	Psilaster andromeda	0	1	0	0	0	0
	Psolus fabricii	2	0	0	7	4	4
	Psolus phantapus	2	0	0	2	0	0
	Pteraster militaris	1	13	2	4	0	1
	Pteraster obscurus	1	1	1	4	1	1
	Pteraster pulvillus	2	18	1	6	0	1
	Pterasteridae	0	1	0	0	0	0
	Solaster endeca	1	0	1	5	1	1
	Stephanasterias albula	0	0	2	2	0	0
	Strongylocentrotus sp.	6	36	5	19	5	8
	Thyonidium drummondi	0	0	0	0	0	3
	Tremaster mirabilis	0	3	0	0	0	0

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Mollusca	*Arrhoges occidentalis*	0	1	1	1	3	5
	Astarte sp.	0	4	0	0	0	0
	Bathyarca glacialis	0	0	0	1	0	0
	Bathyarca petunculoides	0	0	0	1	1	0
	Bathypolypus arcticus	0	1	0	1	0	1
	Bathypolypus bairdii	0	8	0	2	0	5
	Beringius turtoni	0	0	0	2	0	0
	Buccinum sp.	4	1	1	7	2	1
	Buccinum ciliatum	0	0	0	1	1	1
	Buccinum cyaneum	0	1	0	1	0	1
	Buccinum finmarkianum	0	0	0	1	0	0
	Buccinum fragile	0	1	0	0	0	0
	Buccinum hydrophanum	0	4	0	1	0	0
	Buccinum scalariforme	0	0	0	1	1	0
	Buccinum undatum	0	1	0	2	5	5
	Calliotropis ottoi	0	0	0	0	0	1
	Chlamys islandica	0	2	4	6	3	3
	Ciliatocardium ciliatum	0	0	0	0	3	2
	Clione limacina	0	1	1	0	0	0
	Colus sp.	0	2	0	0	0	1
	Colus islandicus	0	0	0	4	1	2
	Colus pubescens	0	2	0	1	2	2
	Cryptonatica affinis	1	1	0	1	3	1
	Dendronotus niveus	0	1	2	6	0	0
	Ennucula tenuis	0	0	0	0	0	1
	Gastropoda	3	3	1	1	0	1
	Gonatus fabricii	1	29	0	7	0	4
	Hiatella arctica	0	0	1	3	0	1
	Lepeta caeca	0	0	0	0	0	1
	Limneria undata	1	0	3	1	0	2

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Mollusca	*Macoma calcarea*	0	0	0	1	3	3
	Margarites costalis	0	1	2	1	0	1
	Margarites groenlandicus	0	1	0	1	3	2
	Margarites helicinus	3	0	4	2	0	0
	Musculus discors	0	0	2	2	1	0
	Musculus niger	0	0	0	1	0	0
	Muusoctopus sp.	0	0	0	2	0	0
	Naticidae	0	0	0	1	0	0
	Neptunea despecta	0	0	1	1	3	0
	Nuculana pernula	0	0	0	0	1	0
	Nudibranchia	0	4	0	2	0	1
	Onchidiopsis sp.	1	2	2	2	0	0
	Panomya norvegica	0	0	0	1	0	1
	Piliscus commodus	0	0	1	2	0	0
	Rossia sp.	0	8	0	3	0	5
	Scabrotrophon fabricii	1	2	0	2	1	1
	Similipecten greenlandicus	3	4	0	1	0	0
	Stenosemus albus	0	1	0	0	0	0
	Trichotropis bicarinata	1	0	0	0	0	0
	Velutinidae	1	0	0	0	0	0
	Volutopsius norwegicus	1	2	0	0	2	1
	Yoldia hyperborea	0	0	0	0	1	1
Nemertea	Nemertea	0	3	1	3	2	2
Porifera	*Artemisina arcigera*	0	2	1	2	0	2
	Asconema cf. *foliatum*	0	21	0	1	0	8
	Axinella cf. *arctica*	1	24	0	5	1	8
	Biemna cf. *variantia*	0	2	0	2	0	1
	Chondrocladia sp.	0	1	1	0	0	0
	Cladocroce spatula	0	0	0	0	1	0
	Cladorhiza oxeata	0	14	0	4	0	0

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Porifera	*Clathria (Clathria)* cf. *barleei*	0	0	0	0	0	1
	Craniella sp.	0	13	0	4	0	1
	Crella (Yvesia) pyrula	0	1	1	1	0	0
	Geodia sp.	0	4	1	1	0	2
	Geodia cf. *barretti*	0	5	0	0	0	1
	Geodia cf. *hentscheli*	0	4	0	0	0	0
	Geodia cf. *macandrewii*	0	0	0	0	0	1
	Geodia cf. *parva*	0	5	0	0	0	0
	Geodia cf. *phlegraei*	0	4	0	0	0	0
	Hemigellius arcofer	0	0	0	0	0	2
	Isodictya palmata	0	0	0	0	0	1
	Lissodendoryx sp.	0	3	0	0	0	0
	Lissodendoryx (Lissodendoryx) indistincta	1	0	0	1	1	1
	Lycopodina sp.	0	2	0	0	0	0
	Mycale (Mycale) lingua	0	13	4	9	1	3
	Plicatellopsis bowerbanki	0	0	0	0	0	1
	Polymastia sp.	0	15	0	1	0	3
	Polymastia andrica	0	6	0	0	0	1
	Polymastia grimaldii	0	4	0	0	0	0
	Polymastia cf. *hemisphaerica*	0	17	1	0	0	5
	Polymastia thielei	0	6	1	0	0	1
	Polymastia uberrima	2	14	0	3	0	3
	Porifera	5	55	5	18	4	11
	Quasillina brevis	1	8	0	4	0	1
	cf. *Spinularia sarsii*	0	1	0	0	0	0
	Spongionella pulchella	0	0	2	0	0	0
	Stelletta sp.	0	6	0	1	0	0
	Tentorium semisuberites	1	30	1	11	0	4
	Tethya cf. *norvegica*	0	6	1	0	0	1
	Thenea cf. *muricata*	2	40	2	5	0	0

Phylum	Scientific Name	SFA 2 100–199 m (n=6)	SFA 2 ≥ 200 m (n=62)	SFA 3 100–199 m (n=5)	SFA 3 ≥ 200 m (n=26)	SFA 4 100–199 m (n=6)	SFA 4 ≥ 200 m (n=16)
Porifera	*Weberella bursa*	0	5	0	1	0	4
Sipuncula	Sipuncula	1	0	3	6	1	5

Invertebrate Bycatch Biomass

As shown in Table 2, total catch biomass was lower at stations at depths between 100–199 m (26–493 kg) compared to those from ≥ 200 m (1,337–2,682 kg). Conversely, the invertebrate bycatch biomass was higher at depths between of 100–199 m (42–45 %) compared to those from ≥ 200 m (12–15 %). SFA 2 had an invertebrate bycatch biomass of 207 kg out of the total 1,337 kg caught in trawlsets. Echinodermata (5.7 kg) and Mollusca (5.2 kg) dominated SFA 2 100–199 m, while SFA 2 ≥ 200 m biomass was mainly dominated by Porifera (129.8 kg) and Cnidaria (58 kg) (Figure 6a, b). SFA 3 had an invertebrate bycatch biomass of 262 kg out of 2,166 kg caught in trawlsets. Echinodermata (5.9 kg) and Arthropoda (3.9 kg) dominated the area SFA 3 100–199 m, while Arthropoda (115.1 kg) and Echinodermata (17.7 kg) dominated the area SFA 3 ≥ 200 m (Figure 6 c, d). For reasons mentioned earlier, the bycatch biomass for SFA 4 is not covered in this sudy.

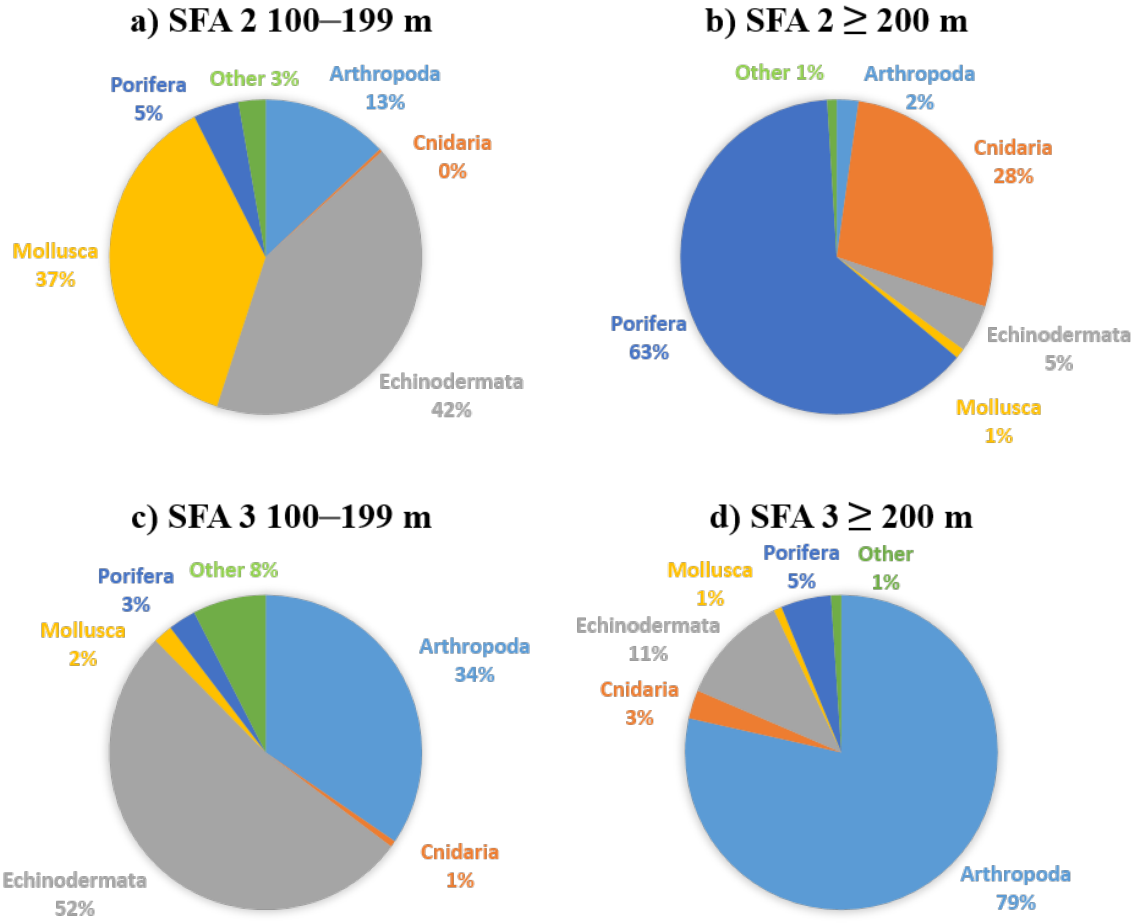


Figure 6. Percentage of biomass by phylum for bycatch invertebrates in SFAs 2 and 3 at depths between 100–199 m (a, c) and depths ≥ 200 m (b, d).

DISCUSSION

Distribution of Invertebrate Taxonomic Diversity

The purpose of this study was to document the diversity of invertebrates caught in the Northern Shrimp and Striped Shrimp survey conducted in the Eastern Canadian Arctic. Large-scale spatial variations of the faunal community structure are related to water depth, currents, temperature, food availability, irradiance, and substrate type (Gray 2002; Piepenburg 2005; Jørgensen et al. 2017). For these reasons and to better understand spatial and depth influences on invertebrate taxonomic richness and biomass, the three SFAs were separated into two depth categories, the continental shelf (100–199 m) and the continental slope (≥ 200 m). In all three SFAs, arthropods (Crustacea and Pycnogonida) and echinoderms were the numerically dominant taxonomic groups.

Some of the taxa identified in this survey were new for the study area, as confirmed by consulting occurrence records on OBIS. The observation of the cephalopod *Muusoctopus* was one example. Species of the genus are known from the Northeast Pacific and Western American Arctic, as well as Northeastern Atlantic, but had not yet been reported in Eastern Canadian Arctic waters (Xavier et al. 2018). However, this genus was only recently erected, following review of *Benthoctopus* (Gleadall 2004; Ibáñez et al. 2016) and earlier records may have been confounded with *Benthoctopus* or *Bathypolypus* genus. Another example is Otto's spiny margarite, *Calliotropis ottoi*, which may be a new record for the Arctic, as this gastropod is normally encountered further south (eastern United States and Europe). Anders (1991) reported the presence of *C. ottoi* near Iceland, but the specimen might be from Europe as it does not look like the one shown in Appendix 1, which corresponds to the specimen described in Abbott (1954).

A special situation occurs with the shrimp *Lebbeus polaris*, which displayed morphological diversity in rostrum shapes, examples of which are presented in Appendix 1. This diversity in shape has been observed in Atlantic Canada and elsewhere in the Arctic (Squires 1990, Nozères et al. 2019), including Russia (Sokolov 2003[1]). Specimen sequences of *L. polaris* published on BOLD (http://www.boldsystems.org/) also revealed high intra-specific diversity. In the description and illustrations of *L. polaris* found in Squires (1990), this species has a long rostrum with or without teeth on its dorsal (0-8 teeth) and ventral (0-5 teeth) sides. Unfortunately, since only three specimens were preserved in the field, no DNA barcoding was done to further explore the differences. An attempt to define the morphological and genetic characteristics that could potentially distinguish different *L. polaris* morphotypes should be undertaken.

Some taxonomic groups (including some Amphipoda, Cnidaria, Polychaeta, Porifera, and Pycnogonida) are difficult to identify to species level without the use of a stereomicroscope or a transmitted light microscope. The abbreviation "cf." was used to indicate that some identifications

[1] see http://megabenthos.info/catalog/arthropoda/malacostraca/decapoda/thoridae/lebbeus/lebbeus-polaris/

were uncertain (*e.g., Pagurus* cf. *pubescens*, cf. *Alcyonidium pachydermatum*), to distinguish these difficult taxa from the others (see Appendix 1). We strongly recommend to not attempt to identify specimens from these taxa to the species level while at sea, but rather to record them at a higher taxonomic level (*e.g.,* genus, family, or order). Detailed photos of fresh specimens and/or collection of well-preserved specimens for further taxonomic and/or genetic identification in the laboratory may be necessary for many of these species. Photos of fresh collected specimens during a cruise might be useful *a posteriori* to help validate identifications, particularly when preserved specimens are sparse. For example, pycnogonid species were exclusively identified in the laboratory with the use of a stereomicroscope and identification keys (Bouvier 1923; Bamber and Thurston 1995). Sponges were identified solely by visual observation of morphotypes using guides such as Kenchington et al. (2015). As such, these identifications may not always be accurate, with examination of spicules or genetic analyses being required for confirmation (*e.g.,* Dinn and Leys 2018). Cnidarian taxa, especially anemones (Class Actiniaria) are also difficult to identify when contracted (*i.e.,* tentacles not visible) and without histological analysis or DNA barcoding. Thus, the identification of anemones was also done with identification keys and is probably not always accurate for some of the specimens encountered.

It should be noted that DNA reference sequences available in genetic sequence repositories (*i.e.,* BOLD and GenBank, https://www.ncbi.nlm.nih.gov/genbank/) are dependent on the accuracy of the available match between the reference sequence and the reliability of the taxonomic identification of the submitted reference specimen. Furthermore, many sequences are from European species and specimens, with relatively few from the Northwest Atlantic or Eastern Canadian Arctic. For this study, difficulties with specimen preservation, DNA sequencing and/or sequence match in GenBank and BOLD resulted in few accurate species matches for Amphipoda, Cnidaria, and Gastropoda. For these reasons, no specimen identification could be fully confirmed with DNA barcoding, but this approach did provide insights for identifying specimens that were initially labeled as "Unidentified". Such was the case for the nudibranch *Dendronotus niveus*, the coral *Corallimorphus profondus,* and the sea cucumber *Thyonidium drummondi*. Hence, more work is needed when using DNA barcoding for species identification.

Distribution of Invertebrate Biomass

Over the entire depth range sampled (100–750 m), more than half of the invertebrate biomass in SFA 2 was composed of sponges, while three quarters of the invertebrate biomass in SFA 3 was composed of arthropods. The Davis Strait continental slope area (SFA 2) is indeed recognized as a sponge hotspot (Knudby et al. 2013; Kenchington et al. 2016a, 2016b). These findings differ from Roy et al. (2015) where the invertebrate biomass in the Eastern Archipelago and Baffin Bay areas was mostly dominated by Echinodermata (46% and 48%, respectively). While Roy et al. (2015) and the present study sampled invertebrates within a similar depth range in the Eastern Canadian Arctic biogeographic region (DFO 2009b), they did not survey exactly the same areas

as the present study which was done only in the southernmost part of the biogeographic region. Moreover, Roy et al. (2015) used a different fishing gear (Agassiz trawl) which is a smaller trawl with a finer mesh size, made of a rigid frame and no wheels, with a horizontal opening of 1.5 m and a 5 mm cod end liner, and more appropriate to adequately sample echinoderm habitats. It is also likely that SFA 2 and SFA 3 areas have different bottom current regimes which directly influence food supply to the seafloor, and therefore biomass and composition of benthic communities (Roy et al. 2014).

Considerations

It is possible that comparative diversity between regions could be affected if there were marked biases in the daily allocation of sampling between SFAs and depth strata. The same argument can apply to biomass comparisons, and even extend to those species performing vertical pelagic migrations. This hypothesis was beyond the scope of the results presented here but could be of interests for future studies.

Recommendations and Perspectives

As previously mentioned, photos of fresh specimens collected during a cruise are highly valuable *a posteriori* in the laboratory, as a mean to validate identifications, particularly when preserved specimens are sparse. For example, the cephalopod *Muusoctopus* sp. was not preserved and was misidentified during the 2018 survey but was later re-examined using the photos and properly identified by Alexey Golikov (Kazan Federal University). Although some taxonomic groups could be difficult to identify to species level without the use of a stereomicroscope or a transmitted light microscope, photos can be used to build a reference catalogue or library and used either in the laboratory or in the field. The use of photo documentation has been shown to be a useful tool while at sea, for the identification of fish and invertebrate bycatch (Nozères et al. 2010, 2014, 2015, 2019).

Some invertebrates sampled in the survey bycatch have been recorded to various taxonomic levels by the NSRF science crew in SFA 2 and SFA 4 since 2005, and in SFA 3 since 2014. However, with the lack of proper protocol to identify and quantify bycatch invertebrates, the science crew has always evaluated them to the best of their taxonomic ability from a catch subsample (5 kg) used for determining *P. borealis* and *P. montagui* demographics. In comparison, the 2018 survey demonstrated that having personnel onboard dedicated to the identification of invertebrate bycatch and using a larger subsample (25 kg) resulted in an eightfold increase in the number of invertebrate taxa than what was previously recorded. Therefore, we suggest continuing such improvements for the identification of invertebrates by survey personnel during NSRF-DFO Northern and Striped Shrimp surveys. These surveys provide invertebrate biodiversity data annually and over a large spatial extent of the Eastern Canadian Arctic. It is the most relevant scientific platform to date, for obtaining baseline information of the current state of benthic species richness, abundance and biomass from the Hudson Strait, Davis Strait and Northern Labrador Coast areas.

ACKNOWLEDGEMENTS

We thank all of the *Aqviq* ship crew and the NSRF technicians for their dedicated work and professionalism with the trawl bycatch captures. Thanks to Bárbara de Moura Neves and Vonda Wareham-Hayes (DFO-Newfoundland and Labrador Region) for identifying several of the corals, Alexey Golikov (Kazan Federal University) for identifying *Muusoctopus*, Curtis Dinn (DFO-Gulf Region) for identifying several of the sponges, and Laure de Montety (Benthic Ecology Laboratory, Laval University). We would also like to thank Bernard Sainte-Marie (DFO-Quebec Region), Denise Methé (DFO-Golf Region), and Curtis Dinn (DFO-Golf Region) for reviewing the manuscript.

REFERENCES

Abbott, R.T. 1954. American seashells. Van Nostrand, Princeton, New Jersey. 541 p.

Alexeyev, D.O. 2003. Gastropod seashells of Russia. VNIRO Publishing Moscow. 80 p.

Anders, W. 1991. New and little known mollusca from Iceland and Scandinavia. Sarsia **76**(1-2): 53-124.

Bamber, R.N., and Thurston, M.H. 1995. The deep-water pycnogonids (Arthropoda: Pycnogonida) of the northeastern Atlantic Ocean. Zool. J. Linnean Soc. **115**: 117–162.

Bernard, F.R. 1979. Bivalve Mollusks of the Western Beaufort Sea. Contributions in science Natural History Museum of Los Angeles County **313**: 1–80.

Bouvier, E.-L. 1923. Faune de France: Pyonogonides. Lechevalier, Paris. 70 p.

Cuny, J., Rhines, P.B., and Kwok, R. 2005. Davis Strait volume, freshwater and heat fluxes. Deep-Sea Res. Pt. I. **52**(3): 519–542.

Curry, B., Lee, C., and Petrie, B. 2011. Volume, freshwater, and heat fluxes through Davis Strait, 2004–05. J. Phys. Oceanogr. **41**(3): 429–436.

DFO. 2009a. Northern Shrimp (SFAs) 0-7 and the Flemish Cap. [online]. Available from http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/shrimp-crevette/shrimp-crevette-2007-eng.html [accessed 14 January 2019].

DFO. 2009b. Development of a framework and principles for the biogeographic classification of Canadian marine areas. Can. Sci. Adv. Secr. Res. Doc. **2009/056**: 1–17.

DFO. 2015. Shrimp [online]. Available from https://www.dfo-mpo.gc.ca/fisheries-peches/sustainable-durable/fisheries-peches/shrimp-crevette-eng.html [accessed 12 December 2019].

DFO. 2018. Northern shrimp and striped shrimp – Shrimp fishing areas 0, 1, 4-7, the Eastern and Western Assessment Zones and North Atlantic Fisheries Organization (NAFO) Division 3M [online]. Available from http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/shrimp-crevette/shrimp-crevette-2018-002-eng.htm [accessed 14 January 2019].

DFO. 2019. DFO BN 2019 Joint Hearing Shrimp TAC [online]. Available from https://www.nwmb.com/en/public-hearings-a-meetings/public-hearings-1/2019-2/nwmb-nmrwb-joint-written-public-hearing-to-consider-the-2019-20-total-allowable-catch-levels-for-northern-and-striped-shrimp-in-the-western-and-eastern-assessment-zone/proposal-for-decision-6?sort=title&direction=desc [accessed 28 November 2019].

Dinn, C., and Leys, S.P. 2018. Field Guide to Sponges of the Eastern Canadian Arctic. A Field and Laboratory Identification Guide. Department of Biological Sciences, University of Alberta, Edmonton, AB. 102 p.

Drinkwater, K.F. 1986. Physical oceanography of Hudson Strait and Ungava Bay. *In* Canadian inland seas. *Edited by* I.P. Martini. Elsevier, Amsterdam. pp. 237–264.

Drinkwater, K.F. Physical and chemical oceanography. *In* Proceedings of a Workshop: Marine Ecosystem Studies in Hudson Strait. Montréal, Qué 1990. *Edited by* J.A. Percy. Can. Tech. Rep. Fish. Aquat. Sci. pp. 87–97.

Frandsen, R.P., and Zumholz, K. 2004. Cephalopods in Greenland Waters - a field guide. Pinngortitaleriffik, Greenland Institute of Natural Resources **58**: 1–26.

Gleadall, I.G. 2004. Some old and new genera of octopus. Interdiscip. Inf. Sci. **10**(2): 99–112.

Grainger, E.H. 1966. Sea stars (Echinodermata: Asteroidea) of arctic North America. J. Fish. Res. Board Can. **152**: viii + 71 p.

Gray, J.S. 2002. Species richness of marine soft sediments. Mar. Ecol. Progr. Ser. **244**: 285–297.

Hamilton, J., and Wu, Y. 2013. Synopsis and trends in the physical environment of Baffin Bay and Davis Strait. Can. Tech. Rep. Hydrography Ocean Sci. **282**: 1–46.

Harvey, M., Therriault, J.-C., and Simard, N. 1997. Late-summer distribution of phytoplankton in relation to water mass characteristics in Hudson Bay and Hudson Strait (Canada). Can. J. Fish. Aquat. Sci. **54**(8): 1937–1952.

Ibáñez, C.M., Pardo-Gandarillas, M.C., Peña, F., Gleadall, I.G., Poulin, E., and Sellanes, J. 2016. Phylogeny and biogeography of Muusoctopus (Cephalopoda: Enteroctopodidae). Zoologica Scripta **45**(5): 494–503.

Jørgensen, L.L., Archambault, P., Blicher, M., Denisenko, N., Guðmundsson, G., Iken, K., Roy, V., Sørensen, J., Anisimova, N., Behe, C., Bluhm, B.A., Denisenko, S., Metcalf, V., Olafsdóttir, S., Schiøtte, T., Tenda, l.O., Ravelo, A.M., Kędra, M., and Piepenburg, D. 2017. Benthos *In* State of the Arctic Marine Biodiversity Report. *Edited by* S.A. Council. Conservation of Arctic Flora and Fauna. pp. 85–106.

Kenchington, E., Beazly, L., Murillo, F.J., Tompkins MacDonald, G., and Baker, E. 2015. Coral, Sponge, and Other Vulnerable Marine Ecosystem Indicator Identification Guide, NAFO Area. Scientific Council Studies **47**: xvii + 74 p doi:doi:10.2960/S.v47.m1.

Kenchington, E., Beazley, L., Lirette, C., Murillo, F., Guijarro, J., Wareham, V., Gilkinson, K., Koen-Alonso, M., Benoît, H., Bourdages, H., Sainte-Marie, B., Treble, M., and Siferd, T. 2016a. Delineation of coral and sponge significant benthic areas in Eastern Canada using Kernel Density Analyses and Species Distribution Models. Can. Sci. Adv. Secr. Res. Doc. **2016/093**: vi + 178 p.

Kenchington, E., Lirette, C., Murillo, F., Beazley, L., Guijarro, J., Wareham, V., Gilkinson, K., Koen Alonso, M., Benoît, H., Bourdages, H., Sainte-Marie, B., Treble, M., and Siferd, T. 2016b. Kernel density analyses of coral and sponge catches from research vessel survey data for use in identification of significant benthic areas. Can. Tech. Rep. Fish. Aquat. Sci. **3167**: viii + 209 p.

Knudby, A., Kenchington, E., and Murillo, F.J. 2013. Modeling the distribution of Geodia sponges and sponge grounds in the Northwest Atlantic. PloS ONE **8**(12): e82306. doi:10.1371/journal.pone.0082306.

NAFO. 2019. NAFO Convention Area (map) [online]. Available from https://www.nafo.int/About-us/Maps [accessed 16 June 2019].

Nozères, C., Archambault, D., and Miller, R. 2014. Photo-catalogue d'invertébrés de l'estuaire et du nord du golfe du Saint-Laurent lors des relevés au chalut (2005-2013). Rapp. manus. can. sci. halieut. aquat. **3035**: iv + 222 p.

Nozères, C., Roy, V., Treau de Coeli, L., Treble, M., Hedges, K., and Walkusz, W. 2019. A photo catalogue of fishes and invertebrates from the 2017 Central and Arctic Region trawl survey in Baffin Bay. Can. Tech. Rep. Fish. Aquat. Sci. **3324**: iv + 94 p.

Nozères, C., Bourrassa, M.-N., Gendron, M.-H., Plourde, S., Savenkoff, C., Bourdages, H., Benoît, H., and Bolduc, F. 2015. Using annual ecosystemic multispecies surveys to assess biodiversity in the Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. **3149**: vii + 126 p.

Nozères, C., Archambault, D., Chouinard, P.-M., Gauthier, J., Miller, R., Parent, E., Schwab, P., Savard, L., and Dutil, J.-D. 2010. Guide d'identification des poissons marins de l'estuaire et du nord du golfe du Saint-Laurent et protocoles suivis pour leur échantillonnage lors des relevés par chalut entre 2004 et 2008. Rapp. tech. can. sci. halieut. aquat. **2866**: xi + 243 p.

Pawson, D.L. 1977. Marine flora and fauna of the northeastern United States. Echinodermata: Holothuroidea. NOAA Tech. Rep. NMFS Circular **405**: iii + 15 p.

Piepenburg, D. 2005. Recent research on Arctic benthos: common notions need to be revised. Polar Biol. **28**(10): 733–755.

Pohle, G.W. 1988. A guide to the deep-sea shrimp and shrimp-like decapod Crustacea of Atlantic Canada. Can. Tech. Rep. Fish. Aquat. Sci. **1657**: iv + 28 p.

Pohle, G.W. 1990. A guide to decapod Crustacea from the Canadian Atlantic: Anomura and Brachyura. Can. Tech. Rep. Fish. Aquat. Sci. **1771**: iv + 29 p.

Roy, V., Iken, K., and Archambault, P. 2014. Environmental drivers of the Canadian Arctic megabenthic communities. PloS one **9**(7): e100900. doi:10.1371/journal.pone.0100900.

Roy, V., Iken, K., and Archambault, P. 2015. Regional variability of megabenthic community structure across the Canadian Arctic. Arctic **88**(2): 180–192.

Sars, G.O. 1895. An account of the crustacea of Norway with short descriptions and figues of all the species. Vol. 1 Amphipoda. Alb. Cammermeyers Forlag. 524 p.

Savard, L., and Nozères, C. 2012. Atlas des espèces de crevettes de l'estuaire et du nord du golfe du Saint-Laurent. **3007**: vi + 67 p.

Sebens, K. 1998. Anthozoa: Actiniaria, Corallimorpharia, Ceriantharia, and Zoanthidea. Marine flora and fauna of the eastern United States. NOAA Tech. Rep. Nat. Mar. Fish. Ser. **141**: iv + 68 p.

Solignac, S., Seidenkrantz, M.-S., Jessen, C., Kuijpers, A., Gunvald, A.K., and Olsen, J. 2011. Late-Holocene sea-surface conditions offshore Newfoundland based on dinoflagellate cysts. The Holocene **21**(4): 539–552.

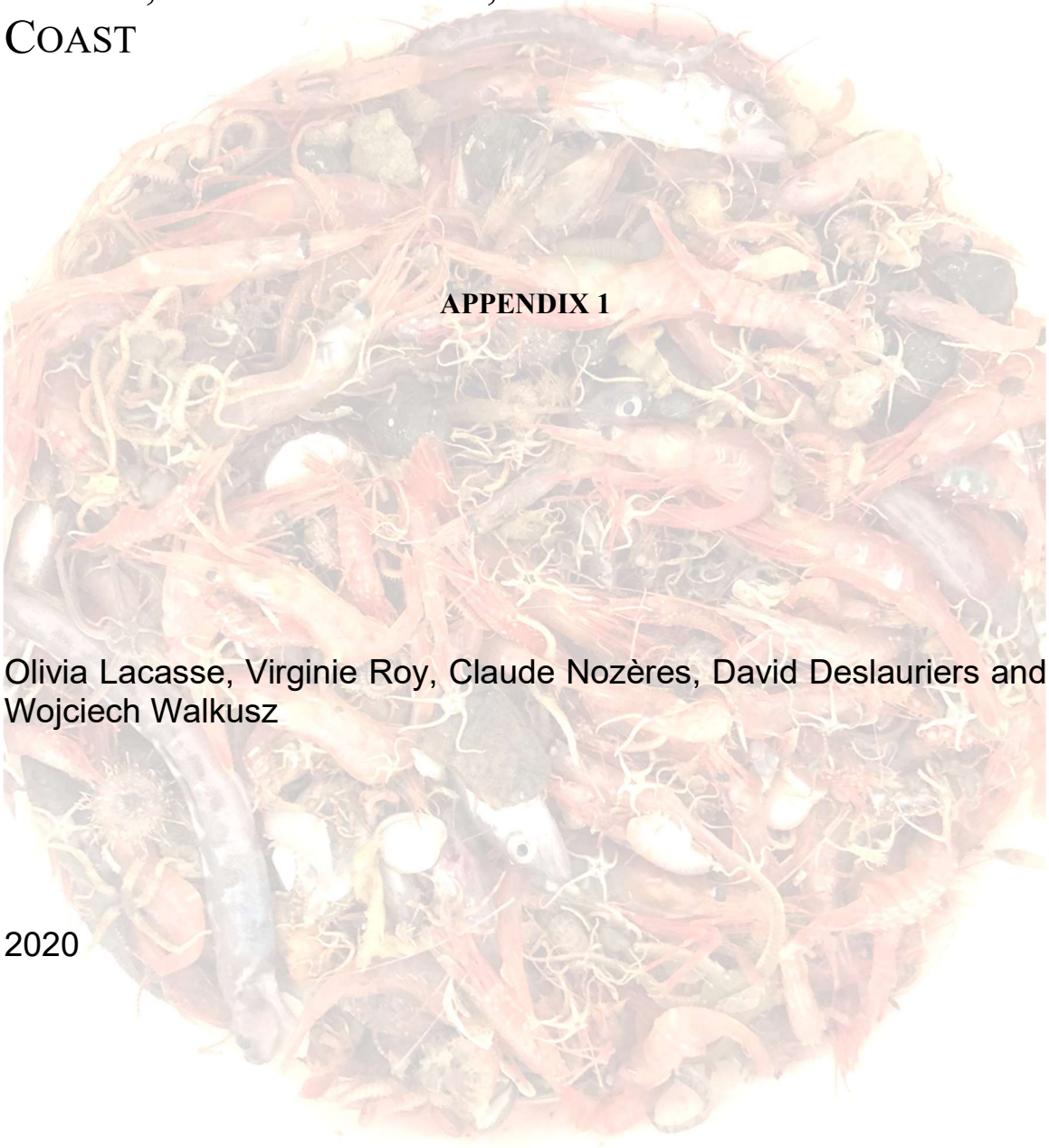
Squires, H.J. 1990. Decapod Crustacea of the Atlantic coast of Canada. Can. Bull. Fish. Aquat. Sci. **221**: 1–532.

Tang, C.C., Ross, C.K., Yao, T., Petrie, B., DeTracey, B.M., and Dunlap, E. 2004. The circulation, water masses and sea-ice of Baffin Bay. Prog. Oceanogr. **63**(4): 183–228.

Xavier, J.C., Cherel, Y., Allcock, L., Rosa, R., Sabirov, R.M., Blicher, M.E., and Golikov, A.V. 2018. A review on the biodiversity, distribution and trophic role of cephalopods in the Arctic and Antarctic marine ecosystems under a changing ocean. Mar. Biol. **165**(93): 1–26.

Zakharov, D.V., Strelkova, N.A., Manushin, I.E., Zimina, O.L., Jørgensen, L.L., Luybin, P.A., Nosova, T.B., Zhuravleva, N.E., Golikov, A.V., and Blinova, D.J. 2018. Atlas of the megabenthic organisms of the Barents Sea and adjacent waters. PINRO, Murmansk. 530 p.

INVERTEBRATE BIODIVERSITY AND PHOTO CATALOGUE FROM THE 2018 NORTHERN AND STRIPED SHRIMP STOCK ASSESSMENT SURVEY IN DAVIS STRAIT, HUDSON STRAIT, AND NORTHERN LABRADOR COAST



APPENDIX 1

Olivia Lacasse, Virginie Roy, Claude Nozères, David Deslauriers and Wojciech Walkusz

2020

Canadian Technical Report of
Fisheries and Aquatic Sciences 3351

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Fisheries and Aquatic Sciences 3351

2020

Invertebrate Biodiversity and Photo Catalogue from the 2018 Northern and Striped Shrimp Stock Assessment Survey in Davis Strait, Hudson Strait, and Northern Labrador Coast

by

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Notes:

* This appendix was designed to be used on its own.

1. The pages are color coded by phylum to allow for a quick search of the desired section.
2. Taxa are generally classified in alphabetical order by species name, except for taxa that are morphologically similar and are placed next to one another to facilitate comparisons for species identification.
3. The tables at the beginning of each phylum section show the number of stations at which a taxon was recorded in the different Shrimp Fishing Areas (SFA).
4. The 2018 survey stations map (below) is repeated here as a quick reference to the SFAs mentioned in the different tables of Appendix 1.
5. Only a representative subset of photos for each taxon are presented here as a photo catalogue. The complete survey database photo catalogue is available from DFO-Quebec Region (MLI).
6. This photo catalogue is not an identification guide, photos are presented to show examples of what was encountered during this survey.
7. All the photos were taken by Olivia Lacasse.

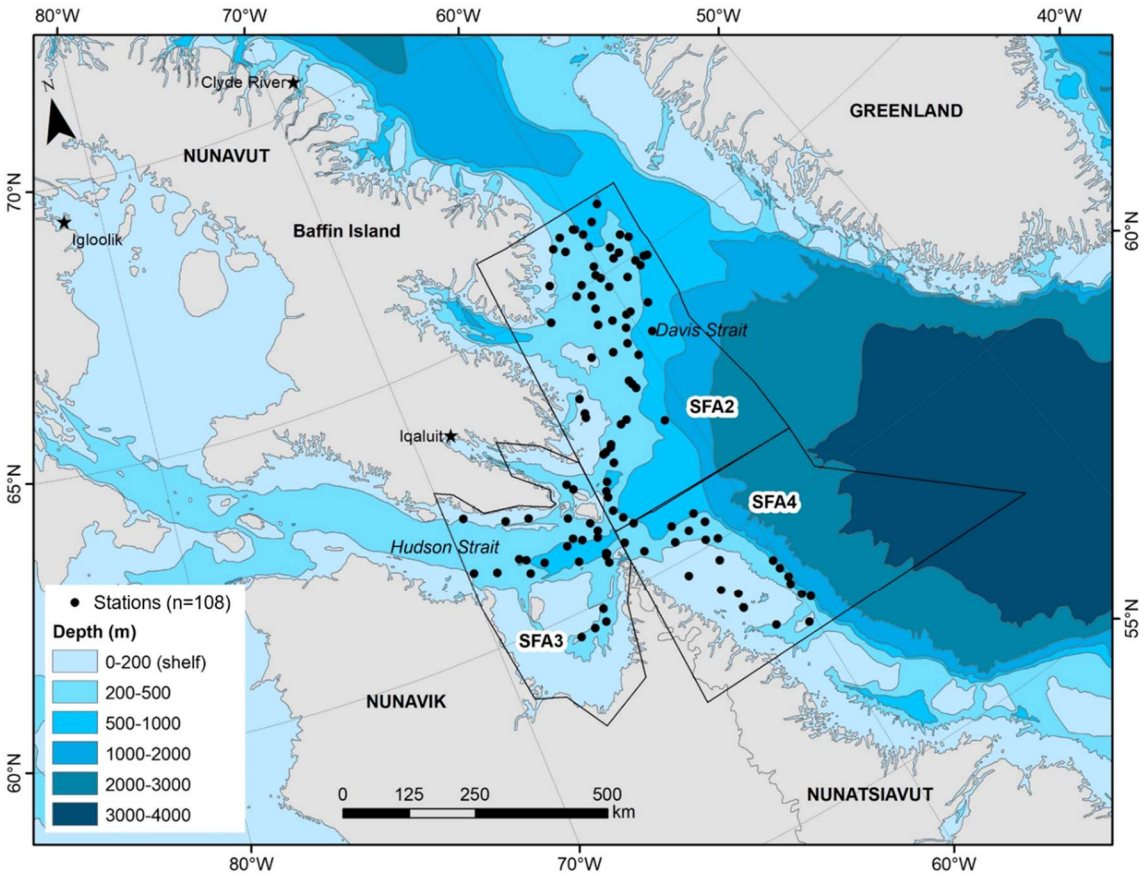


TABLE OF CONTENT

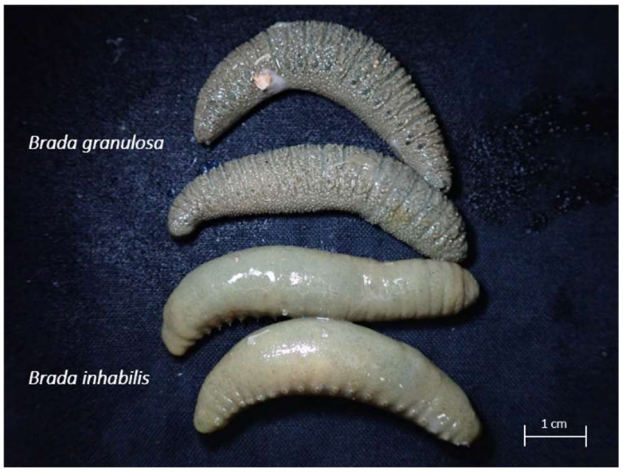
*All polychaetes were identified with photos only.

Class	Scientific Name	SFA 2	SFA 3	SFA 4	Page
Clitellata	*Notostomum laeve*		1		41
Polychaeta	*Brada granulosa*		3		41
	Brada inhabilis	3	5	1	41
	Echiurus echiurus	4			41
	Euphrosine borealis	4	11	2	42
	Laetmonice filicornis	4		5	42
	Polynoidae (fragments)	21	16	11	43
	Phyllodocidae: cf. *Phyllodoce groenlandica*	1			44
	Nephtys sp.	8			44
	Onuphidae		9		44

*Sipunculidae identified here were tentatively identified with photos only. Well preserved specimens and identification keys are required for reliable specimen identification.

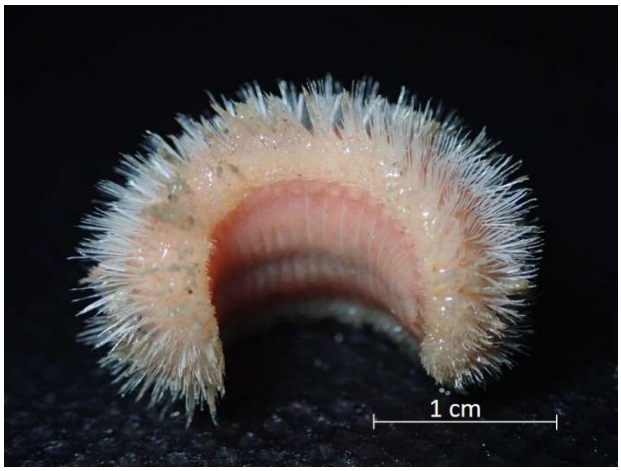
Notostomum laeve (Levinsen, 1882)

Brada granulosa Hansen, 1882 (top) and ***Brada inhabilis*** (Rathke, 1843) (bottom)



Echiurus echiurus (Pallas, 1766)

Euphrosine borealis Örstedt, 1843



Laetmonice filicornis Kinberg, 1856

Polynoidae Kinberg, 1856, fragments (a) and partial tissue of a proboscis (b, c)

* specimen needed for species identification

Phyllodocidae: cf. ***Phyllodoce groenlandica*** Örsted, 1842

Nephtys sp. Cuvier, 1817

Onuphidae Kinberg, 1865

Nemertea

Sipuncula

Order	Scientific name	SFA 2	SFA 3	SFA 4	Page
Scalpelliformes	*Arcoscalpellum michelottianum*			1	48
	Weltnerium nymphocola		1		48
Sessilia	*Balanus balanus*			2	48
Amphipoda	*Acanthonotozoma cristatum*	3	1		49
	Acanthonotozoma cf. *serratum*	1			49
	Gammaracanthus loricatus	1			49
	Epimeria (Epimeria) loricata	28	5	2	50
	Pleustes (Pleustes) panoplus	1	1		50
	Paramphithoe hystrix	12	14	1	50
	Paroediceros lynceus		2	2	51
	Acanthostepheia malmgreni		4		51
	Ampelisca cf. *eschrichtii*		6		51
	Anonyx sp.	13	13	6	52
	Socarnes vahlii	1	1		52
	Pardalisca abyssi	2			52
	Monoculodes cf. *latimanus*		2		52
	Eusirus holmii	7	7		53
	Eusirus cuspidatus	3	10	1	53
	Rhachotropis aculeata	15	9	2	53
	Cleippides tricuspis			1	54
	Cleippides quadricuspis	4			54
	Melita sp.	3			54
	Stegocephalus ampulla	6	12	2	55
	Stegocephalus inflatus	15	7	4	55
	Stegocephalus similis		6		55
	Hyperia galba		1		56
	Themisto compressa	3		1	56
	Themisto libellula	3	11	1	56
Decapoda	*Acanthephyra pelagica*	1			57
	Gennadas elegans	2			57
	Calocaris templemani	1			58
Lophogastrida	*Gnathophausia zoea*	2			58
Decapoda	*Argis dentata*	1	10	7	59
	Pontophilus norvegicus	18		2	59
	Sabinea sarsii	1		1	60
	Sabinea septemcarinata	13	6	5	60
	Sclerocrangon boreas	4	9	1	60
	Sabinea hystrix	3			61
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	Pandalus borealis	-	-	-	62
	Pandalus montagui	-	-	-	62
	Pasiphaea multidentata	5		2	63
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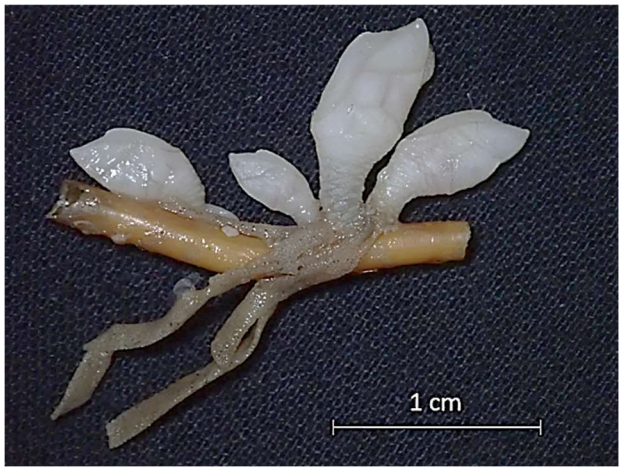
Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Decapoda	*Eualus belcheri*	2	9	12	64
	Eualus gaimardii	1		1	64
	Eualus macilentus		2	7	64
	Spirontocaris spinus	7	13	9	65
	Lebbeus groenlandicus	1	7	3	65
	Lebbeus polaris	37	22	6	66–69
	Eusergestes arcticus	4	5	3	70
Euphausiacea	*Meganyctiphanes norvegica*	40	12	4	70
Mysida	*Boreomysis* sp.	18	12	3	70
	Mysis sp.		2		70
Decapoda	*Hyas alutaceus*		1	3	71
	Lithodes maja	3	1	8	71
	Pagurus cf. *pubescens*		2	2	71
	Munida tenuimana			3	72
	Munidopsis curvirostra	5			72
Isopoda	*Aega psora*	13		4	73
	Aegiochus ventrosa		1	3	73
	Arcturus baffini	9	12	1	74
	Astacilla granulata			1	74
	Synidotea marmorata			1	75
	Tole spinosa	5	5		75
	Munnopsis typica	2	2		75
Pycnogonida	*Pseudopallene brevicollis*	1	1		76
	Colossendeis angusta	1			76
	Colossendeis proboscidea	2	2		76
	Boreonymphon abyssorum	4			77
	Boreonymphon ossiansarsi		1		77
	Nymphon hirtipes	8	6		77
	Nymphon longitarse			1	78
	Nymphon serratum		2		78
	Nymphon stroemi	1		1	78

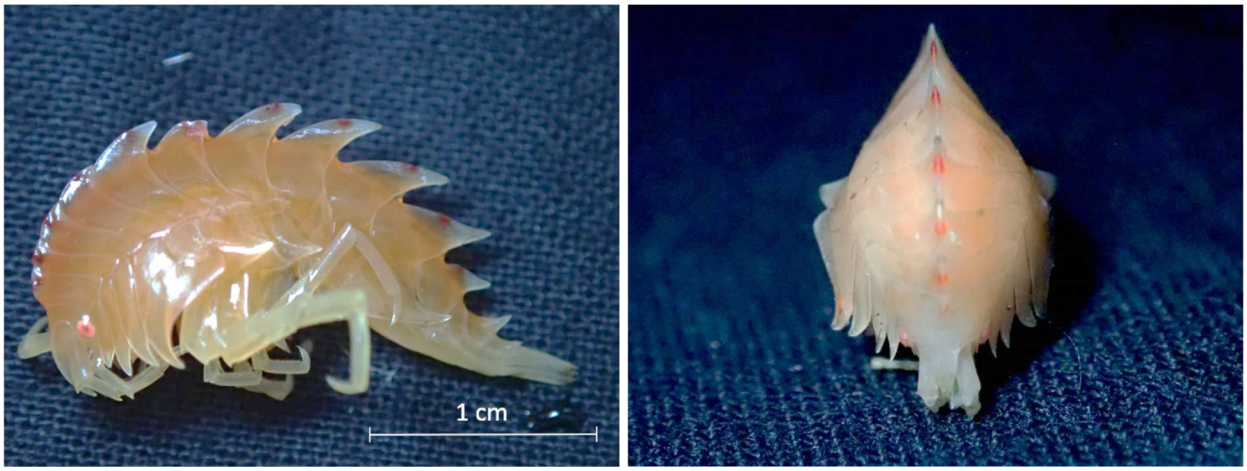
Arcoscalpellum michelottianum (Seguenza, 1876)

Weltnerium nymphocola (Hoek, 1883)



Balanus balanus (Linnaeus, 1758)

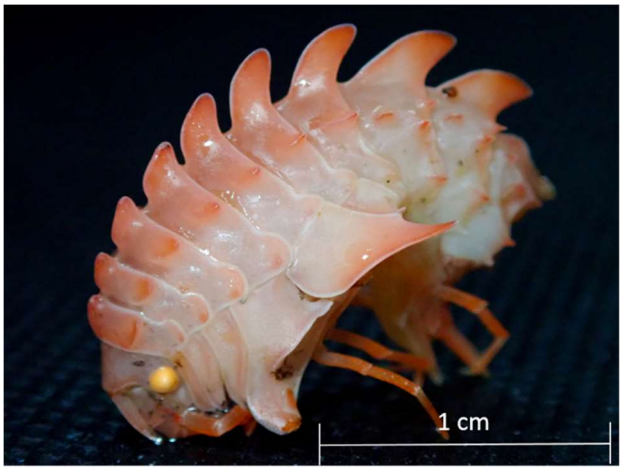
Acanthonotozoma cristatum (Ross, 1835)



Acanthonotozoma cf. ***serratum*** (Fabricius, 1780)

Gammaracanthus loricatus (Sabine, 1824)

Epimeria (Epimeria) loricata G.O. Sars, 1879



Pleustes (Pleustes) panoplus (Krøyer, 1838)

Paramphithoe hystrix (Ross, 1835)

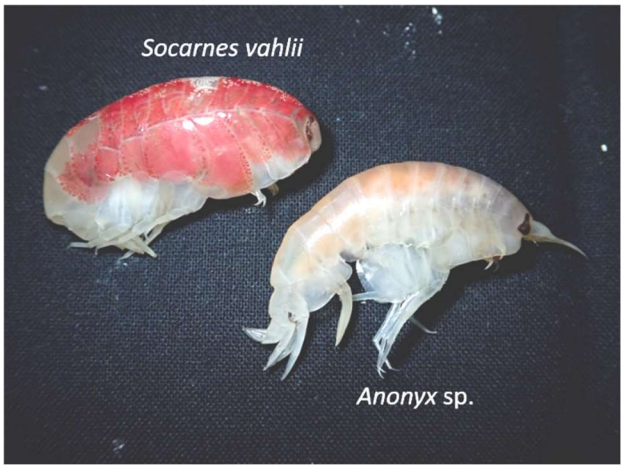
Paroediceros lynceus (M. Sars, 1858)

Acanthostepheia malmgreni (Goës, 1866)

Ampelisca cf. ***eschrichtii*** Krøyer, 1842

Anonyx sp. Krøyer, 1838

Socarnes vahlii (Krøyer, 1838)



Pardalisca abyssi Boeck, 1871

Monoculodes cf. ***latimanus*** (Goës, 1866)

Eusirus holmii Hansen, 1887

Eusirus cuspidatus Krøyer, 1845

Rhachotropis aculeata (Lepechin, 1780)

Cleippides tricuspis Krøyer, 1846


Cleippides quadricuspis Heller, 1875

Melita sp. Leach, 1814

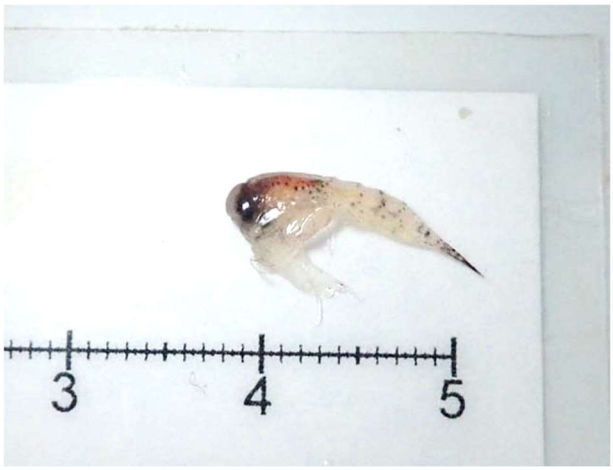

Stegocephalus ampulla (Phipps, 1774)

Stegocephalus inflatus Krøyer, 1842

Stegocephalus similis Sars, 1891

Hyperia galba (Montagu, 1813)

Themisto compressa Goës, 1866



Themisto libellula (Lichtenstein in Mandt, 1822)

Acanthephyra pelagica (Risso, 1816)

Gennadas elegans (Smith, 1882)

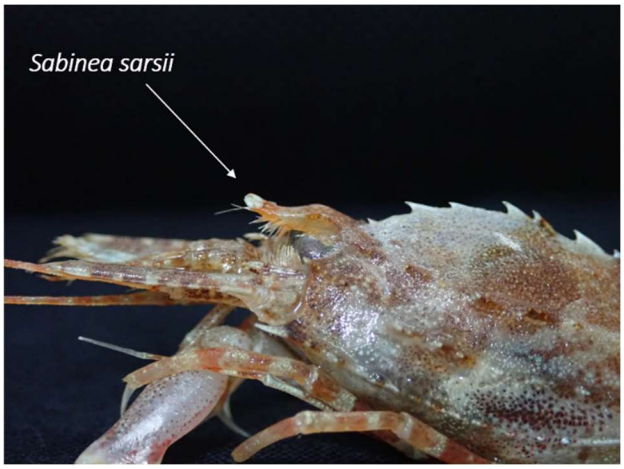
Calocaris templemani Squires, 1965

Gnathophausia zoea Willemoes-Suhm, 1873

Argis dentata (Rathbun, 1902)

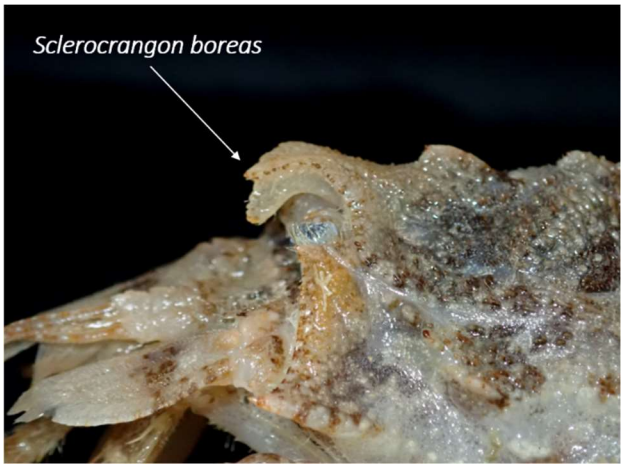
Pontophilus norvegicus (M. Sars, 1861)

Sabinea sarsii Smith, 1879



Sabinea septemcarinata (Sabine, 1824)

Sclerocrangon boreas (Phipps, 1774)



Sabinea hystrix (A. Milne-Edwards, 1881)

Sclerocrangon ferox (Sars G.O., 1877)

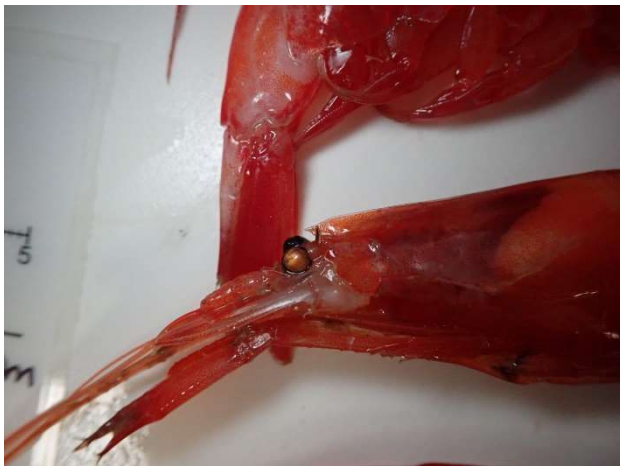
Atlantopandalus propinqvus (Sars G.O., 1870) (top photos : typical specimens, bottom photo: specimen with a broken rostrum)

Pandalus borealis Krøyer, 1838

Pandalus montagui Leach, 1814

Pasiphaea multidentata Esmark, 1866

Pasiphaea tarda Krøyer, 1845

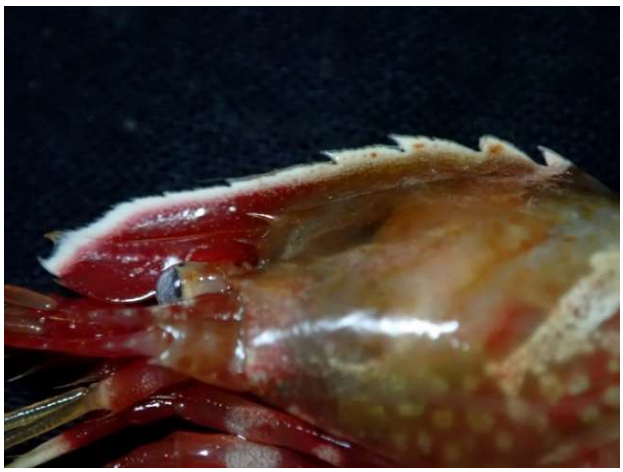


Eualus belcheri (Bell, 1855)

Eualus gaimardii (H. Milne Edwards, 1837 [in H. Milne Edwards, 1834-1840])

Eualus macilentus (Krøyer, 1841)

Spirontocaris spinus (Sowerby, 1805 [in Sowerby, 1804-1806])



Lebbeus groenlandicus (Fabricius, 1775)

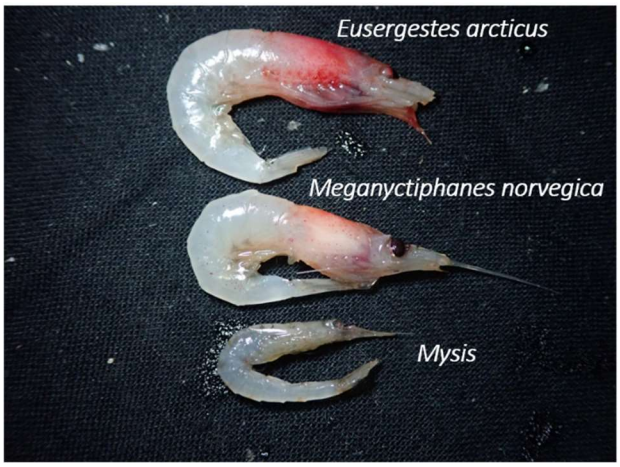
Lebbeus polaris (Sabine, 1824) (12 different shapes of rostrum) (p. 1 of 4)

Lebbeus polaris (Sabine, 1824) (12 different shapes of rostrum) (p. 2 of 4)

Lebbeus polaris (Sabine, 1824) (12 different shapes of rostrum) (p. 3 of 4)

Lebbeus polaris (Sabine, 1824) (12 different shapes of rostrum) (p. 4 of 4)

Eusergestes arcticus (Krøyer, 1855)



Meganyctiphanes norvegica (M. Sars, 1857)

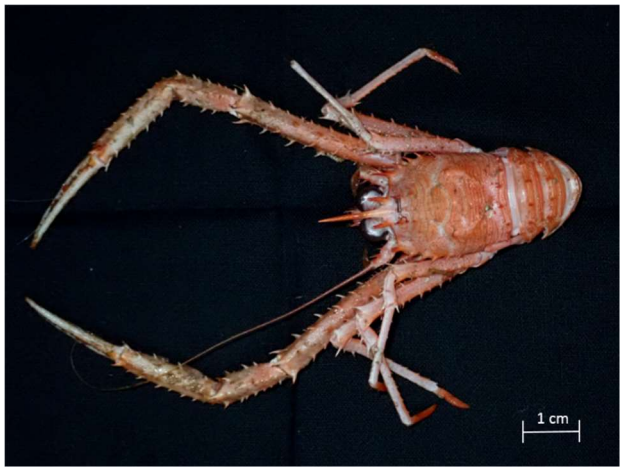
Boreomysis sp. G.O. Sars, 1869 ***Mysis*** sp. Latreille, 1802

Hyas alutaceus Brandt, 1851

Lithodes maja (Linnaeus, 1758)

Pagurus cf. ***pubescens*** Krøyer, 1838

Munida tenuimana Sars, 1872



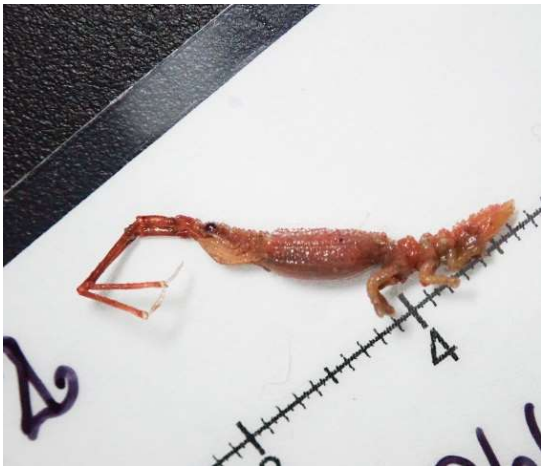
Munidopsis curvirostra Whiteaves, 1874

Aega psora (Linnaeus, 1758)

Aegiochus ventrosa (M. Sars, 1859)

Arcturus baffini (Sabine, 1824)

Astacilla granulata (G. O. Sars, 1877)

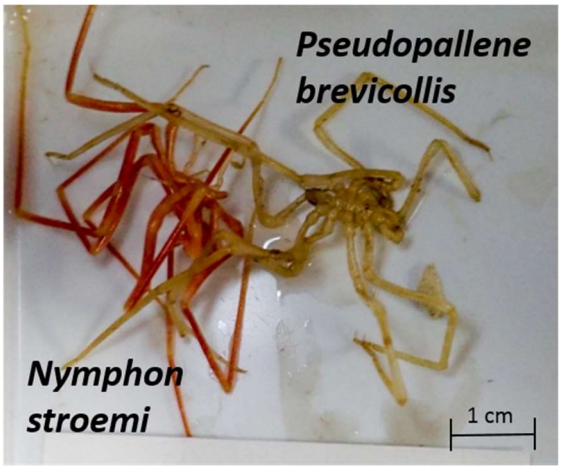


Synidotea marmorata (Packard, 1867)

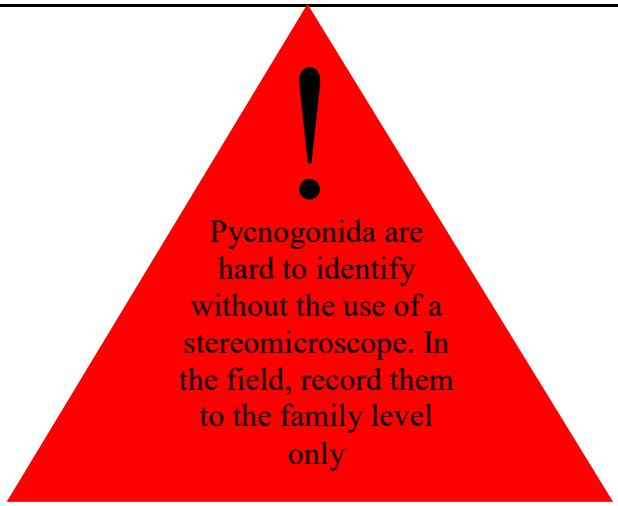
Tole spinosa (Harger, 1879)

Munnopsis typica M. Sars, 1861

Pseudopallene brevicollis (Sars, 1888)



Colossendeis angusta Sars, 1877



Colossendeis proboscidea (Sabine, 1824)

Boreonymphon abyssorum (Norman, 1873)

Boreonymphon ossiansarsi Knaben in Just, 1972

Nymphon hirtipes Bell, 1855

Nymphon longitarse Krøyer, 1844

Nymphon serratum G. O. Sars, 1879

Nymphon stroemi Krøyer, 1844

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Gymnolaemata	cf. *Alcyonidium pachydermatum*	1	3	6	80
	cf. *Cystisella saccata*	2	4	1	80
	cf. *Leieschara coarctata*	4	2	1	80
	cf. *Microporina articulata*		3		81
	cf. *Reteporella* sp.	10		8	81
	Securiflustra securifrons	3	10	12	81
Stenolaemata	cf. *Diplosolen intricarium*	6	3		82
	cf. *Hornera lichenoides*	29	7	5	82
	Bryozoa (unidentified)	13	5	7	82

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Priapulida	*Priapulus caudatus*			1	83

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Ascidiacea	*Ascidia* sp.	4	4	2	84
	Styelidae	15	20	7	84
	Didemnidae	27	1	3	84
	Eudistoma vitreum	10	11	3	85
	Boltenia ovifera		1		85
	Dendrodoa aggregata	1	3		85
	Styela rustica		1		86

cf. ***Alcyonidium pachydermatum*** Denisenko, 1996


cf. ***Cystisella saccata*** (Busk, 1856)


cf. ***Leieschara coarctata*** (M. Sars, 1863)


cf. ***Microporina articulata*** (Fabricius, 1821)

cf. ***Reteporella*** sp. Busk, 1884

Securiflustra securifrons (Pallas, 1766)

cf. ***Diplosolen intricarium*** (Smitt, 1872)


cf. ***Hornera lichenoides*** (Linnaeus, 1758)

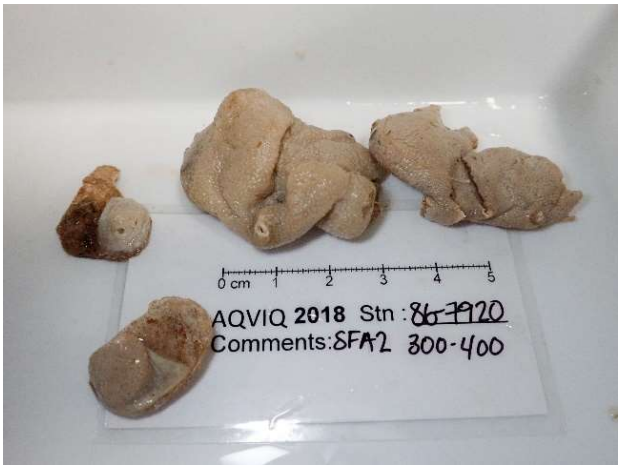

Bryozoa (unidentified)


Priapulus caudatus Lamarck, 1816

Ascidia sp. Linnaeus, 1767

Styelidae Sluiter, 1985 (**left**: *Botrylloides* cf. *aureus* | **right**: *Kukenthalia borealis*)

Didemnidae Giard, 1872

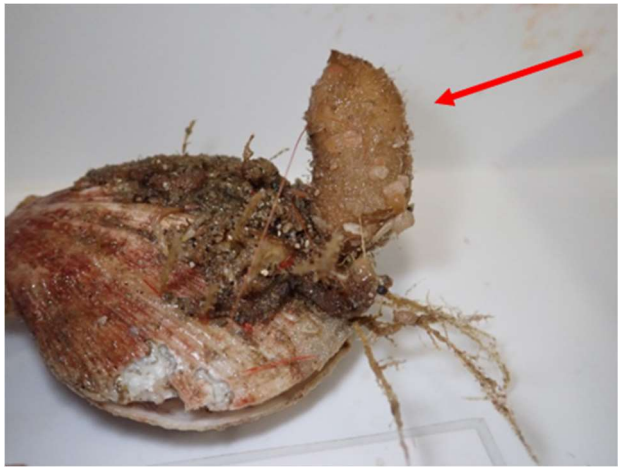


Eudistoma vitreum (Sars, 1851)

Boltenia ovifera (Linnaeus, 1767)

Dendrodoa aggregata Müller, 1766

Styela rustica Linnaeus, 1767



Order	Scientific name	SFA 2	SFA 3	SFA 4	Page
Actiniaria	*Actinauge cristata*	10	1	1	88
	Hormathia nodosa	1	1	2	88
	Hormathiidae	10	10	5	88
	Actinostola callosa	10	12	1	89
	Stephanauge nexilis	4			89
	Actiniidae: cf. *Urticina felina*	1		2	90
	Stomphia coccinea	4	4	5	90
	Bolocera tuediae	3	2	5	90
	Liponema multicorne	2			91
	Ptychodactis patula	2			91
	Halcampidae: cf. *Halcampa* sp.		1		92
	Metridiidae: cf. *Metridium* sp.		1		92
	Actiniaria (unidentified)		1		93
Alcyonacea	*Ceratocaulon wandeli*	2			94
	Drifa glomerata	16	10	12	94
	Gersemia rubiformis	8	15	10	94
	Duva florida	15	5	6	95
	Pseudodrifa sp.	4		1	95
	Pseudodrifa racemosa		3	1	95
	Acanella arbuscula	12			96
	Paramuricea sp.	3	1		96
	Primnoa resedaeformis	4			96
	Heteropolypus sp.	4			97
Corallimorpharia	*Corallimorphus profundus*	2			97
Pennatulacea	*Anthoptilum grandiflorum*			1	98
	Halipteris finmarchica	7			98
	Umbellula encrinus	6			98
Scleractinia	*Flabellum (Ulocyathus) alabastrum*	5		1	99
Zoantharia	*Epizoanthus* cf. *erdmanni*	3			99
	Zoantharia	6	1		99
Class: Hydrozoa	Lafoeidae	7	3		100
	Thuiaria thuja	7	19	5	100
	Hydrozoa (unidentified)	17	19	9	100
Class: Scyphozoa	*Atolla wyvillei*	7		2	101
	Periphylla periphylla	16	1	5	101
	Aurelia aurita	3			102
	Cyanea capillata	2			102

Actinauge cristata Riemann-Zürneck, 1986

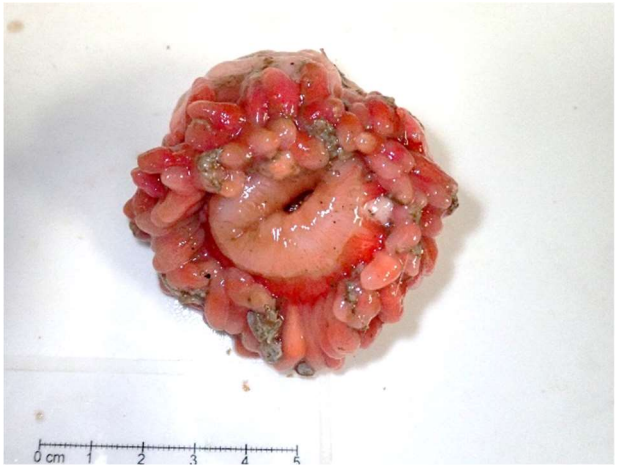
Hormathia nodosa (Fabricius, 1780)

Hormathiidae Carlgren, 1932

Actinostola callosa (Verrill, 1882)

Stephanauge nexilis (Verrill, 1883) seen on *Halipteris finmarchica* (left)

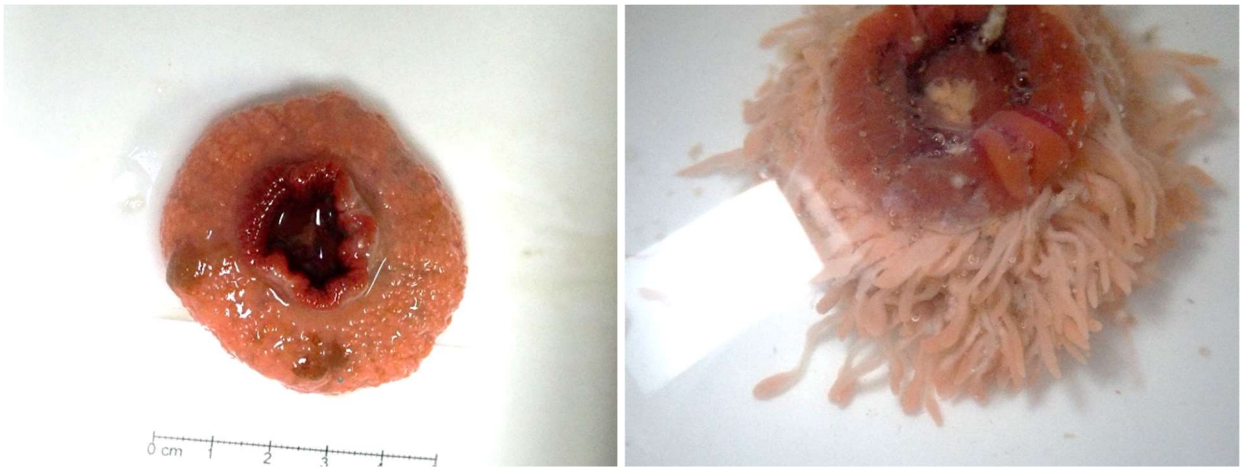
Actiniidae: cf. ***Urticina felina*** (Linnaeus, 1761)

Stomphia coccinea (Müller, 1776)

Bolocera tuediae (Johnston, 1832)

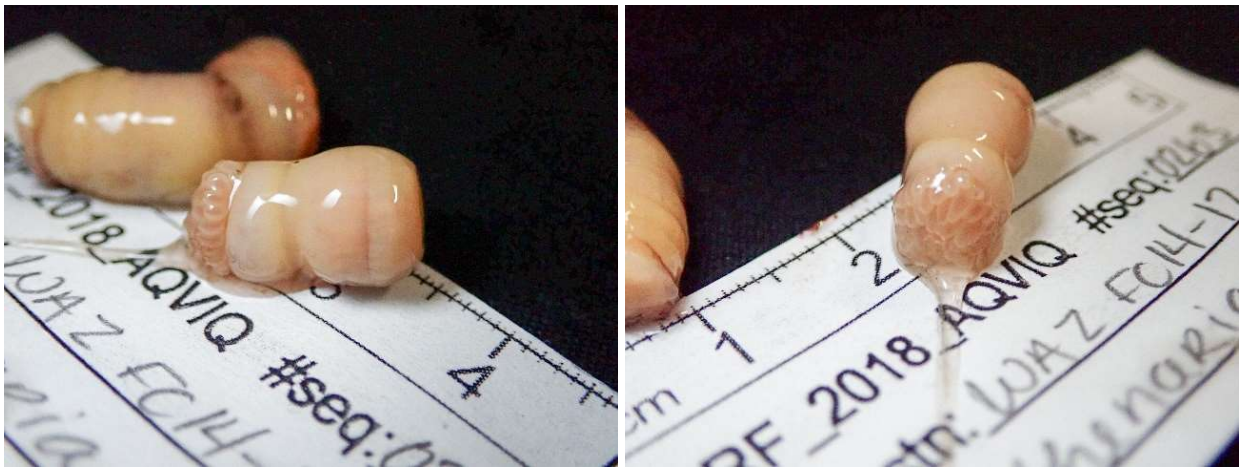

Liponema multicorne (Verrill, 1880)



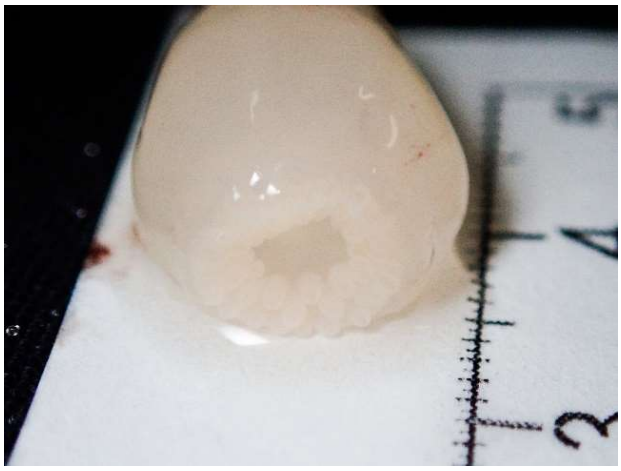
Ptychodactis patula Appellöf, 1893

cf. ***Halcampa*** sp. Goss, 1858

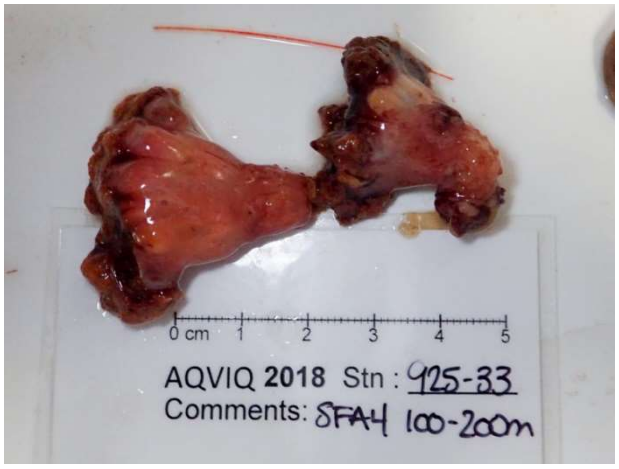
cf. ***Metridium*** sp. de Blainville, 1824



Actiniaria (unidentified)



!!! These **ARE NOT** Actiniaria but pieces of *Thyonidium drummondi* (see p. 118) !!!



Ceratocaulon wandeli Jungersen, 1892

Drifa glomerata Verrill, 1869

Gersemia rubiformis (Ehrenberg, 1834)

Duva florida (Rathke, 1806)

Pseudodrifa sp. Utinomi, 1961

Pseudodrifa racemosa (Studer, 1891)

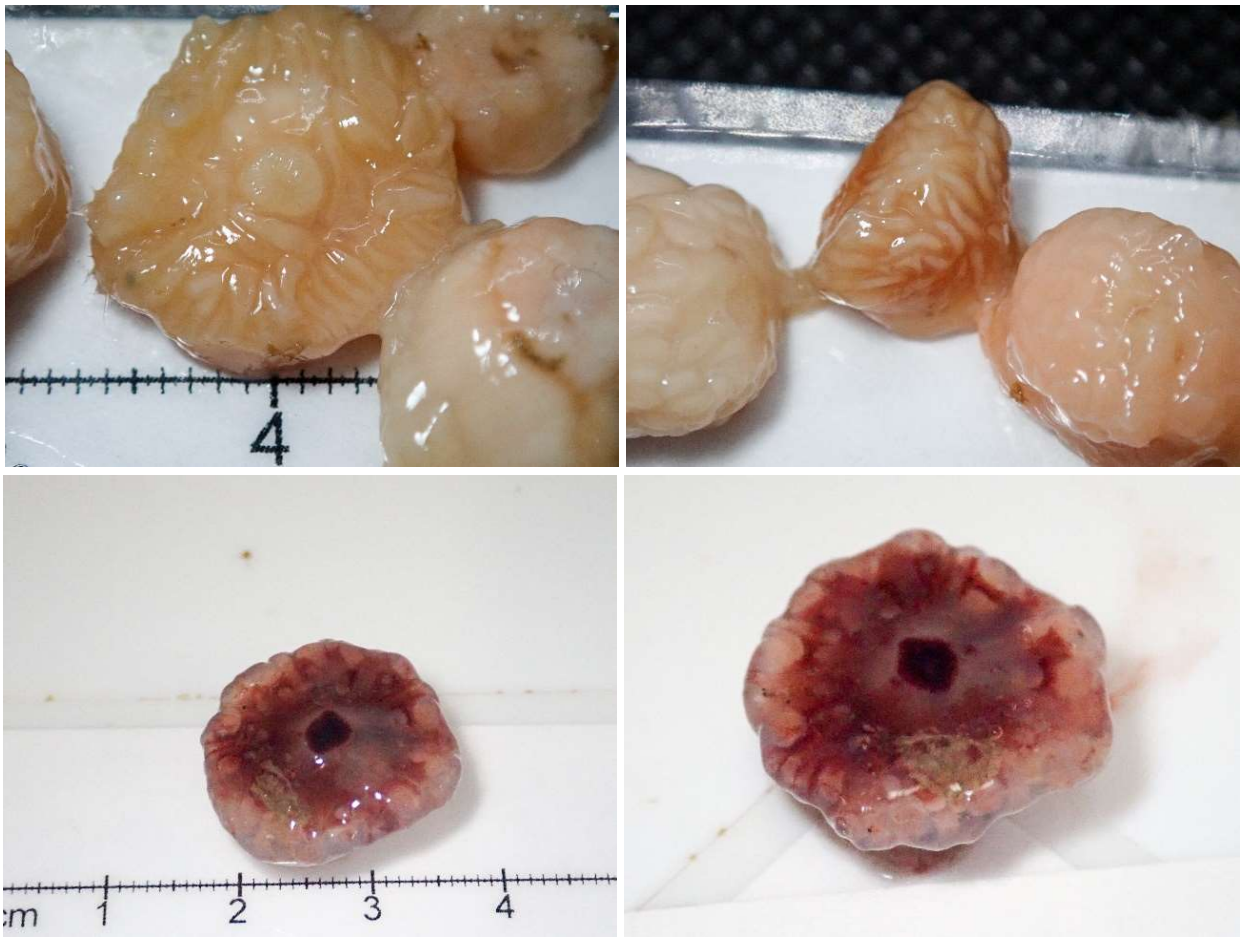
Acanella arbuscula (Johnson, 1862)

Paramuricea sp. Kölliker, 1865

Primnoa resedaeformis (Gunnerus, 1763)

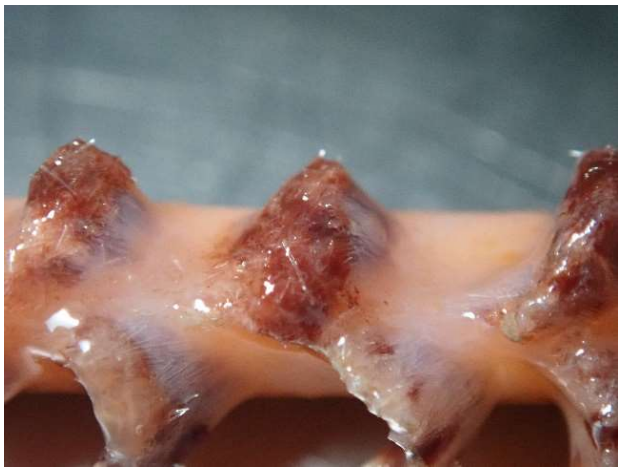
Heteropolypus sp. Tixier-Durivault, 1964

Corallimorphus profundus Moseley, 1877



Anthoptilum grandiflorum (Verrill, 1879)

Halipteris finmarchica (Sars, 1851)

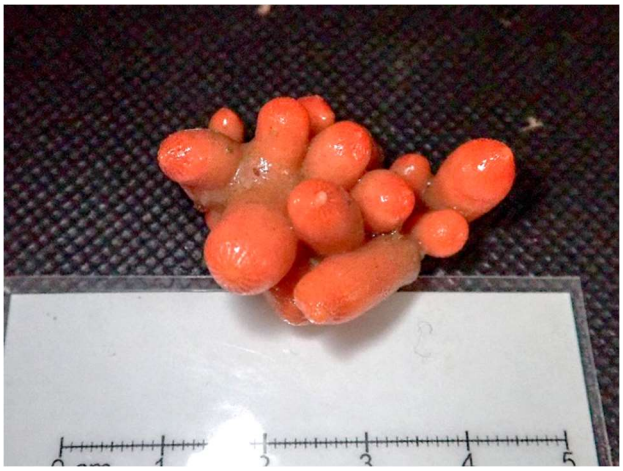


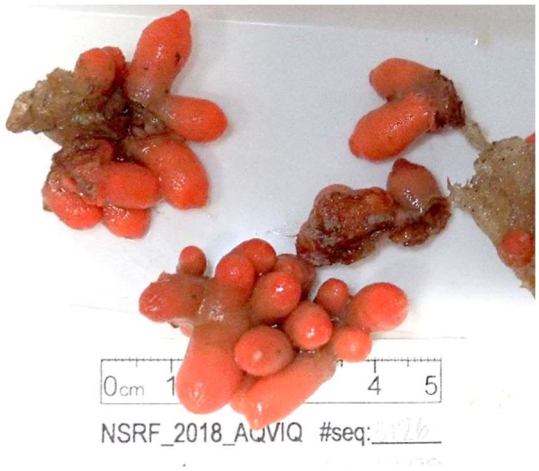
Umbellula encrinus Linnaeus, 1758

Flabellum (Ulocyathus) alabastrum Moseley in Thompson, 1873

Epizoanthus cf. ***erdmanni*** (Danielssen, 1890)

Zoantharia Gray, 1832





Lafoeidae Hincks, 1868

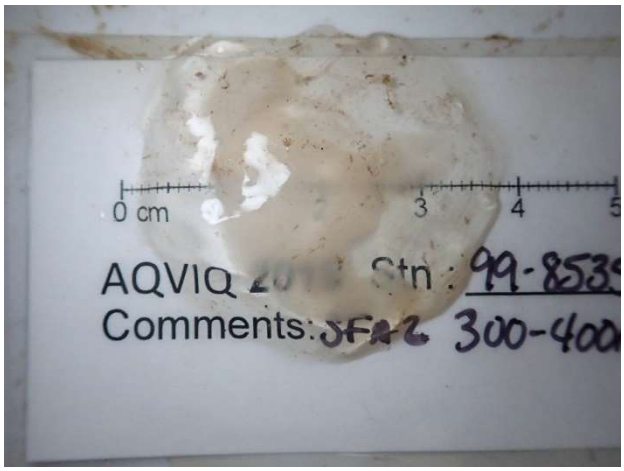
Thuiaria thuja (Linnaeus, 1758)

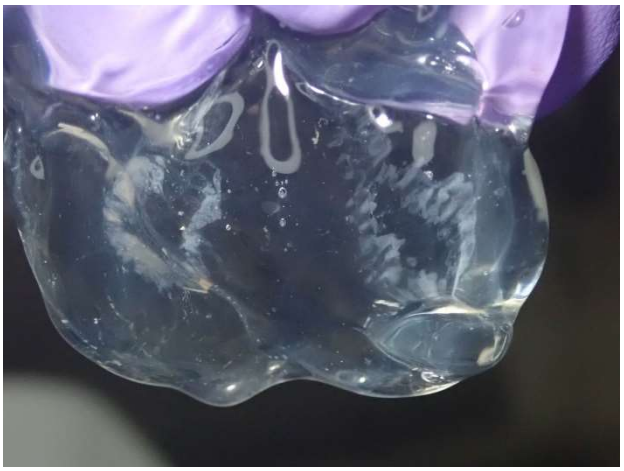
Hydrozoa (unidentified)

Atolla wyvillei Haeckel, 1880

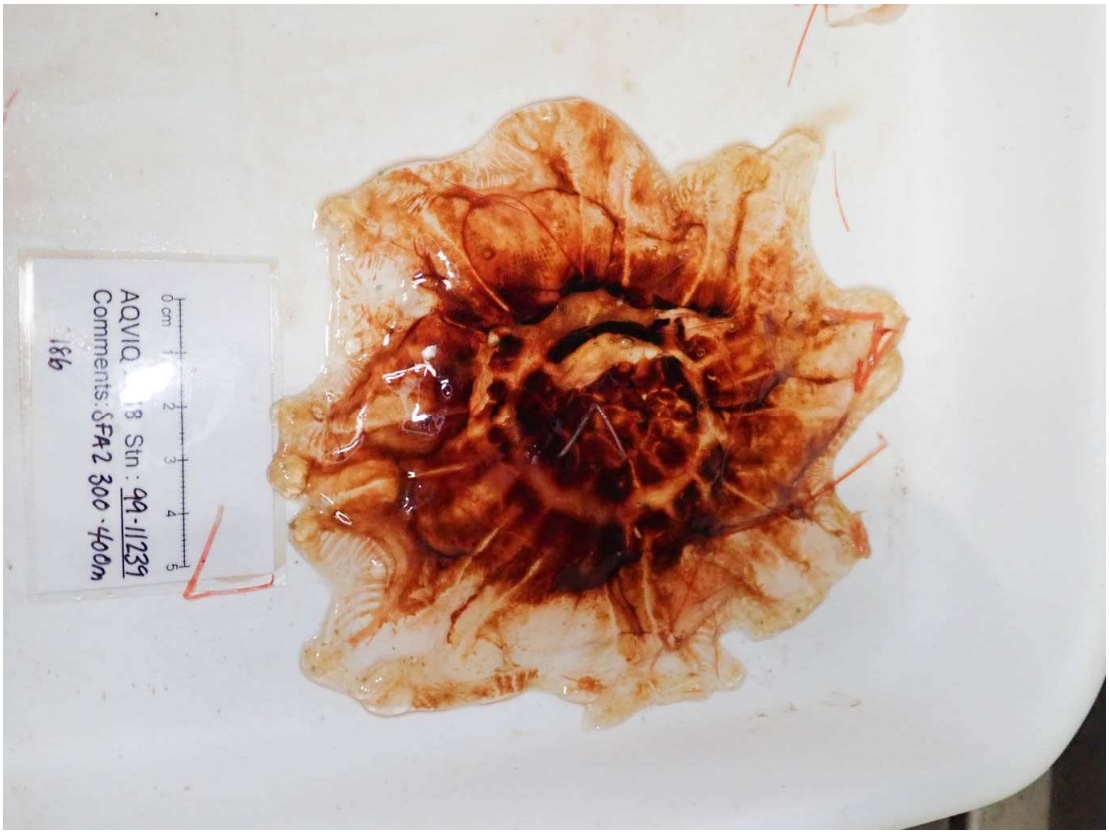
Periphylla periphylla (Péron & Lesueur, 1810)

Aurelia aurita (Linnaeus, 1758)





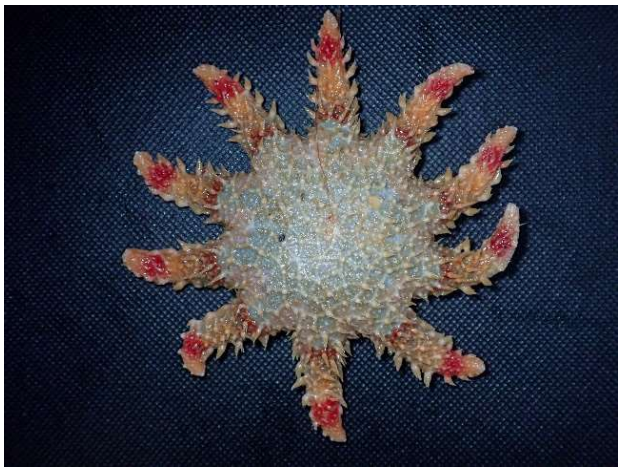
Cyanea capillata (Linnaeus, 1758)



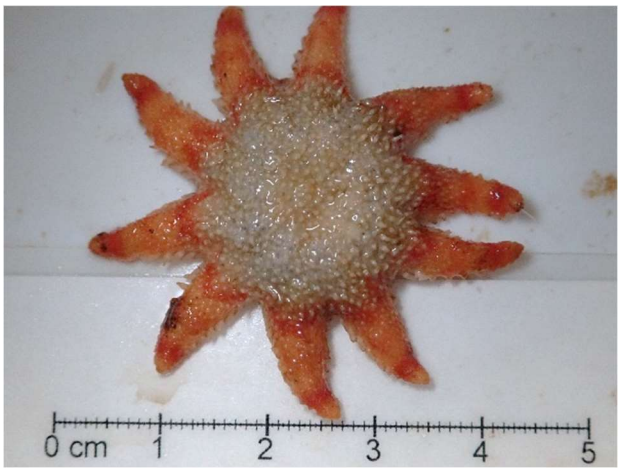
Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Asteroidea	*Crossaster papposus*	11	21	7	105
	Crossaster squamatus	9	8	2	105
	Solaster endeca	1	6	2	105
	Ceramaster granularis	5		3	106
	Hippasteria phrygiana	6	4	6	106
	Lophaster furcifer	8	7	1	106
	Poraniomorpha sp.	4			107
	Hymenaster pellucidus	9			107
	Henricia sp.	39	20	11	107
	Icasterias panopla	13			108
	Leptasterias (Hexasterias) polaris		2		108
	Leptasterias groenlandica	1	1		108
	Stephanasterias albula		4		108
	Novodinia americana	3		1	109
	Pontaster tenuispinus	7			109
	Ctenodiscus crispatus	1	6	3	109
	Leptychaster arcticus	6		2	110
	Pseudarchaster parelii	8			110
	Psilaster andromeda	1			110
	Pteraster militaris	14	6	1	111
	Pteraster obscurus	2	5	2	111
	Pteraster pulvillus	20	7	1	111
	Tremaster mirabilis	3			112
Ophiuroidea	*Ophiopholis aculeata*	31	24	16	112
	Ophiactis abyssicola	9	1	1	112
	Ophioscolex glacialis	13		2	113
	Ophiopus arcticus	1	3		113
	Ophiacantha sp.	29	28	6	113
	Ophiomusa lymani	6			114
	Ophiura robusta	11	11	7	114
	Ophiura sarsii	27	21	14	115
	Ophiopleura borealis		2		115
	Ophiocten sericeum	1			115

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Ophiuroidea	*Gorgonocephalus* sp. (juveniles)	8	5	8	116
	Gorgonocephalus cf. *arcticus*	4	17	2	116
	Gorgonocephalus cf. *eucnemis*	10	15	5	116
Crinoidea	*Heliometra glacialis*	20	15	10	117
	Poliometra prolixa	14	2		117
Echinoidea	*Brisaster fragilis*	4			118
	Phormosoma placenta	1		1	118
	Strongylocentrotus sp.	42	24	13	118
Holothuroidea	*Cucumaria frondosa*	1	6	1	119
	Thyonidium drummondi			3	119
	Molpadia sp.	1			120
	Psolus fabricii	2	7	8	120
	Psolus phantapus	2	2		120
	Ocnus glacialis	1			121

Crossaster papposus (Linnaeus, 1767)

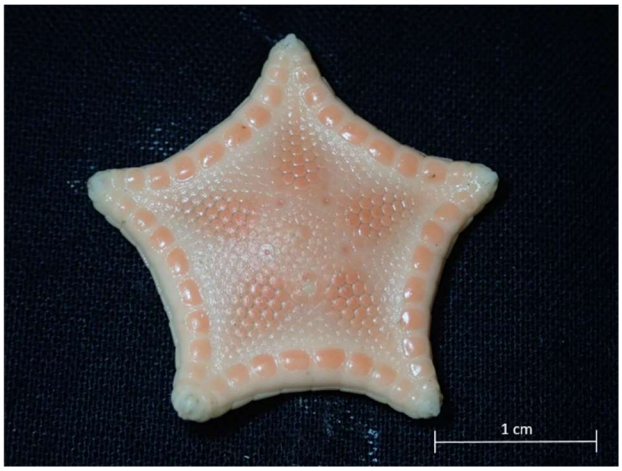


Crossaster squamatus (Döderlein, 1900)

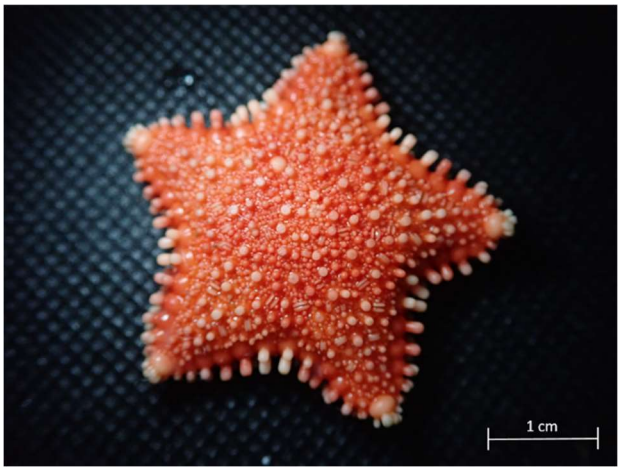


Solaster endeca (Linnaeus, 1771)

Ceramaster granularis (Retzius, 1783)



Hippasteria phrygiana (Parelius, 1768)



Lophaster furcifer (Düben & Koren, 1846)

Poraniomorpha sp. Danielssen & Koren, 1881

Hymenaster pellucidus Thomson, 1873

Henricia sp. Gray, 1840

Icasterias panopla (Stuxberg, 1879)

Leptasterias (Hexasterias) polaris (Müller & Troschel, 1842) with ***S. albula*** (smaller specimen)

Leptasterias groenlandica (Steenstrup, 1857)

Stephanasterias albula (Stimpson, 1853)

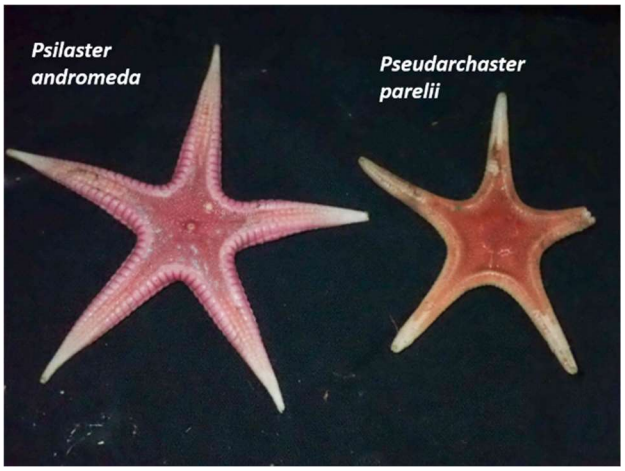
Novodinia americana (Verrill, 1880)

Pontaster tenuispinus (Düben & Koren, 1846)

Ctenodiscus crispatus (Bruzelius, 1805)

Leptychaster arcticus (M. Sars, 1851)

Pseudarchaster parelii (Düben & Koren, 1846)



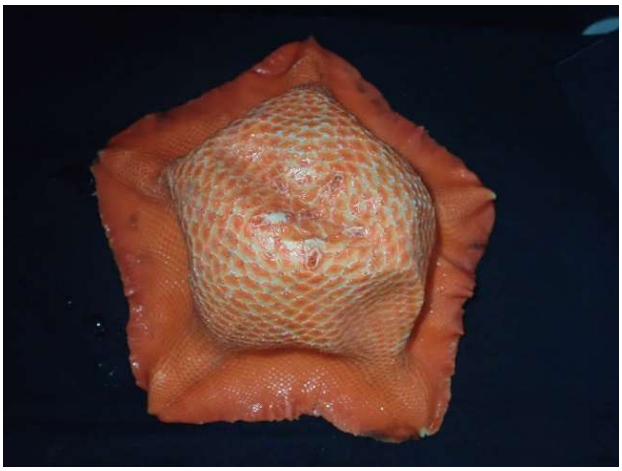
Psilaster andromeda (Müller & Troschel, 1842)

Pteraster militaris (O.F. Müller, 1776)

Pteraster obscurus (Perrier, 1891)

Pteraster pulvillus M. Sars, 1861

Tremaster mirabilis Verrill, 1880



Ophiopholis aculeata (Linnaeus, 1767)

Ophiactis abyssicola (M. Sars, 1861)

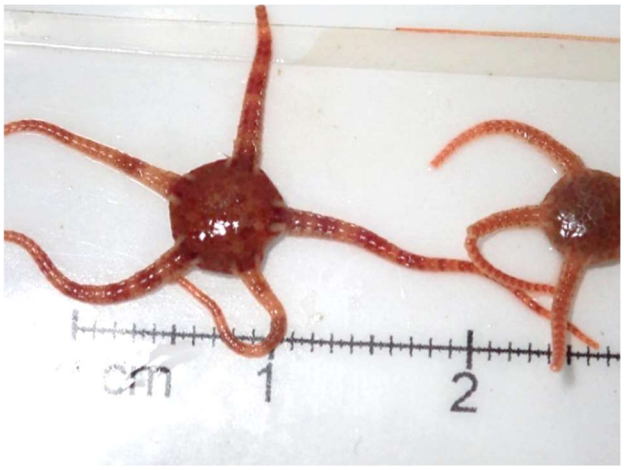
Ophioscolex glacialis Müller & Troschel, 1842

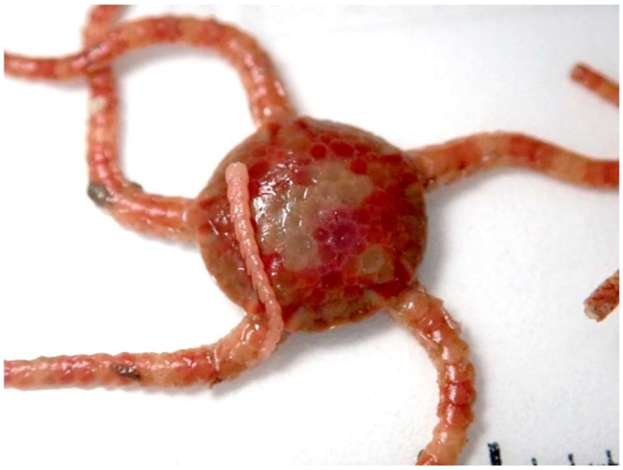
Ophiopus arcticus Ljungman, 1867

Ophiacantha sp. Müller & Troschel, 1842.

Ophiomusa lymani (Wyville Thomson, 1873)

Ophiura robusta (Ayres, 1852)





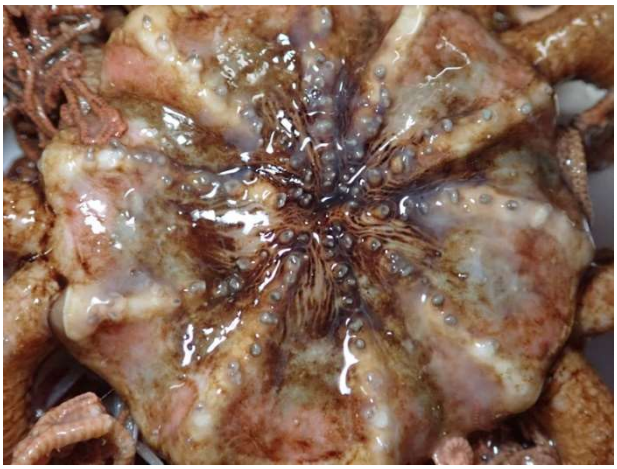
Ophiura sarsii Lütken, 1855

Ophiopleura borealis Danielssen & Koren, 1877

Ophiocten sericeum (Forbes, 1852)

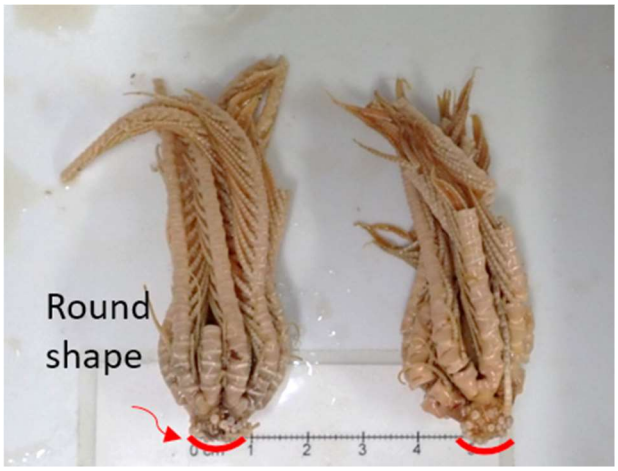
Gorgonocephalus sp. (juveniles) Leach, 1815


Gorgonocephalus cf. ***arcticus*** Leach, 1819

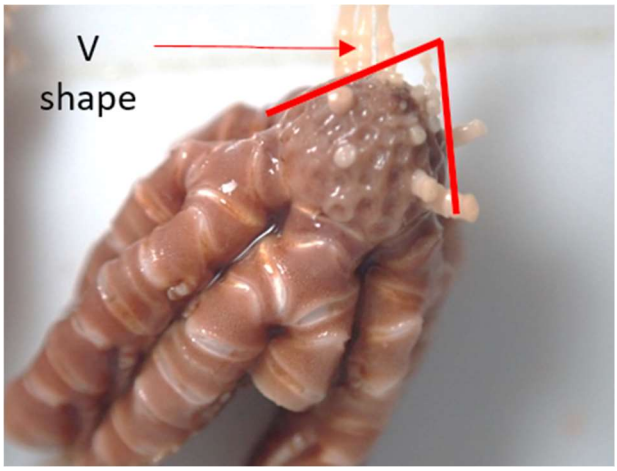



Gorgonocephalus cf. ***eucnemis*** (Müller & Troschel, 1842)

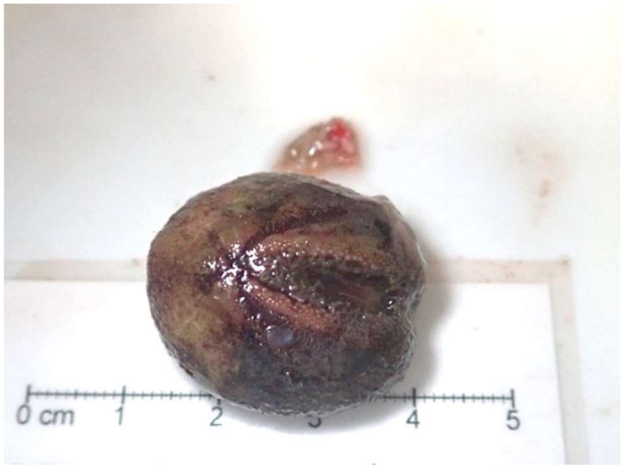

Heliometra glacialis (Owen, 1833 ex Leach MS)



Poliometra prolixa (Sladen, 1881)



Brisaster fragilis (Düben & Koren, 1844)

Phormosoma placenta Thomson, 1872


Strongylocentrotus sp. Brandt, 1835 (two species possible, record as *Strongylocentrotus* sp.)


Cucumaria frondosa (Gunnerus, 1767)

Thyonidium drummondi (Thompson, 1840)

Pieces of ***Thyonidium drummondi*** (Thompson, 1840)

Molpadia sp. Cuvier, 1817

Psolus fabricii (Düben & Koren, 1846)

Psolus phantapus (Strussenfelt, 1765)

Ocnus glacialis (Ljungman, 1879)

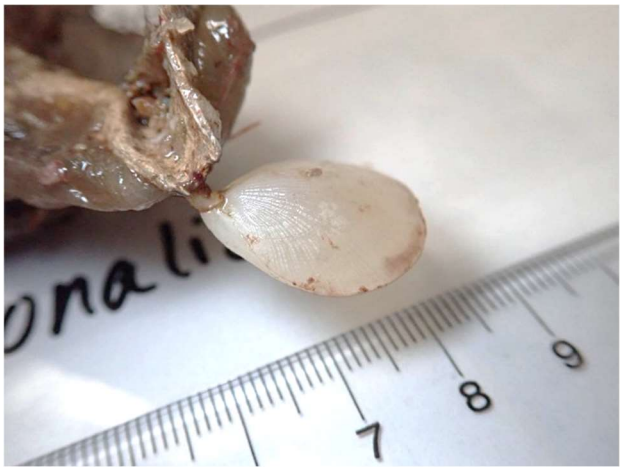
Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Rhynchonellata	*Hemithiris psittacea*	4	7		124
	Terebratulina septentrionalis	4		3	124

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Polyplacophora	*Stenosemus albus*	1			125
Bivalvia	*Astarte* sp.	4			125
	Bathyarca glacialis		1		125
	Bathyarca pectunculoides		1	1	125
	Chlamys islandica	2	10	6	126
	Similipecten greenlandicus	7	1		126
	Ciliatocardium ciliatum			5	127
	Macoma calcarea		1	6	127
	Hiatella arctica		4	1	128
	Panomya norvegica		1	1	128
	Musculus discors		4	1	129
	Musculus niger		1		129
	Nuculana pernula			1	130
	Yoldia hyperborea			2	130
	Ennucula tenuis			1	130
Cephalopoda	*Bathypolypus arcticus*	1	1	1	131–132
	Bathypolypus bairdii	8	2	5	131, 133
	Muusoctopus sp.		2		131, 134
	Gonatus fabricii	30	7	4	135
	Rossia sp.	8	3	5	135
Gastropoda	*Arrhoges occidentalis*	1	2	8	136
	Trichotropis bicarinata	1			136
	Cryptonatica affinis	2	1	4	136
	Limneria undata	1	4	2	137
	Piliscus commodus		3		137
	Velutinidae	1			137
	Lepeta caeca			1	137

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Gastropoda	*Buccinum* sp.	5	8	3	138
	Buccinum ciliatum		1	2	138
	Buccinum cyaneum	1	1	1	138
	Buccinum finmarkianum		1		139
	Buccinum fragile	1			139
	Buccinum hydrophanum	4	1		139
	Buccinum scalariforme		1	1	140
	Buccinum undatum	1	2	10	140
	Beringius turtoni		2		140
	Volutopsius norwegicus	3		3	141
	Colus islandicus		4	3	141
	Colus pubescens	2	1	4	141
	Neptunea despecta		2	3	142
	Scabrotrophon fabricii	3	2	2	142
	Calliotropis ottoi			1	142
	Margarites costalis	1	3	1	143
	Margarites groenlandicus	1	1	5	143
	Margarites helicinus	3	6		143
	Dendronotus niveus	1	8		144
	Nudibranchia (unidentified)	4	2	1	144
	Onchidiopsis sp.	3	4		145
	Clione limacina	1	1		145

Hemithiris psittacea (Gmelin, 1791)

Terebratulina septentrionalis (Couthouy, 1838)



Stenosemus albus (Linnaeus, 1767)

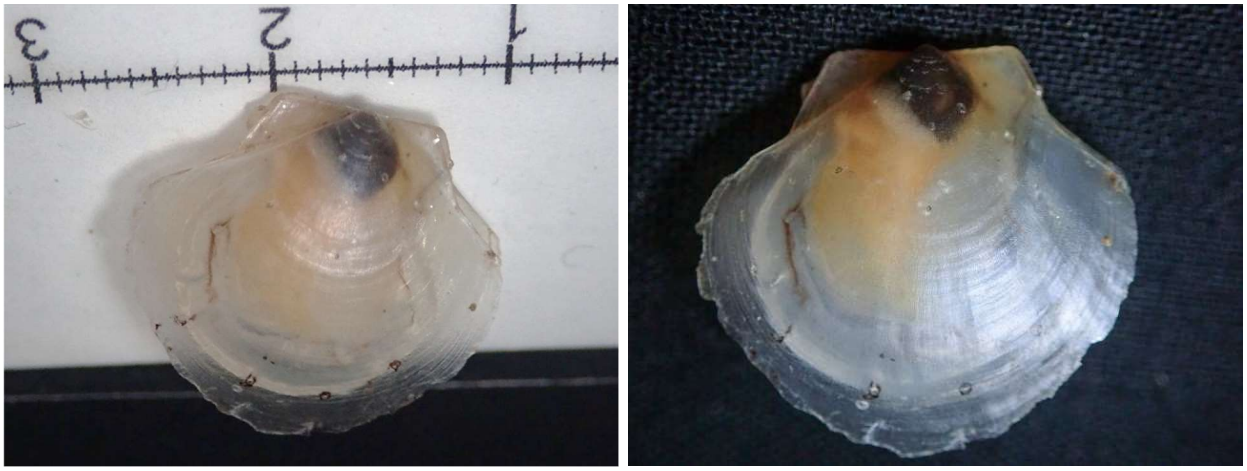
Astarte sp. J. Sowerby, 1816

Bathyarca glacialis (Gray, 1824)

Bathyarca pectunculoides Scacchi, 1835

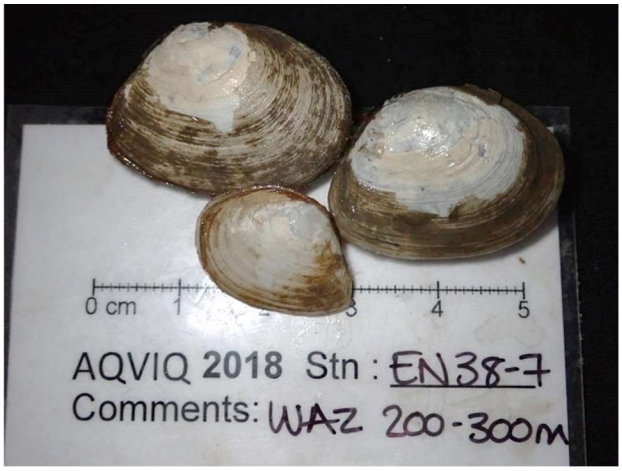
Chlamys islandica (O. F. Müller, 1776)

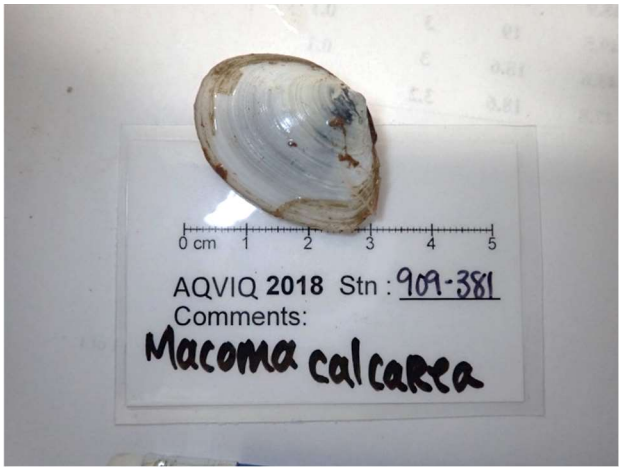
Similipecten greenlandicus (G. B. Sowerby II, 1842)



Ciliatocardium ciliatum (Fabricius, 1780)

Macoma calcarea (Gmelin, 1791)



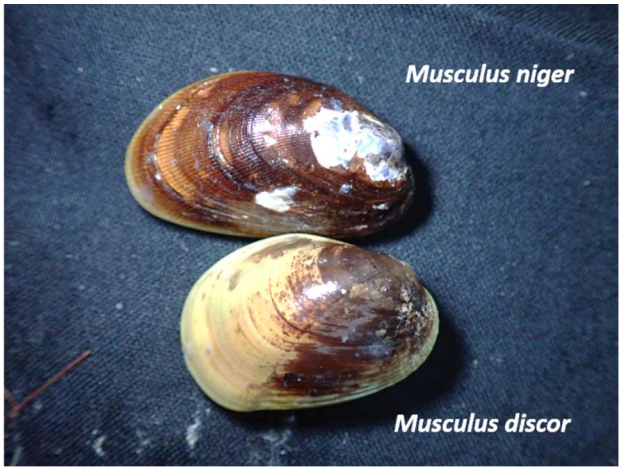


Hiatella arctica (Linnaeus, 1767)

Panomya norvegica (Spengler, 1793) (detached siphons, not whole specimens)

Musculus discors (Linnaeus, 1767)

Musculus niger (J.E. Gray, 1824)



Nuculana pernula (O. F. Müller, 1779)

Yoldia hyperborea (Gould, 1841)

Ennucula tenuis (Montagu, 1808)


Muusoctopus sp.


Bathypolypus arcticus
AQVIQ 2018 Stn : 924-207
Comments: SFA4


Bathypolypus bairdii
AQVIQ 2018 Stn : 967-61
Comments: SFA4 · 400-500m

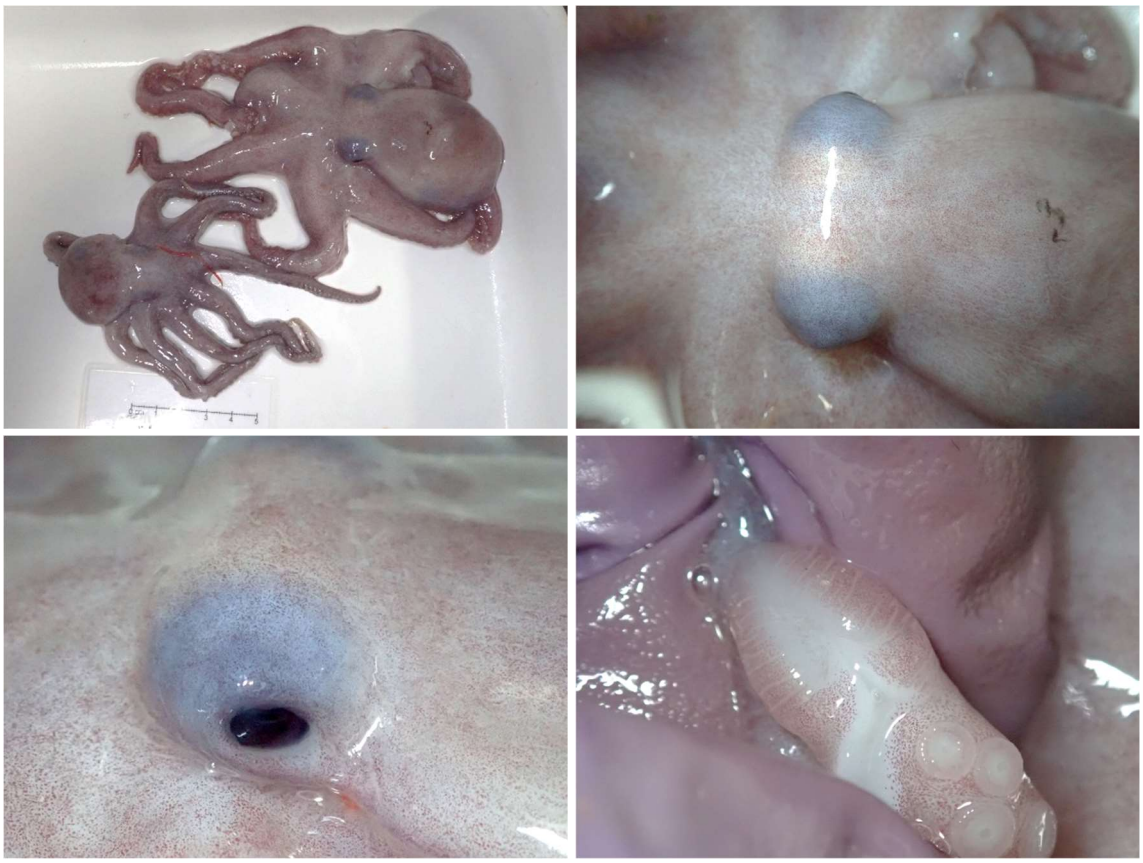
Bathypolypus arcticus* (Prosch, 1849)

***** If a male specimen with a spoon shaped ligula of 11-17 transverse ridges is present (as seen above) then record as *B. arcticus* and if not, record as *Bathypolypus* sp.

Bathypolypus bairdii* (Verrill, 1873)

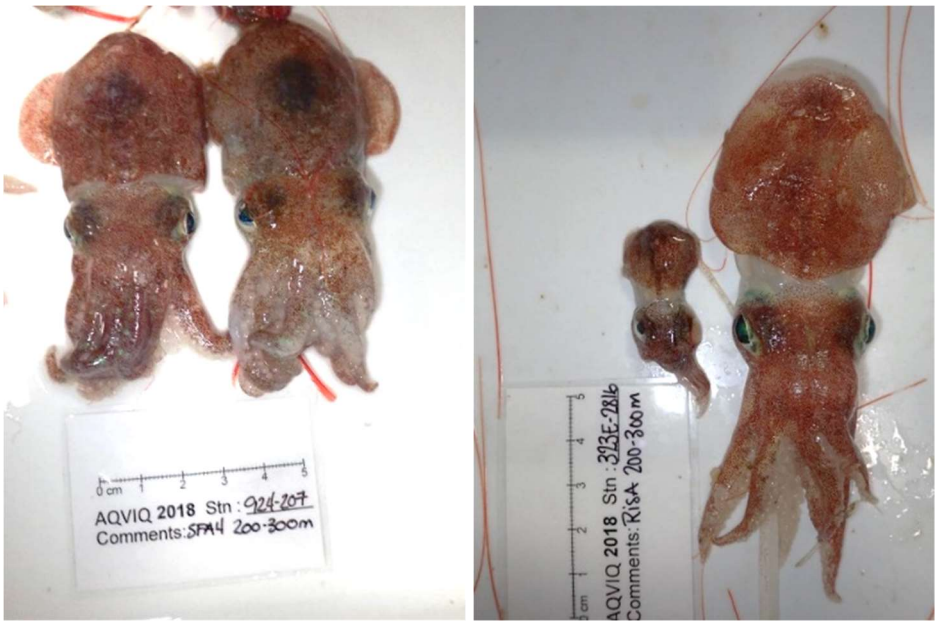
***** Only males with ligula can be separated from *B. pugniger* (ligula with 4-6 transverse ridges). If a spoon shaped ligula with 7-11 transverse ridges is present (not seen on these pictures) then record as *B. bairdii* and if not, record as *Bathypolypus* sp.

Muusoctopus sp. Gleadall, 2004



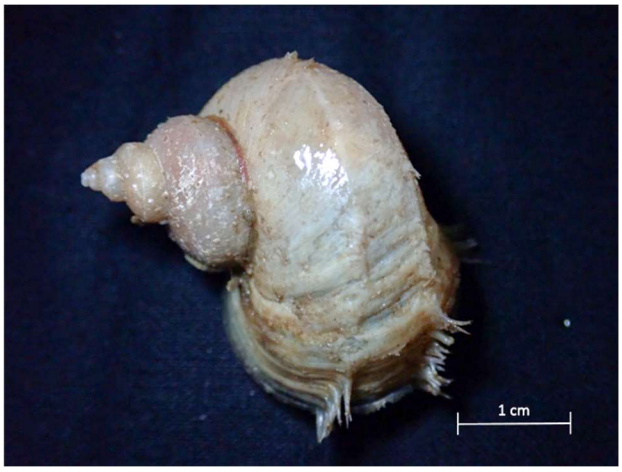
Gonatus fabricii (Lichtenstein, 1818)

Rossia sp. Owen, 1834 (two species possible, *R. palpebrosa* and *R. moelleri*)

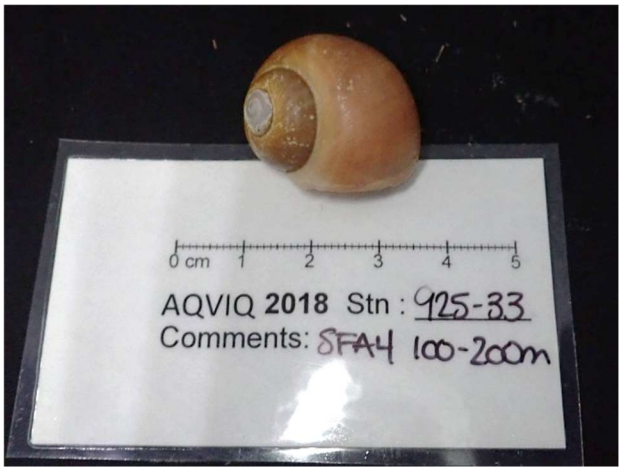


Arrhoges occidentalis (Beck, 1836)

Trichotropis bicarinata (Sowerby I, 1825)



Cryptonatica affinis (Gmelin, 1791)



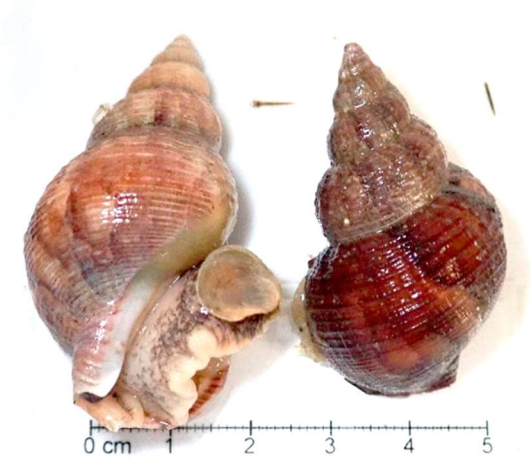
Limneria undata (T. Brown, 1839)

Piliscus commodus (Middendorff, 1851)

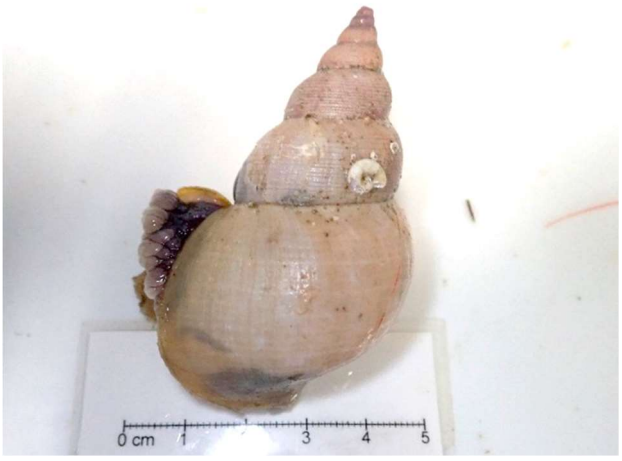
Velutinidae Gray, 1840 ***Lepeta caeca*** (O. F. Müller, 1776)

Buccinum sp. Linnaeus, 1758 ****All *Buccinum* taxa are in need of a review.****

Buccinum ciliatum (Fabricius, 1780)



Buccinum cyaneum Bruguière, 1789



Buccinum finmarkianum Verkrüzen, 1875

Buccinum fragile Verkrüzen, 1878

Buccinum hydrophanum Hancock, 1846

Buccinum scalariforme Møller, 1842

Buccinum undatum Linnaeus, 1758

Beringius turtoni (Bean, 1834)

Volutopsius norwegicus (Gmelin, 1791) (juvenile on left)

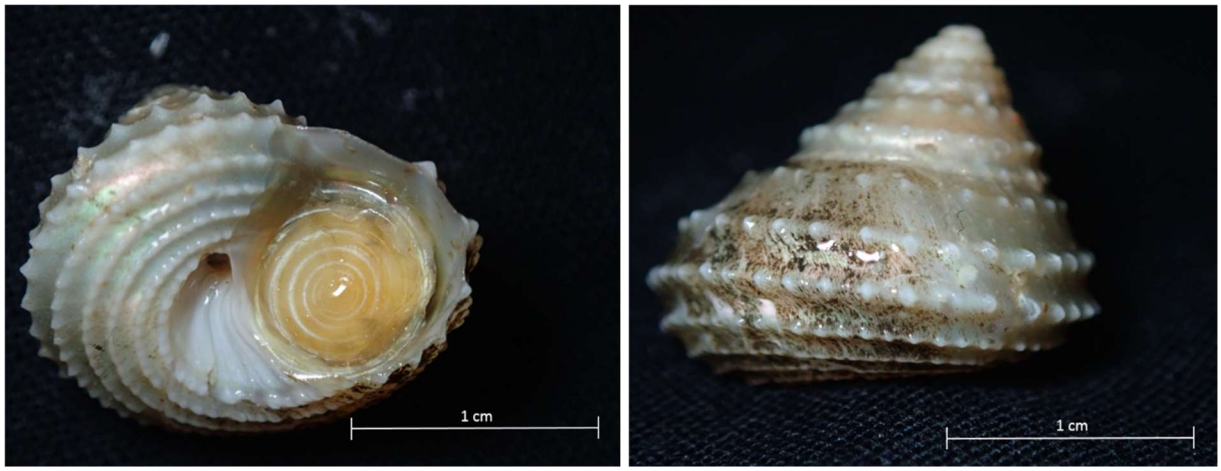
Colus islandicus (Mohr, 1786)

Colus pubescens (A. E. Verrill, 1882)

Neptunea despecta (Linnaeus, 1758)

Scabrotrophon fabricii (Møller, 1842)

Calliotropis ottoi (Philippi, 1844)



Margarites costalis (Gould, 1841)

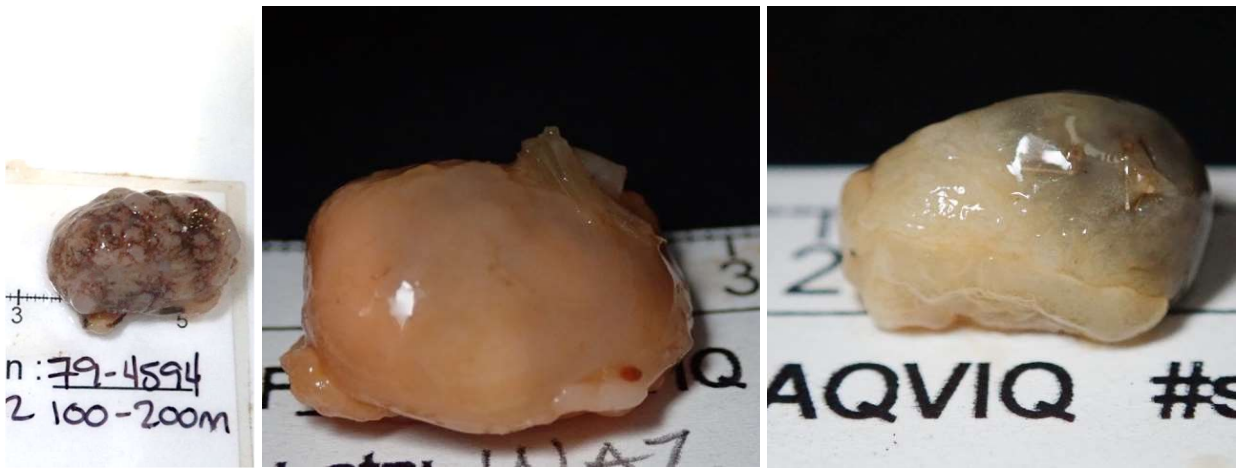
Margarites groenlandicus (Gmelin, 1791)

Margarites helicinus (Phipps, 1774)

Dendronotus niveus Ekimova, Korshunova, Schepetov, Neretina, Sanamyan & Martynov, 2015

Nudibranchia (unidentified)

Onchidiopsis sp. Bergh, 1853



Clione limacina (Phipps, 1774)

Class	Scientific name	SFA 2	SFA 3	SFA 4	Page
Hexactinellida	*Axinella* cf. *arctica*	25	5	9	147
	Cladocroce spatula			1	147
	Isodictya palamata			1	147
	Clathria (Clathria) cf. *barleei*			1	147
	Plicatellopsis bowerbanki			1	148
	Asconema cf. *foliatum*	21	1	8	148
	Crella (Yvesia) pyrula	1	2		148
	Chondrocladia sp.	1	1		149
	Cladorhiza oxeata	14	4		149
	Mycale (Mycale) lingua	13	13	4	149
	Lycopodina sp.	2			150
	Biemna cf. *variantia*	2	2	1	150
	Hemigellius arcofer			2	150
	Lissodendoryx sp.	3			151
	Lissondendoryx (Lissodendoryx) indistincta	1	1	2	151
Demospongiae	*Artemisina arcigera*	2	3	2	151
Hexactinellida	*Geodia* sp.	4	2	2	152
	Geodia cf. *barretti*	5		1	152
	Geodia cf. *hentscheli*	4			152
	Geodia cf. *macandrewii*			1	153
	Geodia cf. *parva*	5			153
	Geodia cf. *phlegraei*	4			153
	Craniella sp.	13	4	1	154
	Stelleta sp.	6	1		154
	Thenea cf. *muricata*	42	7		155
	Quasillina brevis	9	4	1	155
	Tentorium semisuberites	31	12	4	155
	Polymastia andrica	6		1	156
	Polymastia grimaldii	4			156
	cf. *Spinularia sarsii*	1			156
	Polymastia cf. *hemisphaerica*	17	1	5	157
	Polymastia thielei	6	1	1	157
	Polymastia uberrima	16	3	3	157
	Werberella bursa	5	1	4	158
	Tethya cf. *norvegica*	6	1	1	158
	Spongiella pulchella		2		158
	Porifera (unidentified)	-	-	-	159

Axinella cf. ***arctica*** (Vosmaer, 1885)

Cladocroce spatula (Lundbeck, 1902)

Isodictya palmata (Ellis & Solander, 1786)

Clathria (Clathria) cf. ***barleei*** (Bowerbank, 1866)

Plicatellopsis bowerbanki **(**Vosmaer, 1885)

Asconema cf. ***foliatum*** (Fristedt, 1887)

Crella (Yvesia) pyrula (Carter, 1876)

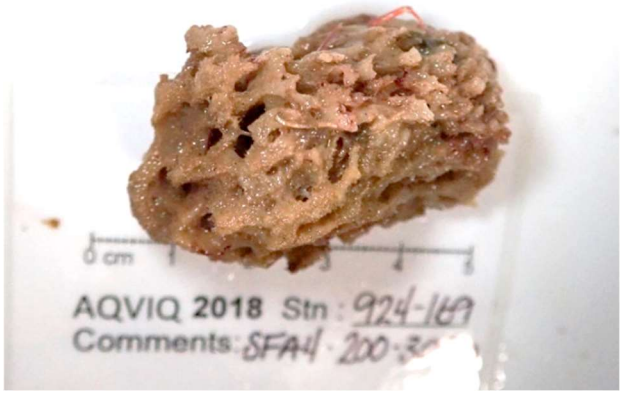
Chondrocladia sp. Thomson, 1873

Cladorhiza oxeata Lundbeck, 1905

Mycale (Mycale) lingua (Bowerbank, 1866)

Lycopodina sp. Lundbeck, 1905

Biemna cf. ***variantia*** (Bowerbank, 1858)



Hemigellius arcofer (Vosmaer, 1885)

Lissodendoryx sp. Topsent, 1892

Lissodendoryx (Lissodendoryx) indistincta (Fristedt, 1887)

Artemisina arcigera (Schmidt, 1870)

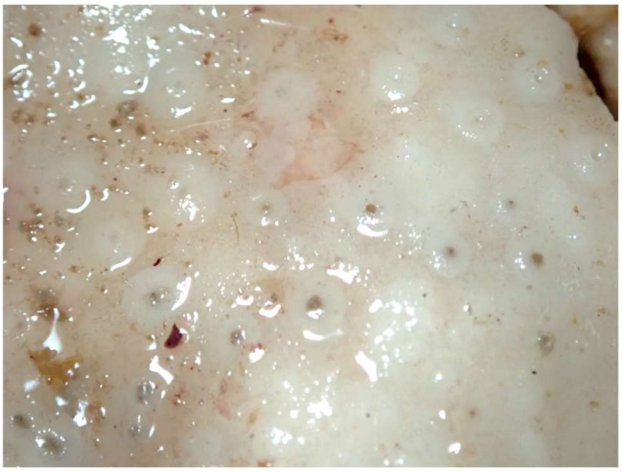
Pieces of ***Geodia*** sp. Lamarck, 1815

Geodia cf. ***barretti*** Bowerbank, 1858

Geodia cf. ***hentscheli*** Cárdenas, Rapp, Schander & Tendal, 2010

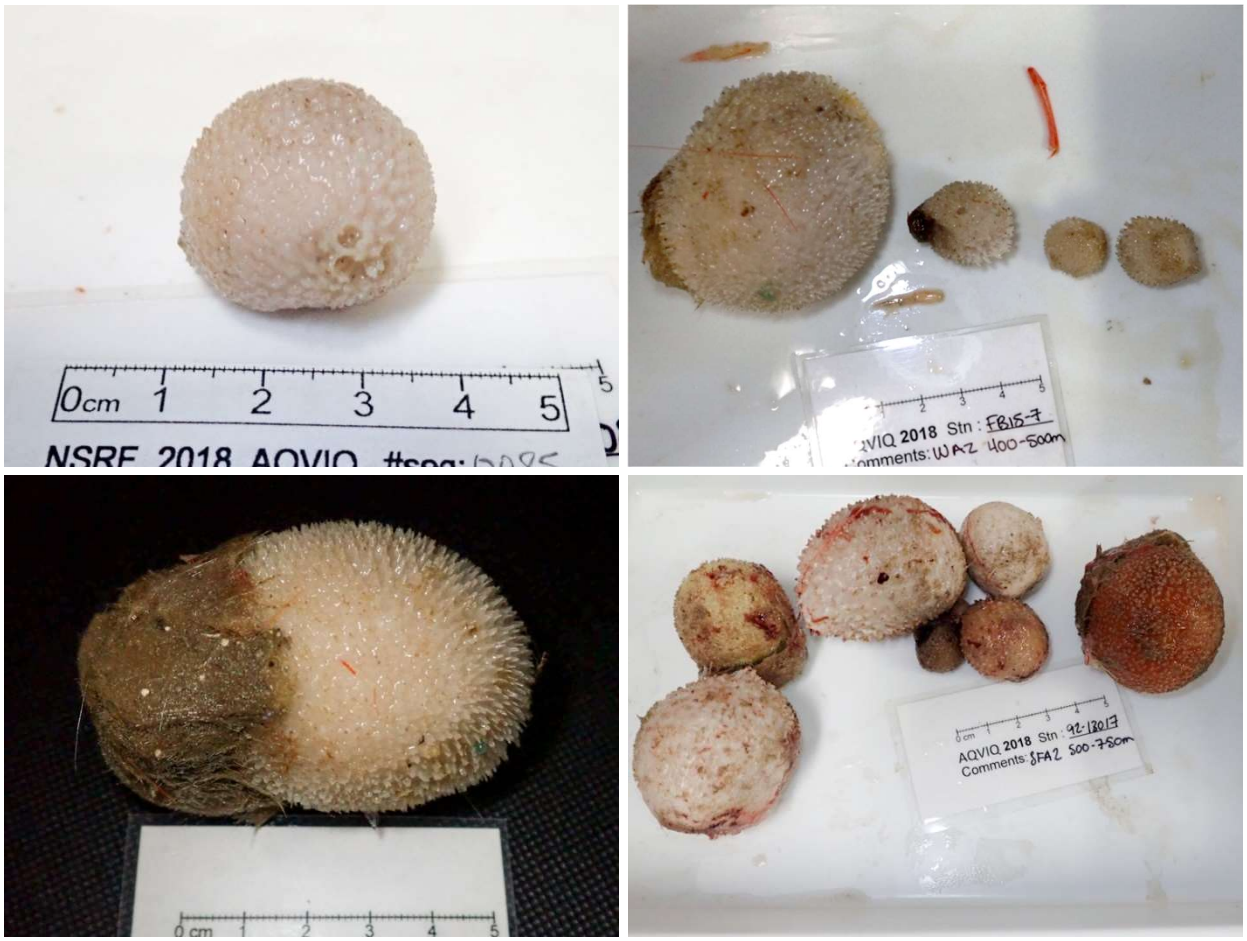
Geodia cf. ***macandrewii*** Bowerbank, 1858

Geodia cf. ***parva*** Hansen, 1885



Geodia cf. ***phlegraei*** (Sollas, 1880)

Craniella sp. Schmidt, 1870



Stelletta sp. Schmidt, 1862

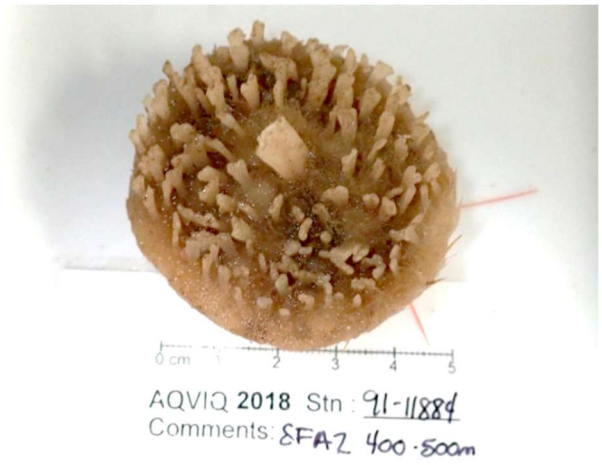
Thenea cf. ***muricata*** (Bowerbank, 1858)

Quasillina brevis (Bowerbank, 1861)

Tentorium semisuberites (Schmidt, 1870)

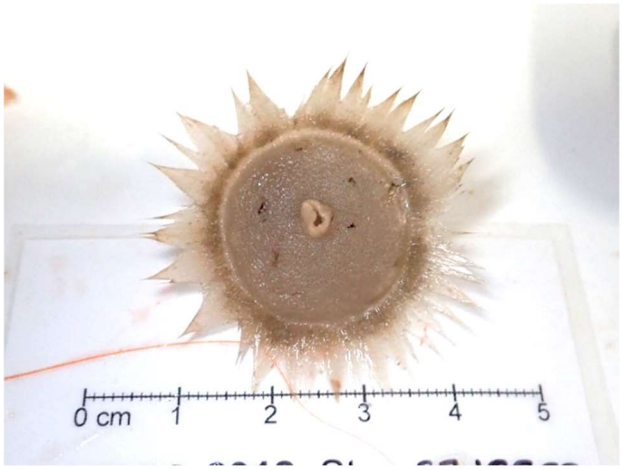
Polymastia andrica Laubenfels, 1949

Polymastia grimaldii (Topsent, 1913)

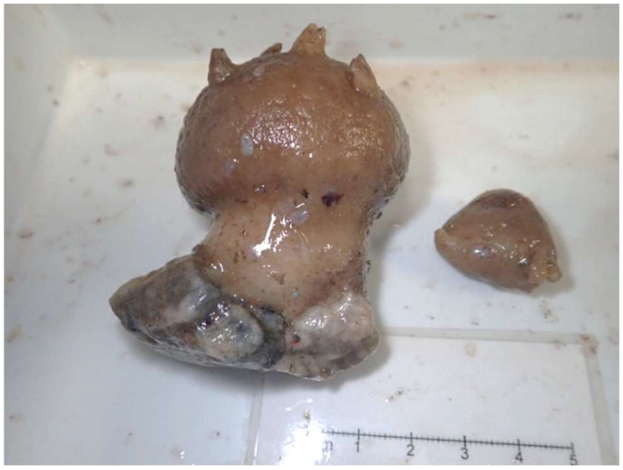


Spinularia cf. ***sarsii*** (Ridley & Dendy, 1886)

Polymastia cf. ***hemisphaerica*** (Sars, 1872)



Polymastia thielei Koltun, 1964



Polymastia uberrima (Schmidt, 1870)

Weberella bursa (Linnaeus, 1758)

Tethya cf. ***norvegica*** Bowerbank, 1872

Spongionella pulchella (Sowerby, 1804)

Porifera (unidentified**)** A few examples of unidentified sponges (left: found in SFA 3, right: found in SFA 4)

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