A photo catalogue of fishes and invertebrates from the 2017 Central and Arctic Region trawl survey in Baffin Bay

Claude Nozères, Virginie Roy, Lisa Treau de Coeli, Margaret Treble, Kevin Hedges, and Wojciech Walkusz

Fisheries and Oceans Canada

Maurice Lamontagne Institute
850 route de la Mer, PO Box 1000
Mont-Joli, QC G5H 3Z4

Freshwater Institute
501 University Crescent, PO Box 5030
Winnipeg, MB R3T 2N6

2019

Canadian Technical Report of Fisheries and Aquatic Sciences 3324

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of Fisheries and Oceans Canada, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in the data base *Aquatic Sciences and Fisheries Abstracts*.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. II n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications à part entière. Le titre exact figure au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la base de données *Résumés des sciences aquatiques et halieutiques.*

Les rapports techniques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

Canadian Technical Report of
Fisheries and Aquatic Sciences 3324

2019

A photo catalogue of fishes and invertebrates from the 2017 Central and Arctic Region trawl survey in Baffin Bay

by

Claude Nozères[1], Virginie Roy[1], Lisa Treau de Coeli[2], Margaret Treble[3], Kevin Hedges[3], and Wojciech Walkusz[3]

[1]Fisheries and Oceans Canada
Maurice Lamontagne Institute
850 route de la Mer
PO Box 1000
Mont-Joli, QC G5H 3Z4

[2]Université Laval
Département de biologie
1045, av. de la Médecine
Québec, QC G1V 0A6

[3]Fisheries and Oceans Canada
Freshwater Institute
501 University Crescent
PO Box 5030
Winnipeg, MB R3T 2N6

Cat. No. Fs97-6/3324E-PDF ISBN 978-0-660-31782-3 ISSN 1488-5379

Correct citation for this publication:

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.

TABLE OF CONTENTS

ABSTRACT

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

A digital image catalogue has been created to validate the occurrences of fish and invertebrate taxa sampled from October 27 to November 8, 2017 during a bottom trawl survey in Northwest Atlantic Fisheries Organization Division 0A (Baffin Bay) conducted by Fisheries and Oceans Canada Central and Arctic Region. Captures at 74 stations revealed 116 taxa, representing mostly deepwater demersal fishes, shrimps, sea stars, and sponges. Photos helped to reduce the need to conserve specimens for identification following surveys and can be a source of additional biological information that would not otherwise be recorded while at sea. While more taxa would be revealed using a variety of sampling gear, trawl surveys remain a valuable tool for monitoring mega-epibenthos and demersal fishes. Selected photos of the taxa are presented in an appendix.

RÉSUMÉ

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.

Un catalogue d'images numériques a été créé pour valider les occurrences de taxons de poissons et d'invertébrés échantillonnés du 27 octobre au 8 novembre 2017 lors d'un relevé au chalut de fond réalisé par Pêches et Océans Canada, région du Centre et de l'Arctique, dans la division 0A (baie de Baffin) de l’Organisation des pêches de l'Atlantique Nord-Ouest. Les captures effectuées dans 74 stations ont révélé la présence de 116 taxons représentant principalement des poissons démersaux d'eaux profondes, des crevettes, des étoiles de mer et des éponges. Les photos ont aidé à réduire la nécessité de conserver les spécimens pour identification à la suite des relevés et peuvent constituer une source d'informations biologiques supplémentaires qui ne seraient autrement pas enregistrées en mer. Tandis que davantage de taxons seraient comptabilisés en utilisant divers engins d'échantillonnage, les relevés au chalut restent un outil précieux pour la surveillance de la méga-épifaune benthique et des poissons démersaux. Des sélections de photos des taxons sont présentées en annexe.

INTRODUCTION

Since 1999, Canada's Department of Fisheries and Oceans (DFO) has conducted multi-species bottom trawl surveys on the western side of Davis Strait and Baffin Bay in Northwest Atlantic Fisheries Organization (NAFO) Subarea 0 (Figure 1) (Treble 2018). A principal goal of the survey is to assess stock distribution, abundance, and biomass of Greenland halibut (*Reinhardtius hippoglossoides*). In addition to commercial species, the surveys provide distribution, abundance and biomass information on other fish and invertebrate species collected in the trawls. Several of these species are difficult to identify. Improving species identification on these surveys would increase our understanding of benthic-demersal biodiversity in the region (Jørgensen et al. 2017).

The use of digital images to document captures and their compilation in reports and guides has helped to improve species identification by survey personnel in the Gulf of St. Lawrence and has resulted in faster data processing by reducing the need to collect specimens for later examination by specialists (Nozères et al. 2010; 2014). Even as cameras have become more widespread and their image quality has improved, computer software and file storage have become simpler and more readily available, resulting in many images being produced and stored with minimal effort. It then becomes prudent to develop a plan for organizing the image files, such as with a photo catalogue (Nozères 2011). A photo catalogue is presented here, displaying a representative subset of taxa as documented in the full image collection from the 2017 survey.

MATERIALS AND METHODS

STUDY AREA

Baffin Bay is a semi-enclosed ocean basin that connects the Arctic and Northwest Atlantic Oceans. It is characterized by a deep basin in the central western portion (nearly 2,500 m depth) and is bounded on the south by the sill of Davis Strait (300 km wide and 1,000 m deep) which separates it from the Labrador Sea (Hamilton and Wu 2013). Along the Baffin Island coast, the slope is abrupt and the shelf (up to 200 m) is relatively narrow. Arctic Ocean water enters Baffin Bay mainly through northern passages, including Lancaster Sound (Figure 1). These cold, fresh northern inflows travel southward in the western portion of Baffin Bay as the Baffin Island Current, eventually exiting via Davis Strait. In contrast, warm, saline water flows north from the Labrador Sea, through Davis Strait and along the eastern side of Baffin Bay as the West Greenland Current. The 2017 survey took place in Canadian waters on the western side of Baffin Bay, defined as the Baffin-Bay-Davis Strait Ecoregion in the Marine Ecoregions of the World classification (Spalding et al. 2007). Due to a late start in 2017, the survey for that year only covered Division 0A and excluded the Division 0B part of Subarea 0.

SURVEY SAMPLING METHODS

Sampling was conducted by the Research Vessel *Paamiut* in collaboration with the Greenland Institute of Natural Resources. The gear was an Alfredo bottom trawl with a

30 mm mesh liner in the cod end. The survey used a depth-stratified random design to select stations between 400 m and 1500 m. The trawl was towed on the seafloor for 30 minutes at 3 knots. Catch was sorted by species and weighed, with the exception of jellyfishes (Scyphozoa), which are pelagic and were discarded prior to entering the catch data. Individual length, weight, sex, maturity, and otoliths for age determination were also collected for certain fish species when prompted by the catch database. The data was recorded in a MS Access database developed by DFO Central and Arctic Region. Additional details on the survey design are presented in Treble (2018).

PHOTOS

As a multispecies survey, a number of requests for biodiversity studies are carried out each year. Since 2010, there have been requests for sponge and coral samples (*e.g.*, Tompkins et al. 2017). The sponge and coral sampling protocol included a plan for documenting the samples with photos, which was adapted in 2017 to include taking photos of all caught species.

The principal camera used was a waterproof, compact model with 12 megapixels (MP) and a LED ring light (Olympus TG-4). This camera has advanced macro-focusing capabilities, reducing the need for a stereomicroscope. For greater detail in selected specimens, a 24 MP digital single lens reflex (DSLR) camera was used (Pentax K-3). Occasionally, a 12 MP smartphone (iPhone SE) was also used for selected scenes. Photos were recorded as JPEG (.JPG file extension), except for the DSLR which produced RAW files in a Digital Negative (DNG) file container (.DNG file extension).

Specimens were photographed whenever possible on a white background, often in a plastic bin or along a measuring board, with a white survey label, and typically a scaled label (2 cm or 5 cm scale). Camera flash was often used for the photos, especially for specimens that were placed underwater in a bin, in order to better reveal details such as fish fins, scales and lateral lines.

PHOTO CATALOGUE

The camera photos, recorded on a Secure Digital (SD) flash memory card, were transferred to a laptop computer by importing the files into an Adobe Photoshop Lightroom 6 catalogue. Briefly, Lightroom is an SQLite-based database and image editing platform with extensive image and metadata editing tools (Nozères 2011). A preset was selected to organize files into folders by date, and then to rename the photos by date, camera, and sequence number, e.g., 20171027_OTE_27011.JPG. Metadata was then added to selected catalogue fields. The trawl name was entered in the *Sublocation* field as ship, year, survey, and trawl set, e.g. PA2017-9 Set001. The start position of the trawl was added to the fields of *GPS Latitude*, *GPS Longitude*, and *Altitude*. Altitude was recorded as a negative value to indicate depth. The species seen in images were tagged in the *Keywords* field using taxonomic names, obtained from the World Register of Marine Species (WoRMS) 2017. Image editing was restricted to

correcting exposure, white balance and cropping. Image storage was on a laptop solid state drive (SSD), with file copies made to an external SSD and a portable hard drive.

Once organized, tagged, and edited in the survey's Lightroom catalogue, the photos were available for review and further editing. The sponge and coral request had a specific need for file renaming by location and species. A preset was used to export versions of the files with the requested name format, e.g., PA2017-9 Set002_Asconema foliatum_280561.JPG. Along with exporting individual photos, the catalogue metadata was also exported as text files using a third-party software plugin (LR/Transporter).

IDENTIFICATION

The 2017 survey included two taxonomic specialists, Claude Nozères (DFO, Québec Region) and Lisa Treau de Coeli (Laval University). Invertebrate taxa of arthropods, echinoderms and molluscs were identified using selected reports and guides (Grainger 1966, MacPherson 1971, Pohle 1988, Squires 1990, Clark and Downey 1992, Vassilenko and Petryashov 2009, Nozères et al. 2014). Sponges were identified using internal photo guides produced by Ellen Kenchington's group at the Bedford Institute of Oceanography (DFO, Maritimes Region). Eelpout fish species (*Lycodes* sp., family Zoarcidae) were identified using the recent Conservation of Arctic Flora and Fauna Pacific Arctic Fishes atlas (Mecklenburg et al. 2016) and consulting internal documents produced by Jan Poulsen (Greenland Institute of Natural Resources) and Tim Siferd (DFO, Central and Arctic Region). Skates were identified using photo guides produced by Carolyn Miri (DFO, Newfoundland and Labrador Region). Following the survey, new publications were also consulted for recent information, in particular for fish using the Pan-Arctic atlas (Mecklenburg et al. 2018) and for invertebrates using the Barents Sea atlas (Zakharov et al. 2018).

Certain difficult groups were only recorded at genus, family or class levels, namely the lanternfishes, sea anemones, and brittle stars. Lanternfishes are small, fragile fishes that are often found damaged in the trawl. These were usually recorded to the family level (Myctophidae), although photos were also taken of some intact specimens with species-specific features present (i.e., photophores). Sea anemones were examined, but identifications were not certain, often being recorded in the database as class Actiniaria. Brittle stars (Ophiuroidea) were identified to genus or species when possible.

RESULTS

STATIONS

The 2017 survey conducted 74 successful fishing sets between October 27 and November 8 (Table 1). The mean bottom depths of sets in 2017 ranged from 451 m to 1478 m. The stations were located between 70.78º N near Clyde River to 66.32º N near Qikiqtarjuaq (Figure 1).

TAXA

The total number of taxa recorded was 116 (Table 2). The principal groups, in descending order of numbers of identified taxa, were fishes (33), arthropods (23; including 12 shrimps), sponges (20), and echinoderms (18; mostly sea stars). Minor groups included cnidarians (10; anemones, soft corals, and jellyfishes), molluscs (7; cephalopods and buccinid gastropods), and polychaete worms (3).

A few species stood out as unusual compared to previous surveys. A sea star, *Bathybiaster vexillifer*, was not recorded in 2016, but was found in 12 captures in 2017. This species may have been misidentified during previous surveys as *Psilaster andromeda*, which had 50 records in 2016 and none in 2017. A new sea star for the survey was *Tylaster willei*; this species is less well known and may have been mistaken on previous surveys for others in the family Pterasteridae.

New species for the survey were also obtained post-survey while reviewing species information. The variegated snailfish, *Liparis gibbus* is likely *Liparis bathyarcticus*, while the other species may be confined to the western Canadian Arctic (Mecklenburg et al. 2018). In another case of sea stars, the common species *Crossaster papposus* may be overreported in the Arctic, as only *Crossaster squamatus* was encountered in 2017 (Grainger 1966, Zakharov et al. 2018). Among sea pens (Pennatulacea), *Umbellula* was reported as *U. lindahli*, while *U. encrinus* is considered the valid species (Dolan 2008)

PHOTOS

The Lightroom photo catalogue for the 2017 survey holds 2,356 digital photos, including 2,103 photos of taxa, with approximately 200 photos being produced every day. Sponge and coral species were photographed at each station. Most other invertebrates, along with fishes, were also documented for each set, except for common shrimp and skate species, as their identification was not in doubt. Greenland halibut was also not photographed at each station. Apart from documenting representatives of all taxa, photos were taken of general work scenes (Figures 2 and 3) or to record special morphotypes of known species (Figure 4). Additional photos were also taken of specimen details and some dissections, in particular for skates. The number of photos taken during this survey was higher than usual because both the compact camera and the DSLR were being evaluated for image quality. The results showed that the DSLR was better at recording colour and detail, while the compact was more convenient to use. In normal operations, only 100 images per day would be produced (20 photos per tow, approximately 5 tows per day). The sum of the archived files (JPG and DNG) required 35 gigabytes (GB) of storage space. When exported as versions of corrected and cropped JPG images, the storage space was less than 4 GB. In addition to being presented in this photo catalogue report, a number of photos were uploaded to the WoRMS photo gallery including 20 species that had no previous images (Table 3). The photos were published by route of the Canadian node of WoRMS photogallery (CaRMS, http://www.marinespecies.org/carms/photogallery.php). The photos are free to use, following an Attribution-Noncommercial-Share Alike licence (CC BY-NC-SA 4.0).

The occurrence of a few taxa was documented differently in the photo catalogue than in the survey catch database. Usually this was because the survey protocol instructs the sampler to enter certain fragile and problematic species at a general taxonomic level, such as Class Actiniaria for sea anemones, Class Ophiuroidea for brittlestars, and Family Myctophidae for lanternfishes. In the photo catalogue, some intact specimens could be identified to species, for example the lanternfish *Benthosema glaciale*. The jellyfish (Class Scyphozoa) were not recorded as part of the bottom trawl catch because they are pelagic, but two deep water species (*Atolla wyvillei, Periphylla periphylla*) were documented in photos, thus confirming their presence in the survey area. A special situation arose with specimens of two amphipods, *Anonyx* sp. and *Wimvadocus torelli,* and a mysid*, Meterythrops* sp. These were not collected directly from the catch but photographed opportunistically while examining stomach contents of Roughhead Grenadier (*Macrourus berglax*) catch (Figure 5). There are also photos recording debris of certain species, such as sea pens (Pennatulacea) and basket stars (*Gorgonocephalus* sp.) that can remain enmeshed in the trawl and be recorded as taxa present on consecutive tows (Figure 6).

DISCUSSION

The purpose of a trawl survey photo catalogue is to assist with species identification. Additionally, photos helped to document special cases or circumstances, such as pelagic or planktonic taxa, prey in fish stomach contents, differing morphotypes, and carryover organisms from previous trawl sets. This review of taxa using photos then leads to discussion regarding their suitability in biodiversity analyses.

UTILITY OF THE PHOTO CATALOGUE TO VALIDATE DATABASE RECORDS

Cataloguing the species using photos was helpful in several instances during the survey to compare and correct identifications between stations, particularly for new finds and for inexperienced personnel. Such was the case with two sea stars, *Bathybiaster vexillifer* and *Tylaster willei*, that were correctly re-identified by reviewing capture photos while still on the survey. Other corrections based on photos were made for eelpouts and some of the sponges (e.g., *Stelletta* sp.). Nonetheless, reviewing survey photos has practical limits, and examining conserved specimens in the laboratory is preferred or even necessary to resolve certain taxa, as is often the case with sponges (Hestetum et al. 2017, Dinn and Leys 2018, Murillo et al. 2018). Even when photographed and conserved, some specimens are difficult to confirm, an example being the family Buccinidae that contains several species in need of extensive revision (Bouchet and Warén 1985, Fraussen and Terryn 2019).

The usefulness of a photo catalogue also depends on image presentation and file management. When taking photos, labels with survey information should be included. For ease in finding photos a consistent style for photo renaming and organization should also be developed, including metadata that contains keywords, dates, station information, and file organization.

For this catalogue, in most cases, only one photo is shown for each taxon, however additional images showing differing sizes and forms may also be useful. One example encountered on the 2017 survey was the difficulty in distinguishing juveniles of the shrimp *Pasiphaea tarda* from adults of the smaller species *P. multidentata* when examining the spine of the rostrum (Squires 1990, Bjørnestad 2016). The full image catalogue with different specimens will be helpful for future identification guides.

While revising taxon names in photos is easily accomplished in an active catalogue database, it becomes more difficult to manage once a report or dataset becomes a published product. Updates to taxonomy or identifications in reports, including this one, will require new publications. Public datasets will also need periodic review. The largest collection of marine biodiversity datasets in Canada are the DFO trawl survey records published on OBIS Canada (https://obis.org/node/7dfb2d90-9317-434d-8d4e-64adf324579a), which includes records from past Canadian Arctic surveys. Records may be corrected by reviewing photos when available (e.g., Nozères et al. 2014, 2015). However, each record change requires republishing the entire source dataset. Currently, biodiversity datasets are being posted, but are not often revised. Another approach is to post photos of observed taxa on the iNaturalist portal (Canadian site: https://inaturalist.ca) to elicit the crowdsourced response of both amateurs and experts from around the world. On this website, when an observation is confirmed by multiple reviewers, the occurrence receives a 'research grade' stamp of approval and becomes published on GBIF (Global Biodiversity Information Facility, https://www.gbif.org). The individual record remains linked to the source and may be edited as needed for the taxonomy and the photos. This approach to viewing and annotating records is currently being tested by DFO Pacific Region (project: *Marine Life of the Northeast Pacific* https://inaturalist.ca/projects/marine-life-of-the-northeast-pacific).

UTILITY OF THE PHOTO CATALOGUE TO EVALUATE TAXA REPRESENTATIVITY

With the photo catalogue having helped to identify taxa in the catch, attention can then be turned to the use of the records from the 2017 trawl survey in Baffin Bay for biodiversity analyses. Demersal fishes, shrimps, sea stars and sponges were regular in occurrence and of relatively high diversity (Table 2). Several other groups, such as gastropods, appeared infrequently, making them more difficult to analyze for occurrence, even at a general level across the survey area. Another survey, using trawl gear with a smaller mesh liner (5 mm) and covering depths 250 m to 750 m, caught a larger number of invertebrate taxa (243) than the 2017 survey which had only 83 invertebrate taxa (Roy et al. 2015). By gathering available historic and recent data from all research-based inventories, a total of 841 invertebrate taxa has been recorded in the western Davis Strait-Baffin Bay region (Jørgensen et al. 2017). With regards to fishes, throughout the Canadian Arctic there are 221 species, of which half (104) have been recorded in Baffin Bay (Coad and Reist 2017) and one-third (32) of these were collected on the 2017 survey. While not as high in taxonomic diversity as dedicated benthic surveys, the DFO Central and Arctic Region Subarea 0 trawl survey has the advantage of taking place annually and covers a wide range in depth and latitude.

In addition to gear selectivity, another concern with bottom trawl survey records is the capture of mesopelagic species that may have been collected when the trawl was actively fishing on the bottom or during the transit of the net through the water column. During the 2017 survey, these incidental captures included several shrimp species (Pasiphaeidae*, Acanthephyra pelagica, Gennadas elegans, Hymenodora glacialis*), zooplankton (*Boreomysis* sp., *Themisto libellula*), squid, cirrate octopus, lanternfishes (Myctophidae) and other deepwater pelagic species. While evaluating the abundance of pelagics from a demersal trawl is not recommended for fine-scale spatial analyses, their occurrence may occasionally be useful as indicators for the survey region. For example, lumpfish, *Cyclopterus lumpus*, was recorded once at the southernmost station in the 2017 survey. Future surveys can monitor changes or an expansion in its distribution which may signal environmental changes are occurring in the region.

Sessile invertebrates represent an additional challenge for biodiversity analyses of trawl captures. When abundant in a haul these invertebrates can remain as debris entangled in the net meshes on subsequent hauls. Sponges, sea pens, and basket stars (*Gorgonocephalus* sp.) are frequent candidates for entanglement. Some biodiversity analyses are performed with presence-only data, in which case, they would be vulnerable to records with debris. During the 2017 survey, *Umbellula* sea pens were the most likely species to be recorded in trace amounts after an initial capture, over the course of several tows that took place at widely differing depths.

OTHER BIOLOGICAL DATA COLLECTED USING PHOTOS

Along with recording taxa in captures, photos are useful to document tissue sampling of specimens. For example during the 2017 survey several specimens of the shrimp *Lebbeus polaris* and *Eualus belcheri* were selected for barcoding genetic analysis carried out by the Laboratory of Genomics (G. Parent) at the Maurice Lamontagne Institute (DFO, Mont-Joli, QC), with the photos of the morphotypes to be posted along with the sequences on the Barcode of Life Data System (http://www.boldsystems.org).

Stomach sampling may serve as another source of taxa for biodiversity assessment. During the 2017 survey the dissection of a few fish specimens revealed diverse amphipods and other crustaceans. Examining and photographing stomach contents provided occurrence information for these otherwise unavailable small taxa.

Photos may also provide information about individual specimens with analyses done afterwards, not during the survey, and thus reducing processing time on ship. For skate species, photos can be used to record maturity stages, such as pterygiphore length in males and mature females (evidence of expanded cloaca), without requiring their dissection. Some fish species (e.g., Myctophidae) are too damaged by the trawl to identify to species or to measure total length. Alternatively, photos could be used to measure fishes using standard length (to the caudal peduncle), which would distinguish between subfamilies and genera (e.g., long-bodied Lampanyctinae vs short and stout Myctophinae species). In this situation, measurements from specimen photos could indirectly lead to better identification of fragile specimens.

CONCLUSION

A photo catalogue of the 2017 Central and Arctic Region Subarea 0 Survey helped to document the presence, size, and diversity of forms, for several taxa, including fishes, sponges, and shrimps. Improvements were made in the identification of fishes and sea stars. Photos also helped to reduce, although not to eliminate, the need to conserve specimens for identification. Captures currently recorded at general taxonomic levels (brittle stars, lanternfishes and sea anemones) in some instances may now be recorded to the species level. The bottom trawl sampled mostly demersal fishes, shrimps, sea stars and sponges which may be taxa suitable for biodiversity analyses. Several other taxa, in particular pelagic species, may have been incidental captures and are best used only to indicate their presence in the area. Photos of fish stomach contents represent an additional sources of biodiversity data. Photos can also provide additional information on specimen size and maturity that would otherwise not be recorded while at sea. Although more taxa would be revealed using a variety of sampling gears (e.g., box corer, grab, Agassiz trawl), trawl surveys remain a valuable tool to monitor mega-epibenthos and demersal fishes.

ACKNOWLEDGEMENTS

We thank all of the R/V *Paamiut* ship crew and especially the fisheries technicians Paul Beck, Gary Tuff, and Marie-France Gagnon for their dedicated work and professionalism with the trawl captures. Special thanks to the personnel of the Greenland Institute of Natural Resources (GINR) for their help on the survey. Thanks also to reviewers Bernard Sainte-Marie and Francisco Javier Murillo for their insightful comments that improved the manuscript.

REFERENCES

Bjørnestad, F. E. 2016. A taxonomic revision of the Caridean shrimp, *Pasiphaea tarda* (Krøyer, 1845). M. Sc. thesis, U. Bergen, 79 p.

Bouchet, P., and Warén, A. 1985. Revision of the Northeast Atlantic Bathyal and Abyssal Neogastropoda excluding Turridae (Mollusca, Gastropoda). Bolletino Malacologico, Supplemento 1. Milano.

Clark, A. M., and Downey, M. E. 1992. Starfishes of the Atlantic. Chapman & Hall Identification Guides, 3, London, UK. xxvi + 794 p.

Coad B. W., and Reist, J. D. 2018. Marine fishes of Arctic Canada. Toronto, University of Toronto Press. 618 p.

Dinn, C., and Leys, S. 2018. Field Guide to Sponges of the Eastern Canadian Arctic. A field and laboratory identification guide. U. of Alberta. 102 p.

Dolan, E. 2008. Phylogenetic, Systematics and Biogeography of Deep-Sea Pennatulacea (Anthozoa: Octocorallia). Evidence from molecules and morphology. Ph.D. Thesis, University of Southampton. 211 p.

Fraussen, K., and Terryn, Y. 2019. How well are the northern whelks known? On the history of the Polar Whelk, *Buccinum polare* Gray, 1839 (Gastropoda: Buccinidae). Gloria Maris 57: 134-153.

Grainger, E. H. 1966. Sea stars (Echinodermata: Asteroidea) of arctic North America. Bull. Fish. Res. Bd. Canada. 152: 1-70.

Hamilton, J. M., and Wu, Y. 2013. Synopsis and trends in the physical environment of Baffin Bay and Davis Strait. Can. Tech. Rep. Hydrogr. Ocean Sci. 282: vi + 39 p.

Hestetum, J. T., Tompkins-MacDonald, G., and Rapp, H.-T. 2017. A review of carnivorous sponges (Porifera: Cladorhizidae) from the Boreal North Atlantic and Arctic. Zool. J. Linn. Soc. 181: 1-69.

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., Tendal O., Ravelo A.M., Kędra M., and Piepenburg D. 2017. Chapter 3.3. Benthos *In:* State of the Arctic Marine Biodiversity Report. Arctic Council, Conservation of Arctic Flora and Fauna.

Macpherson, E. 1971. The marine molluscs of Arctic Canada. Nat. Mus. Natl. Sci Publ. Biol. Oceanogr. 3: I-149

Mecklenburg, C. W., Mecklenburg, T. A., Sheiko, B. A., and Steinke, D. 2016. Pacific Arctic Marine Fishes. Conservation of Arctic Flora and Fauna, Akureyri, Iceland. ISBN: 978-9935-431-55-4.

Mecklenburg, C. W., Lynghammar, A., Johannesen, E., Byrkjedal, I., Christiansen, J. S., Dolgov, A. V., Karamushko, O. V., Mecklenburg, T. A., Møller, P. R., Steinke, D., and Wienerroither, R. M. 2018. Marine Fishes of the Arctic Region. Conservation of Arctic Flora and Fauna, Akureyri, Iceland. ISBN 978-9935-431-69-1

Murillo, F. J., Kenchington, E., Tompkins, G., Beazley, L., Baker, E., Knudby, A., and Walkusz, W. 2018. Sponge assemblages and predicted archetypes in the eastern Canadian Arctic. Mar. Ecol. Prog. Ser. 597: 115-135.

Nozères, C. 2011. Managing image data in aquatic sciences: an introduction to best practices and workflows. Can. Tech. Rep. Fish. Aquat. Sci. 2962: xii + 171 p.

Nozères, C., Archambault, D., Chouinard, P.-M., Gauthier, J., Miller, R., Parent, E., Schwab, P., Savard, L., and Dutil, J.-D. 2010. Identification guide for marine fishes of the estuary and northern Gulf of St. Lawrence and sampling protocols used during trawl surveys between 2004 and 2008. Can. Tech. Rep. Fish. Aquat. Sci. 2866: xi + 243 p.

Nozères, C., Archambault, D., and Miller, R. 2014. Photocatalogue of invertebrates of the Estuary and northern Gulf of St. Lawrence from trawl surveys (2005-2013). Can. Manuscr. Rep. Fish. Aquat. Sci. 3035: iv + 221 p.

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

Pohle, G. 1988. A guide to the deep-sea shrimp and shrimp-like Decapod crustacea of Atlantic Canada, Can. Tech. Rep. Fish. Aquat. Sci. 1657: iv + 29 p.

Roy V., Iken K., and Archambault P. 2015. Regional variability of megabenthic community structure across the Canadian Arctic. Arctic. 68: 180-192, doi: 10.14430/arctic4486

Spalding, M. D., Fox, H. E., Allen, G. R., Davidson, N., Ferdana, Z. A., Finlayson, M., Halpern, B. S., Jorge, M. A., Lombana, A., Lourie, S. A., Martin, K. D., McManus, E., Molnar, J., Recchia, C. A., and Robertson, J. 2007. Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. Bioscience 57:573-583. https://doi.org/10.1641/B570707

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

Tompkins, G., Baker, E., Anstey, L., Walkusz, W., Siferd, T., and Kenchington, E. 2017. Sponges from the 2010-2014 Paamiut Multispecies Trawl Surveys, Eastern Arctic and Subarctic: Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Family Coelosphaeridae, Genera *Forcepia* and *Lissodendoryx*. Can. Tech. Rep. Fish. Aquat. Sci. 3224: v + 129 p.

Treble, M. A. 2018. Report on Greenland halibut caught during the 2017 trawl survey in NAFO Division 0A. NAFO SCR Doc. 18/015, Serial No. N6799, 24 p.

Vassilenko, S.V., and V.V. Petryashov (eds.) 2009. Illustrated Keys to Free-Living Invertebrates of Eurasian Arctic Seas and Adjacent Deep Waters, Vol. 1. Rotifera, Pycnogonida, Cirripedia, Leptostraca, Mysidacea, Hyperiidea, Caprellidea, Euphausiacea, Natantia, Anomura, and Brachyura. Alaska Sea Grant, University of Alaska Fairbanks. 186 p.

WoRMS Editorial Board (2019). World Register of Marine Species. Available from http://www.marinespecies.org at VLIZ. Accessed 2019-06-19. doi:10.14284/170

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., Blinova, D. Ju. 2018. Atlas of the megabenthic organisms of the Barents Sea and adjacent waters. Murmansk: PINRO. 530 p.

TABLES

Table 1. List of successful fishing sets conducted in NAFO Division 0A on the 2017 Baffin Bay survey, with start coordinates, start date, and mean depth.

Set	Start Latitude	Start Longitude	Start Date	Mean Depth (m)
1	66.317467	-57.746817	2017-10-27	542
2	66.53075	-57.80845	2017-10-27	592
3	66.570833	-58.233617	2017-10-28	670
4	66.721483	-57.9259	2017-10-28	686
5	66.957267	-58.250683	2017-10-28	1048
6	66.713883	-58.618767	2017-10-28	778
7	66.795833	-58.8725	2017-10-28	979
8	66.752317	-59.380333	2017-10-28	960
9	66.8973	-59.605217	2017-10-29	997
10	67.15045	-59.072333	2017-10-29	1317
11	67.361433	-59.760717	2017-10-29	1379
12	67.5402	-59.7029	2017-10-29	1471
13	67.52665	-60.2222	2017-10-29	1432
14	67.46925	-60.550067	2017-10-29	1354
15	67.580983	-60.913167	2017-10-29	1474
16	67.698183	-61.775517	2017-10-30	1286
17	67.933333	-62.0727	2017-10-30	1459
18	68.215017	-62.9592	2017-10-30	1428
19	68.252767	-63.4546	2017-10-30	1320
20	68.63525	-64.280817	2017-10-30	1181
21	68.99735	-63.976783	2017-10-31	1248
22	69.515333	-64.955417	2017-10-31	1242
23	69.674167	-64.7967	2017-10-31	1484
24	70.000683	-65.108117	2017-10-31	959
25	70.21515	-65.30055	2017-10-31	1077
26	70.60955	-66.159683	2017-11-01	1249
27	70.784417	-66.343083	2017-11-01	1427
28	70.686617	-66.80495	2017-11-01	745
29	70.619733	-66.373317	2017-11-01	1055
30	70.421867	-66.258733	2017-11-01	530
31	70.36625	-65.8928	2017-11-01	941
33	70.525117	-65.585817	2017-11-02	1437
34	70.394017	-65.475283	2017-11-02	1255
35	70.261383	-65.677833	2017-11-02	924
36	70.161883	-65.599883	2017-11-02	733

37	69.879133	-65.360583	2017-11-02	524
38	69.623517	-65.260617	2017-11-02	524
39	69.421867	-65.092983	2017-11-02	952
40	69.42375	-64.4028	2017-11-02	1474
41	69.275317	-64.54445	2017-11-03	675
43	68.920917	-65.602583	2017-11-03	610
45	68.940367	-66.2524	2017-11-03	493
46	68.76845	-65.982817	2017-11-03	744
47	68.895783	-65.326633	2017-11-04	512
48	69.17105	-64.140367	2017-11-04	1072
49	68.854067	-64.290433	2017-11-04	919
50	68.7847	-64.0264	2017-11-04	1446
51	68.532917	-64.066683	2017-11-04	1256
52	68.25825	-63.89965	2017-11-04	1066
53	68.172083	-63.930883	2017-11-04	735
54	68.027933	-63.382	2017-11-05	895
55	68.033183	-62.535233	2017-11-05	1223
56	67.9231	-62.647017	2017-11-05	1124
57	67.659633	-63.47145	2017-11-05	588
58	67.788517	-62.47665	2017-11-06	957
59	67.736833	-62.008017	2017-11-06	1111
60	67.502833	-61.181783	2017-11-06	1134
61	67.39485	-61.317367	2017-11-06	717
62	67.385933	-61.0018	2017-11-06	941
63	67.2663	-60.8122	2017-11-06	770
65	67.127083	-61.14235	2017-11-06	450
66	67.21385	-60.157933	2017-11-07	1043
67	67.09235	-60.45275	2017-11-07	734
68	67.028833	-60.784033	2017-11-07	587
69	66.921517	-60.136033	2017-11-07	748
70	66.819233	-60.038467	2017-11-07	737
71	66.789217	-60.58385	2017-11-07	551
72	66.638167	-60.247567	2017-11-07	560
73	66.519833	-60.643167	2017-11-07	465
74	66.427967	-60.356267	2017-11-08	498
75	66.450133	-59.85295	2017-11-08	678
76	66.61515	-59.49835	2017-11-08	874
77	66.479483	-59.145533	2017-11-08	794
78	66.32335	-58.2648	2017-11-08	643

Table 2. List of taxa tagged in the photo catalogue of the 2017 survey (see Appendix).

Group	Taxon	Note
Annelida		
	Eunoe nodosa	polychaete worm, confirmed identification
	Eunoe oerstedi	polychaete worm
	Laetmonice filicornis	polychaete worm
	Notostomum laeve	Hirudinea; parasite of Greenland halibut
Arthropoda		
Amphipoda		
	Anonyx	collected from a fish stomach, not in catch
	Eurythenes gryllus	
	Eusirus holmii	
	Maera loveni	
	Themisto libellula	pelagic amphipod
	Wimvadocus torelli	collected from a fish stomach, not in catch
Decapoda		
	Acanthephyra pelagica	mesopelagic shrimp
	Bythocaris	cf. *biruli*
	Bythocaris leucopis	
	Eualus belcheri	recorded as *Eualus gaimardii belcheri*
	Gennadas elegans	mesopelagic shrimp
	Hymenodora glacialis	mesopelagic shrimp
	Lebbeus polaris	
	Pandalus borealis	
	Pasiphaea multidentata	mesopelagic shrimp
	Pasiphaea tarda	mesopelagic shrimp
	Parapasiphae sulcatifrons	mesopelagic shrimp
	Sclerocrangon ferox	
Mysida		
	Boreomysis	mesopelagic zooplankton
	Meterythrops	collected from a fish stomach, not in catch
Pycnogonida		
	Boreonymphon abyssorum	
	Nymphon	
	Nymphon helleri	
Cnidaria		
Anthozoa		
	Actinauge cristata	
	Actinostola	*A. callosa* or *A. groenlandica*

	Actiniaria	unknown species (6 examples)
	Drifa	cf. *flavescens*; recorded as Nephtheidae
	Duva florida	soft coral
	Pennatula grandis	sea pen
	Pennatulacea	unknown sea pen, recorded as *Radicipes*
	Umbellula encrinus	sea pen; recorded as *U. lindahli*
Scyphozoa		
	Atolla wyvillei	mesopelagic jellyfish, not recorded in catch
	Periphylla periphylla	mesopelagic jellyfish, not recorded in catch
Echinodermata		
Asteroidea		
	Bathybiaster vexillifer	
	Leptychaster arcticus	
	Mediaster bairdi	
	Pontaster tenuispinus	
	Crossaster squamatus	recorded as *C. papposus*
	Henricia	
	Icasterias panopla	
	Poraniomorpha tumida	
	Diplopteraster multipes	
	Hymenaster pellucidus	
	Pteraster militaris	
	Tylaster willei	
Ophiuroidea		
	Gorgonocephalus	2 types: *G. arcticus* and *G. eucnemis*
	Ophiacantha	*O. bidentata* or *O. fraterna*
	Ophiopholis aculeata	
	Ophiopleura borealis	
Crinoidea		
	Heliometra glacialis	
Holothuroidea		
	Molpadia	
Mollusca		
Cephalopoda		
	Bathypolypus	cf. *bairdii*; benthic octopus
	Cirroteuthis muelleri	benthopelagic octopus
	Gonatus fabricii	pelagic squid
Gastropoda		
	Buccinum glaciale	
	Buccinum hydrophanum	

	Colus islandicus	
	Colus pubescens	
Porifera		
	Artemisina	
	Asconema foliatum	
	Chondrocladia grandis	
	Clathria barleei	
	Geodia barretti	
	Geodia hentscheli	
	Geodia parva	recorded as *Isops phlegraei*
	Iophon	
	Lissodendoryx complicata	
	Lissodendoryx indistincta	
	Mycale lingua	
	Phakellia	under review; cf. *Semisuberites cribrosa*
	Polymastia grimaldii	
	Polymastia hemisphaerica	synonym: *Radiella hemisphaerica*
	Polymastia thielei	
	Polymastia uberrima	
	Stelletta	
	Tetillidae	*Craniella* or *Tetilla*
	Thenea	
	Weberella bursa	
Chordata		
Ascidiacea		
	Didemnidae	
Pisces		
Elasmobranchii		
Rajidae		
	Amblyraja hyperborea	
	Amblyraja jenseni	
	Amblyraja radiata	
Somniosidae		
	Somniosus microcephalus	sharks, measured then released
Actinopterygii		
Gadidae		
	Arctogadus glacialis	
	Boreogadus saida	
Lotidae		
	Gaidropsarus ensis	

Macrouridae		
	Macrourus berglax	
Pleuronectidae		
	Hippoglossoides platessoides	
	Reinhardtius hippoglossoides	
Cottidae		
	Artediellus atlanticus	
	Triglops nybelini	
Psychrolutidae		
	Cottunculus microps	
Liparidae		
	Careproctus reinhardti	
	Liparis bathyarcticus	recorded as *Liparis gibbus*
	Liparis fabricii	
	Paraliparis bathybius	deepwater species
	Rhodichthys regina	deepwater species
Cyclopteridae		
	Cyclopterus lumpus	
Agonidae		
	Leptagonus decagonus	
Sebastidae		
	Sebastes	cf. *Sebastes mentella*
	Sebastes norvegicus	photo is of a NW Atlantic specimen
Myctophidae		
	Benthosema glaciale	mesopelagic; recorded as Myctophidae
	Lampanyctus macdonaldi	mesopelagic; recorded as Myctophidae
Bathylagidae		
	Bathylagus euryops	mesopelagic; presumed species
Gonostomatidae		
	Cyclothone	mesopelagic; possibly *C. microdon*
Paralepididae		
	Arctozenus risso	mesopelagic
Notacanthidae		
	Notacanthus chemnitzii	
Zoarcidae		
	Lycodes eudipleurostictus	
	Lycodes paamiuti	
	Lycodes reticulatus	
	Lycodes rossi	
	Lycodes seminudus	

Table 3. Species photos from the 2017 survey added to the CaRMS photogallery (http://www.marinespecies.org/carms/photogallery.php).

Taxon
Arctogadus glacialis
Bathybiaster vexillifer
Bythocaris leucopis
Cirroteuthis muelleri
Eusirus holmii
Gaidropsarus ensis
Hymenodora glacialis
Lampanyctus macdonaldi
Liparis fabricii
Lycodes eudipleurostictus
Lycodes paamiuti
Lycodes reticulatus
Lycodes seminudus
Mediaster bairdi
Notacanthus chemnitzii
Paraliparis bathybius
Parapasiphae sulcatifrons
Rhodichthys regina
Tylaster willei
Umbellula encrinus

FIGURES

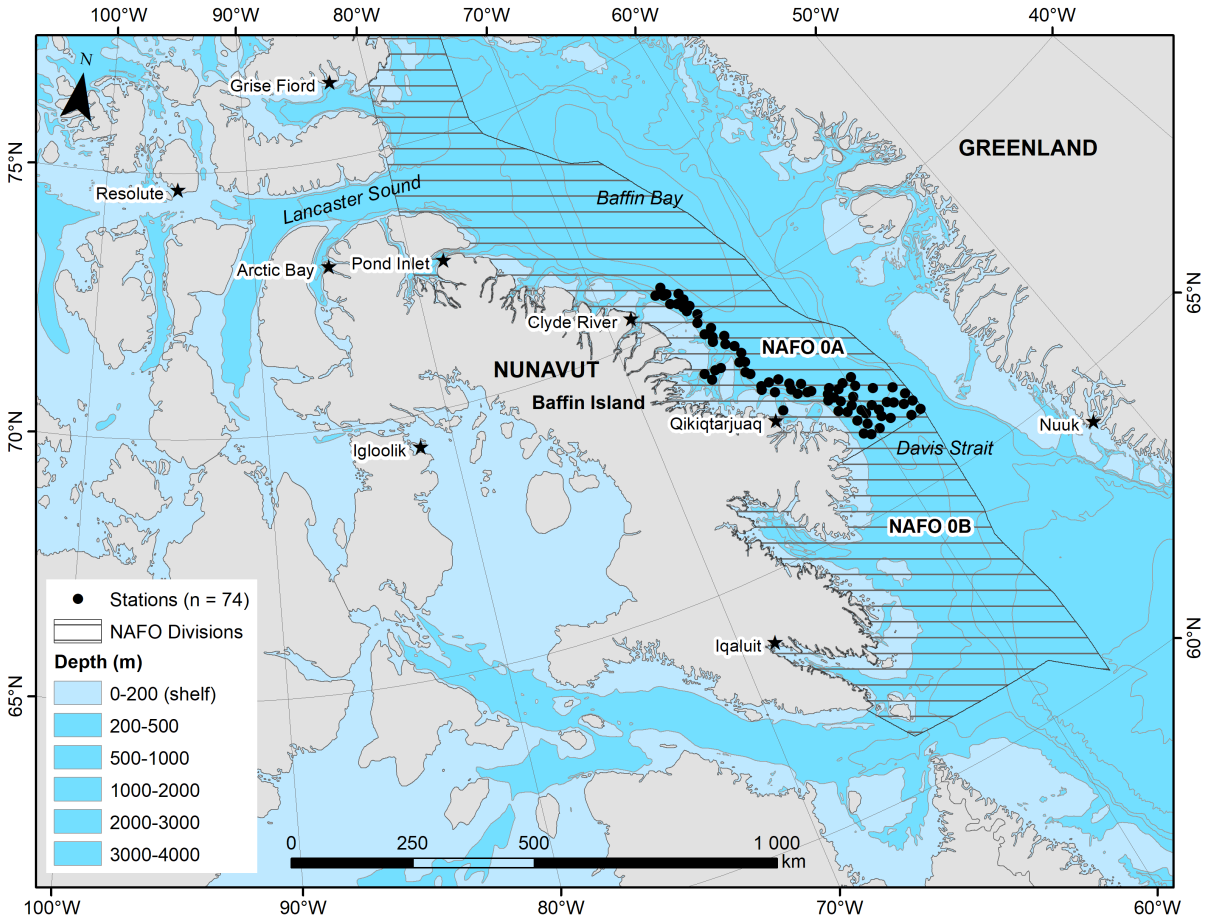


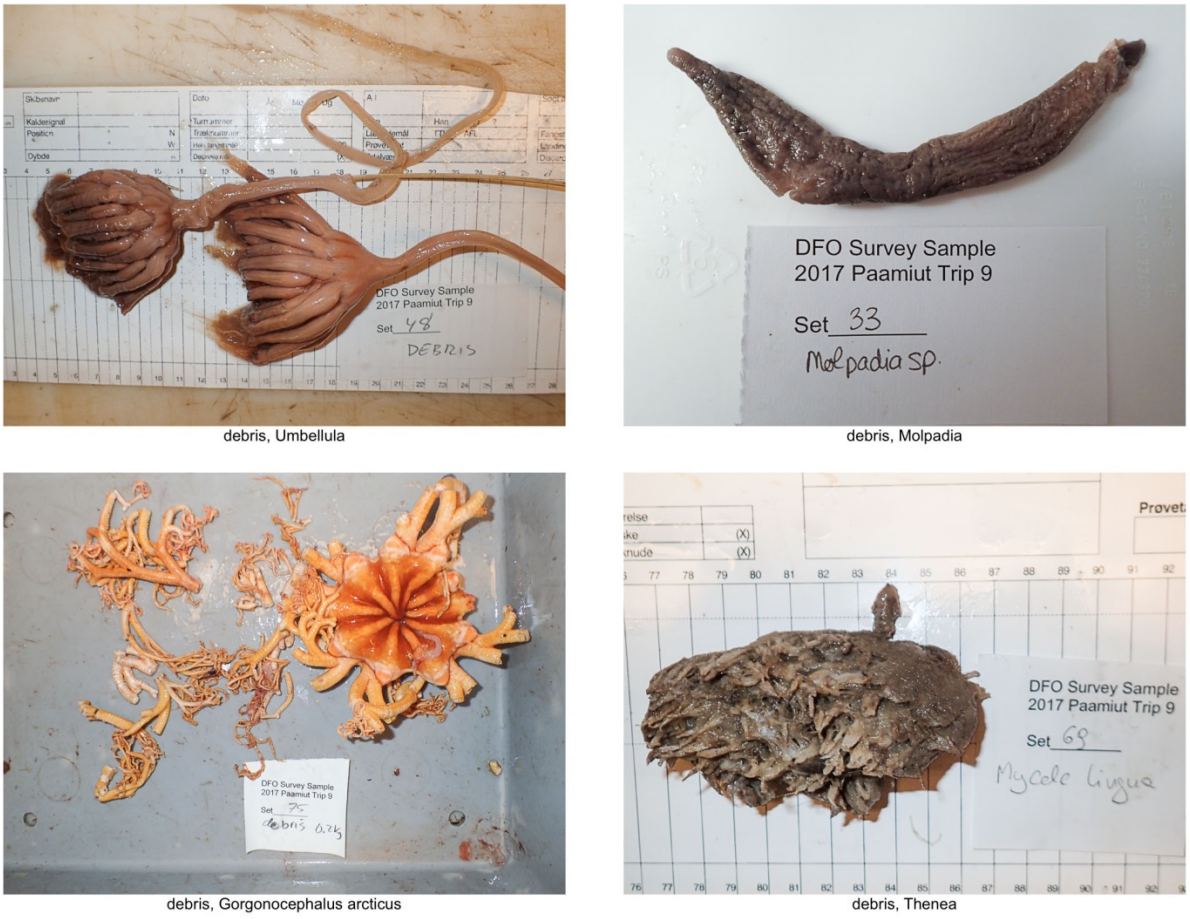
Figure 1. Map displaying the fishing stations for the 2017 Baffin Bay Greenland halibut survey in NAFO Division 0A.

Figure 2. Sorting species on the conveyor belt (top). Example of invertebrates and small fishes found in the catch (bottom).

Figure 3. Wet laboratory (above) and computer dry lab (below).

Figure 4. Example of *Artediellus atlanticus* typically found in Baffin Bay (top) compared to the size of specimen for the same species usually observed in the Gulf of St. Lawrence (bottom).

Figure 5. Example of a Roughead Grenadier, *Macrourus berglax*, and with some of the amphipod and mysid crustaceans found in its stomach contents.



debris, Umbellula

debris, Molpadia

debris, Gorgonocephalus arcticus

debris, Thenea

Figure 6. Examples of debris in net mesh that may become recorded as taxa present on consecutive tows, following an initial large capture.

APPENDIX

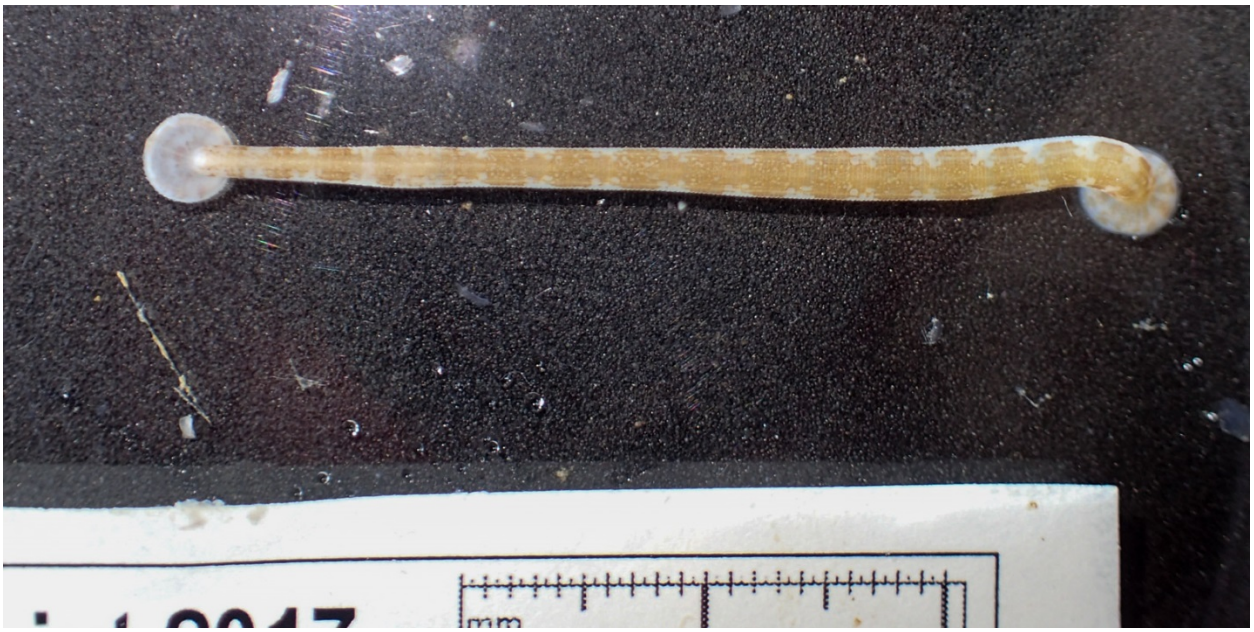
Photo catalogue of taxa viewed in captures of the 2017 survey (see Table 2).

Lisa Treau de Coeli took photos of the following taxa: *Acanthephyra pelagica, Iophon, Lissodendoryx indistincta, Lycodes reticulatus, Drifa,* Pennatulacea*, Phakellia.* All other photos were taken by Claude Nozères.

Eunoe nodosa

Eunoe oerstedi

Laetmonice filicornis



Notostomum laeve (Hirudinea; external parasite of Greenland halibut)

Anonyx (collected from fish stomach, not in capture)

Eurythenes gryllus

Eusirus holmii

Maera loveni

Wimvadocus torelli (collected from fish stomach, not in capture)

Themisto libellula

Acanthephyra pelagica

Bythocaris (cf. *biruli*)

Bythocaris leucopis

Eualus belcheri

Gennadas elegans

Hymenodora glacialis

Lebbeus polaris

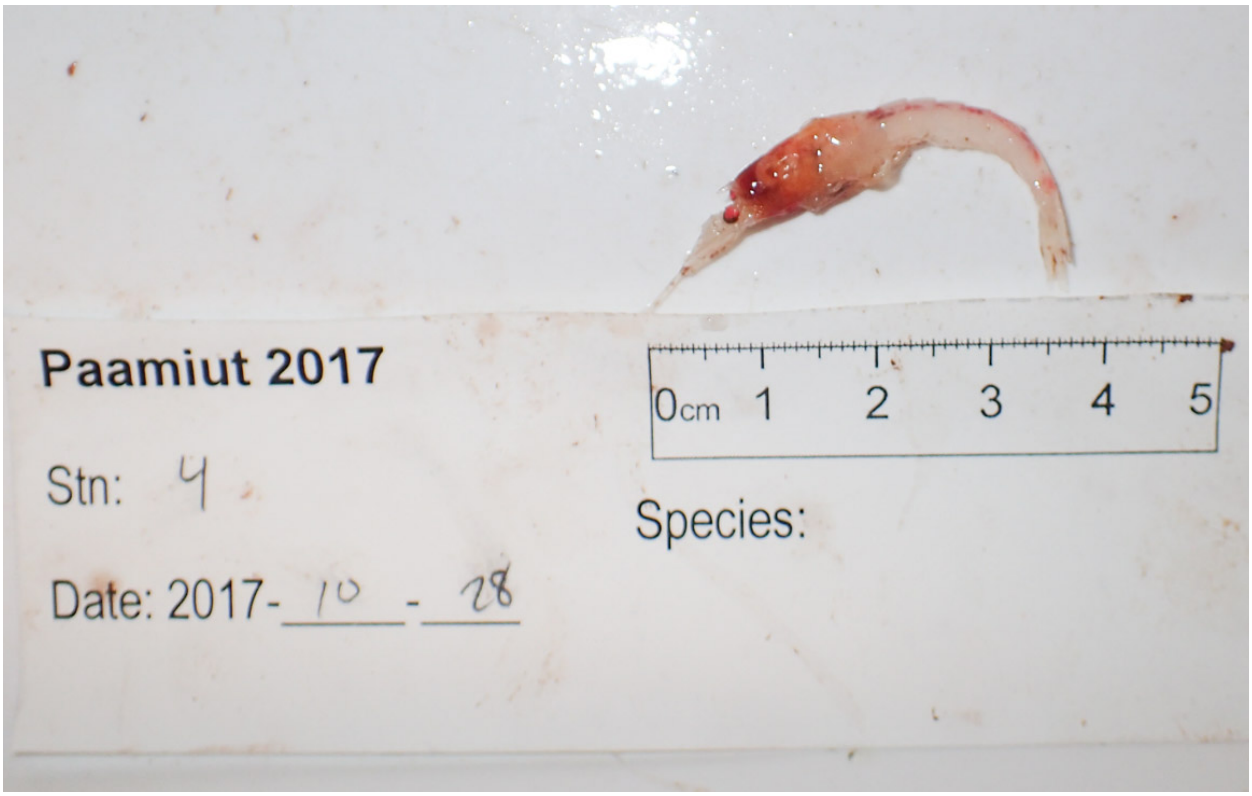
Pandalus borealis

Pasiphaea multidentata

Pasiphaea tarda

Parapasiphae sulcatifrons

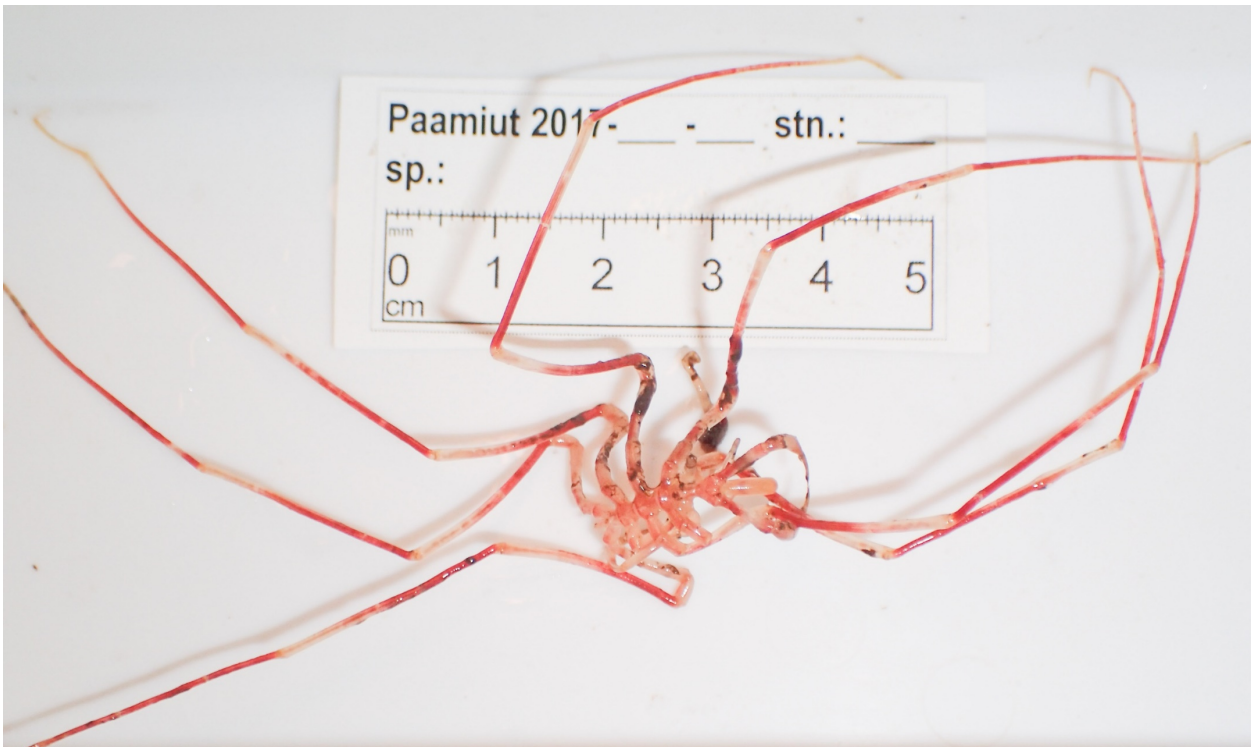
Sclerocrangon ferox



Boreomysis

Mysida (cf. *Meterythrops*; collected from a fish stomach, not in capture)

Boreonymphon abyssorum

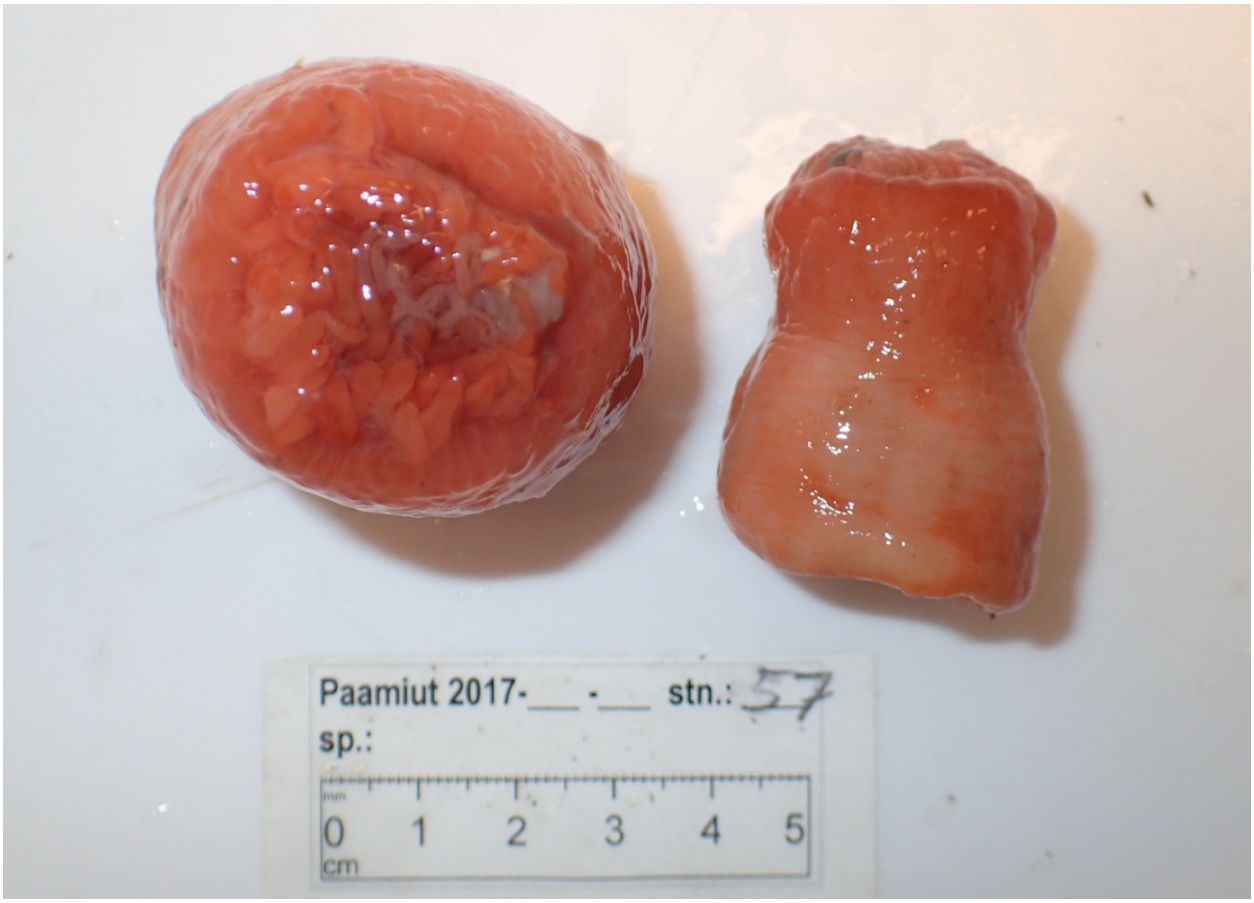


Nymphon

Nymphon helleri

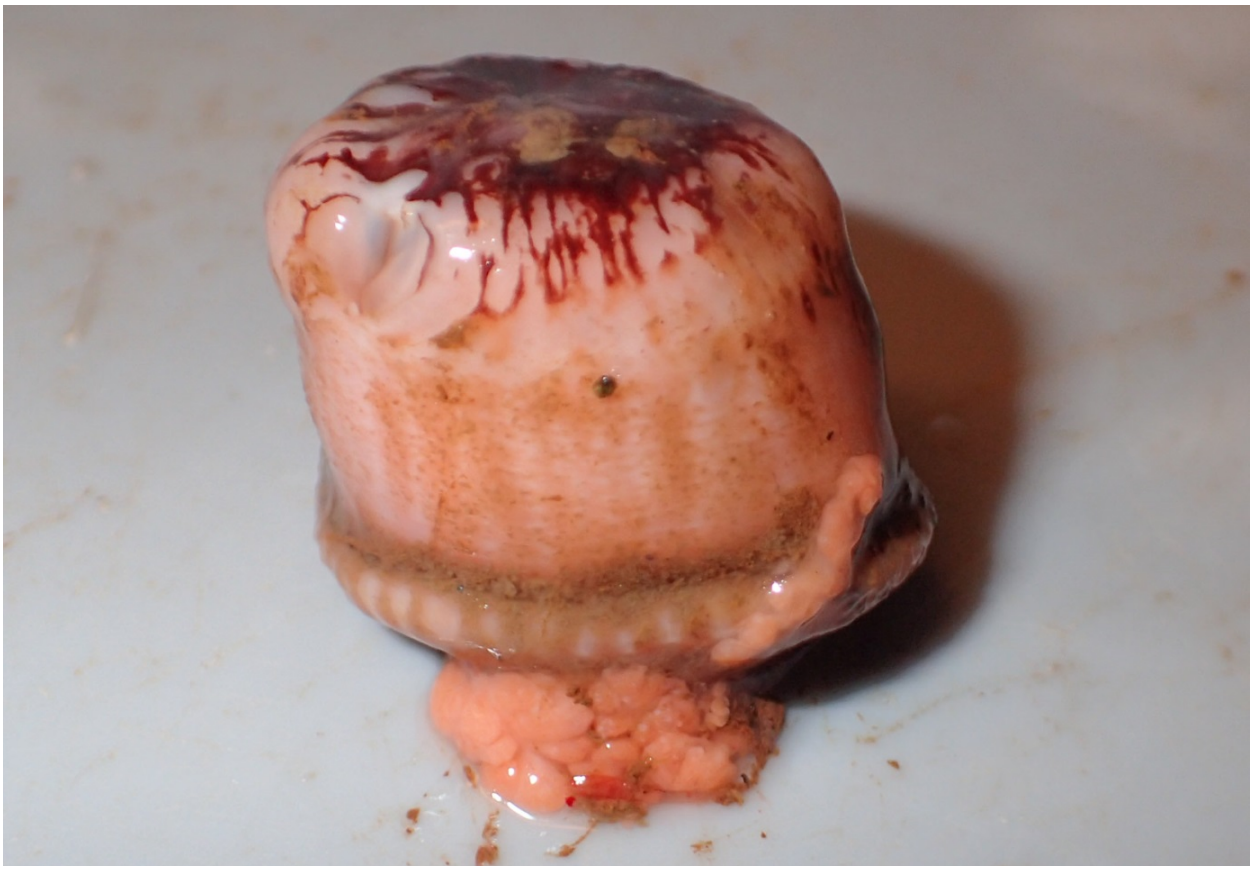
Actinauge cristata

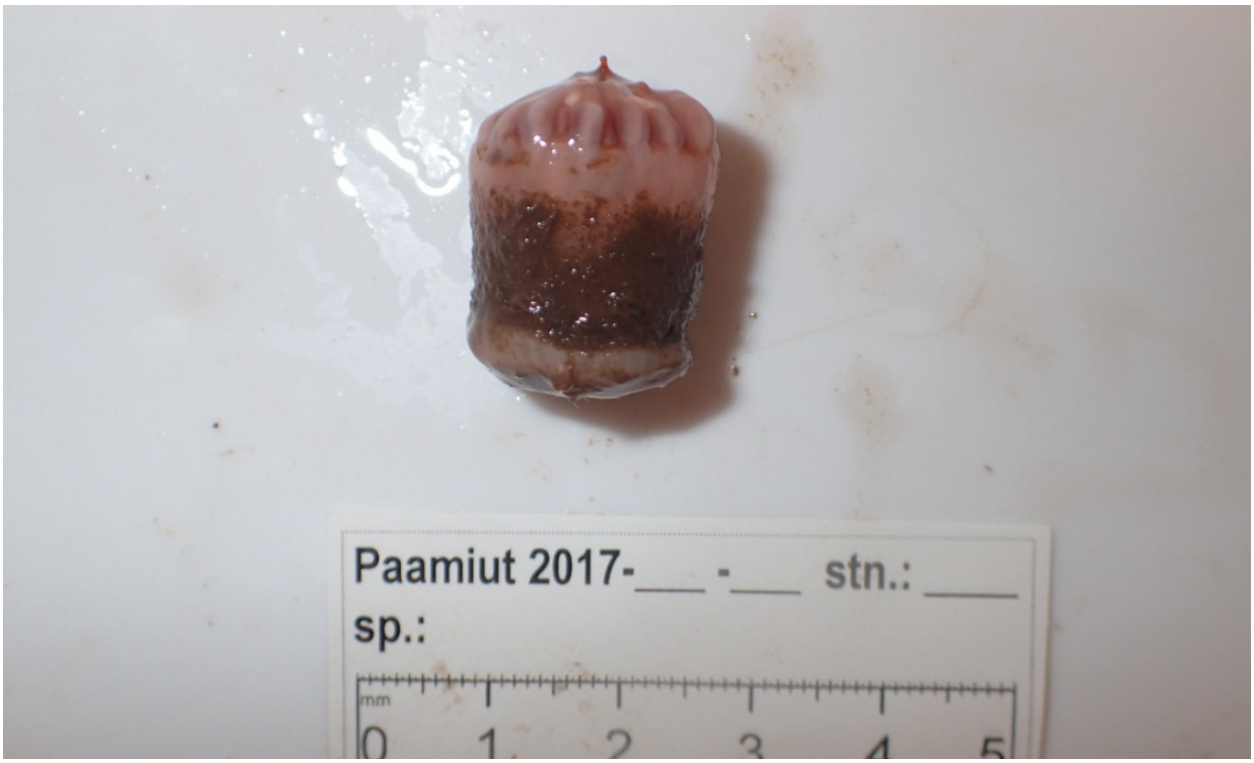
Actinostola



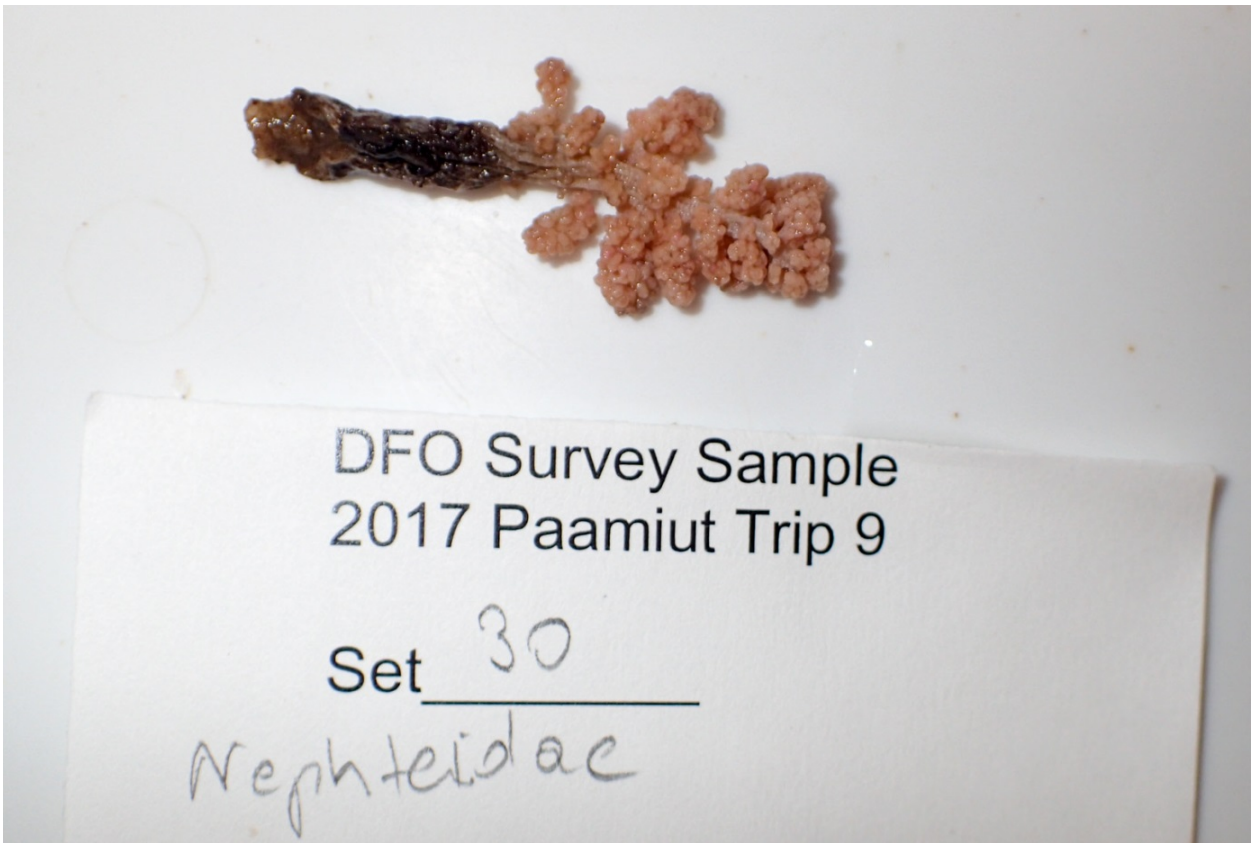
Actiniaria (unknown sea anemones)

Actiniaria (unknown sea anemones)

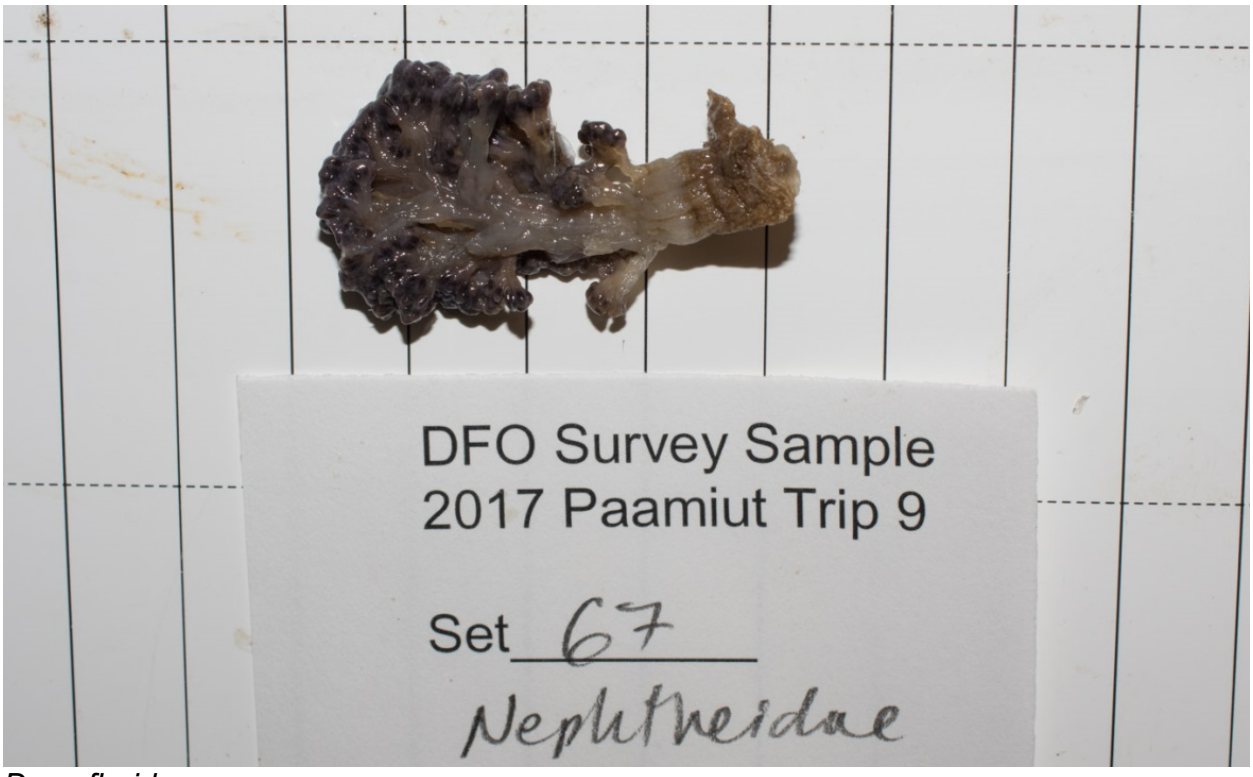




Actiniaria (unknown sea anemones)

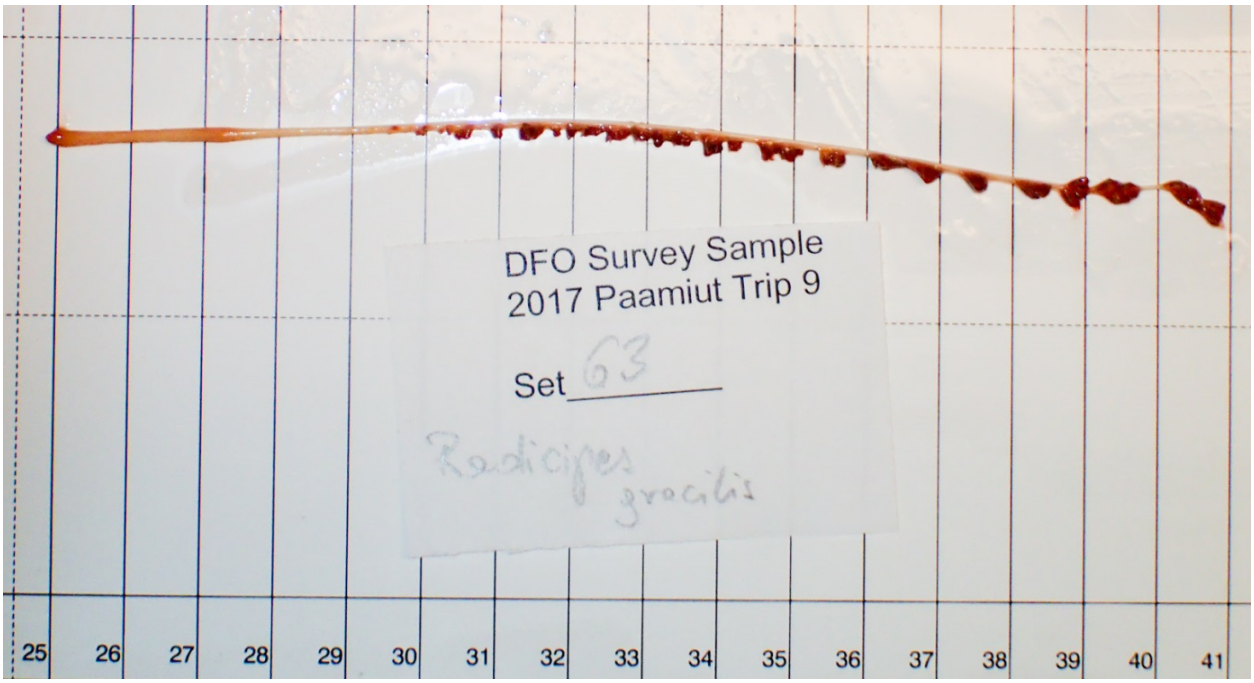


Drifa (cf. *flavescens*)

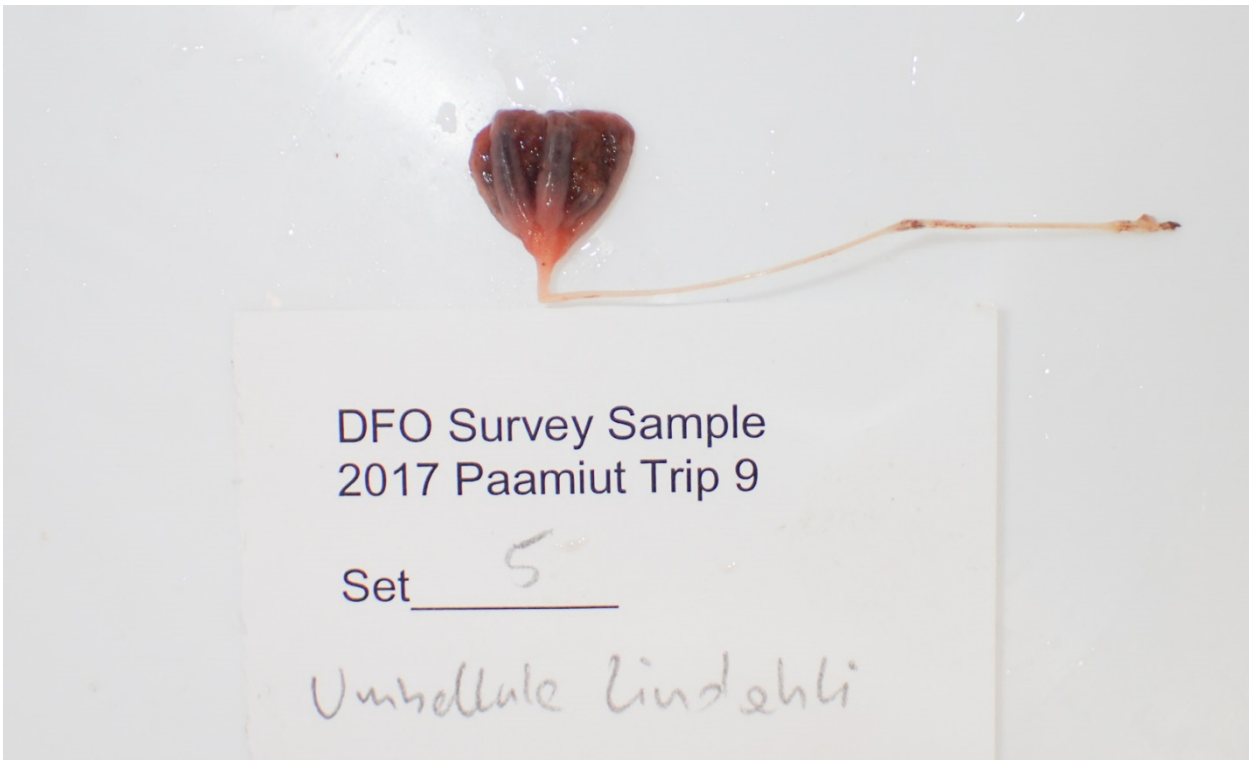


Duva florida

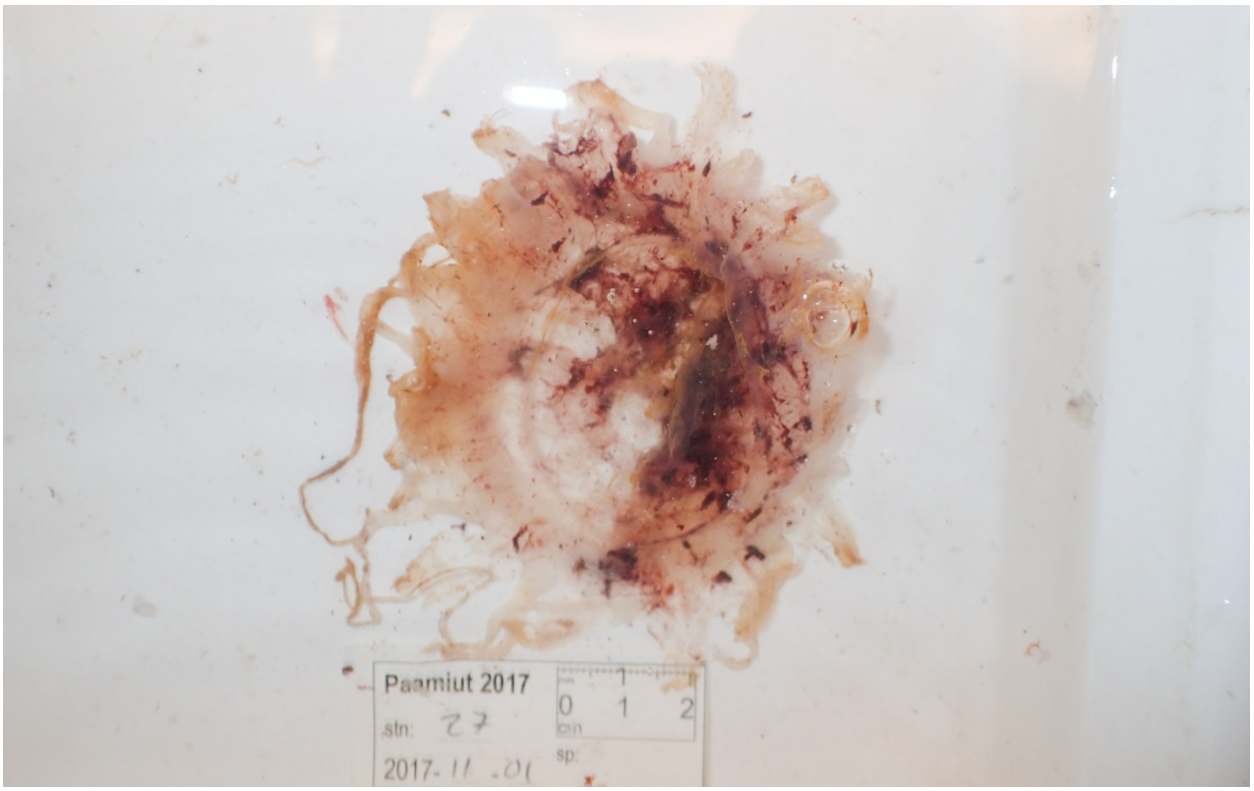
Pennatula grandis



Pennatulacea (recorded as *Radicipes gracilis*)



Umbellula encrinus (recorded as *U. lindahli*)



Atolla wyvillei

Periphylla periphylla

Bathybiaster vexillifer

Crossaster squamatus

Diplopteraster multipes

Henricia

Hymenaster pellucidus

Icasterias panopla

Leptychaster arcticus

Mediaster bairdi

Pontaster tenuispinus

Poraniomorpha tumida

Pteraster militaris

Tylaster willei

Gorgonocephalus (cf. *arcticus*, with spiny-type central disk)

Gorgonocephalus (cf. *eucnemis*, with smooth-type central disk)

Ophiacantha

Ophiopholis aculeata

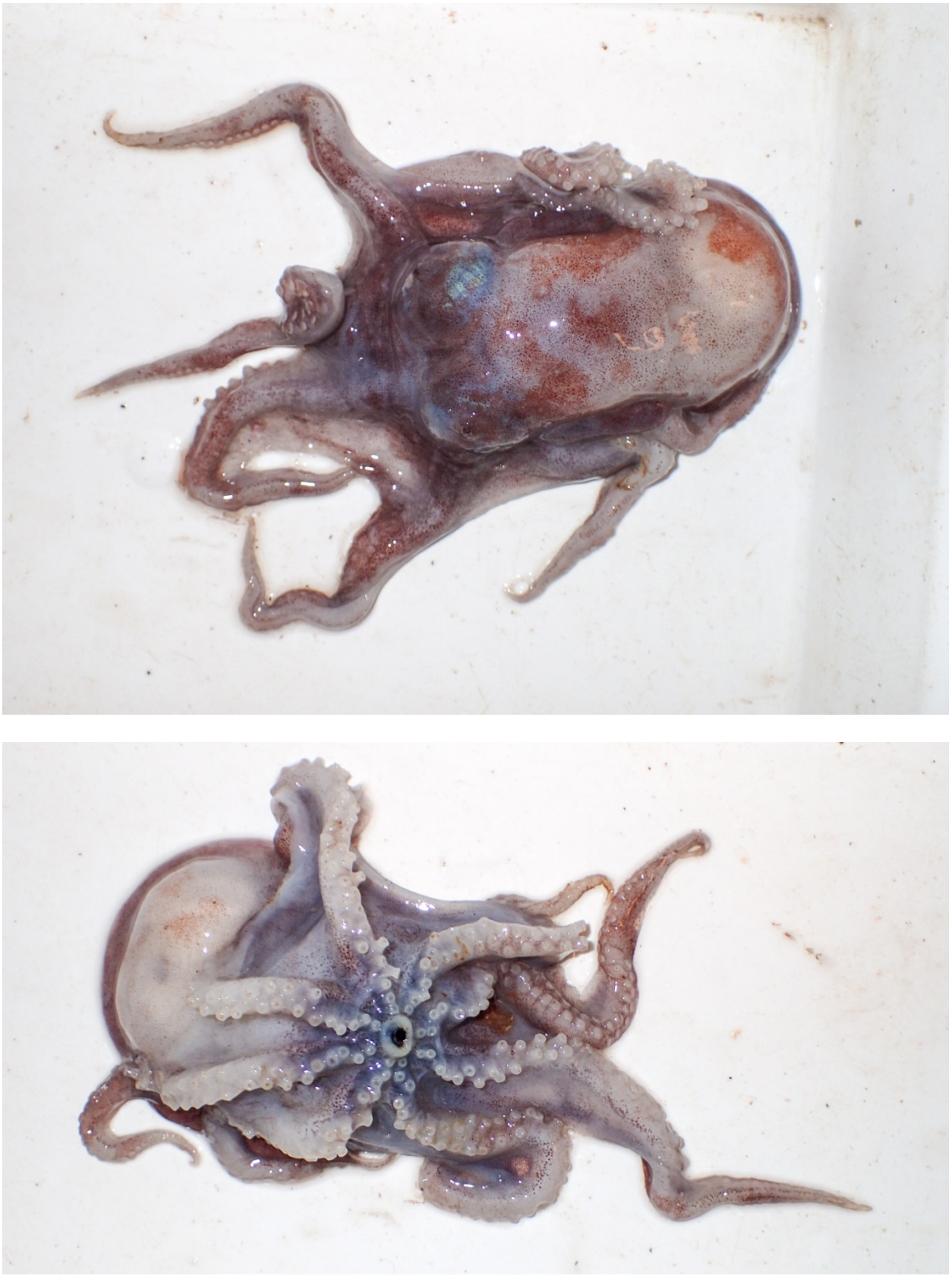
Ophiopleura borealis

Heliometra glacialis


Paamiut 2017
stn: 10
2017- 10 - 29
sp: Molpadia
mm
0 1 2
cm


Paamiut 2017
stn: 29
2017- 11 -01
sp:
mm
0 1 2
cm

Molpadia



Bathypolypus (cf *bairdii*), spoonarm octopus (bottom: ventral view)

Cirroteuthis muelleri , Müller's cirrate octopus (bottom: close-up view of head)

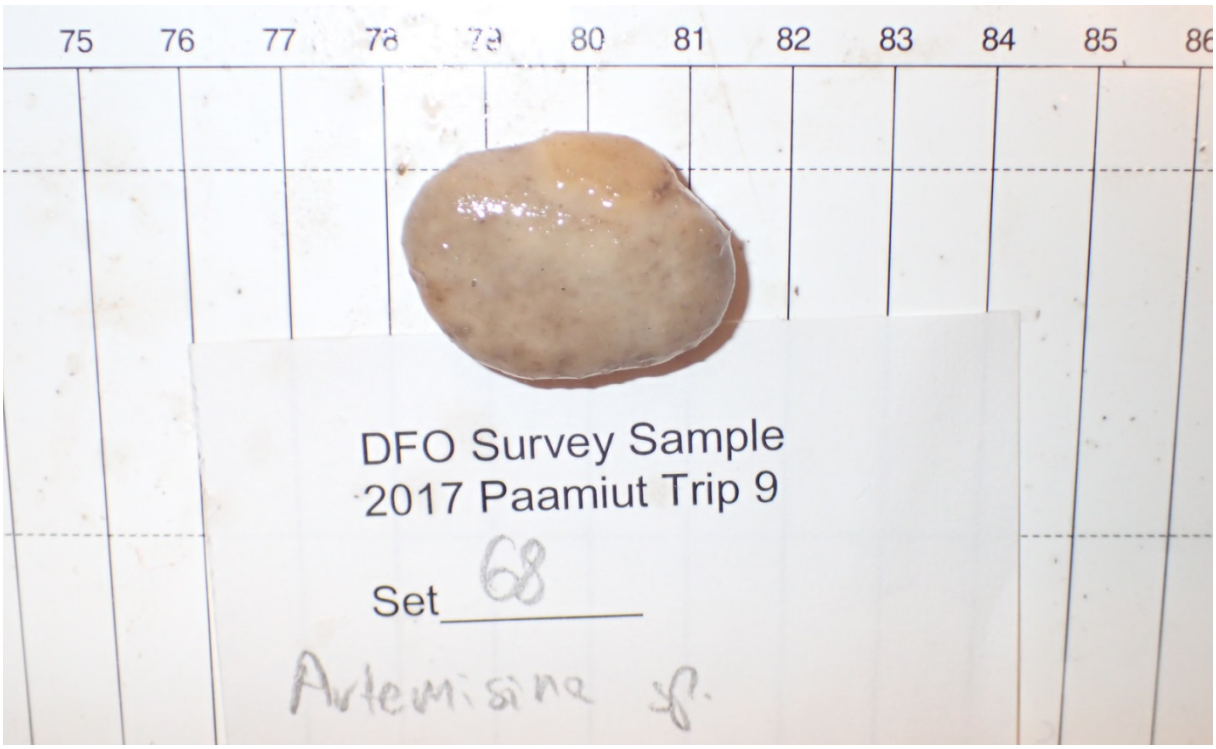
Gonatus fabricii, boreoatlantic armhook squid

Buccinum glaciale

Buccinum hydrophanum

Colus islandicus

Colus pubescens



Artemisina

Asconema foliatum

Chondrocladia grandis

Clathria barleei

Geodia barretti

Geodia hentscheli

Geodia parva

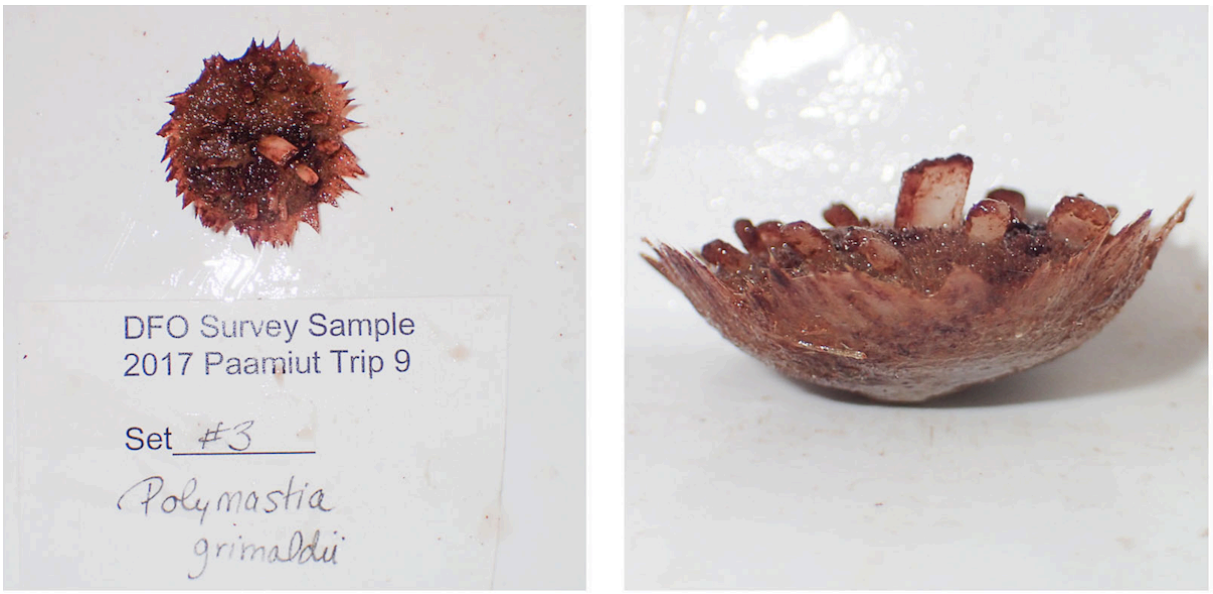
lophon

Lissodendoryx complicata

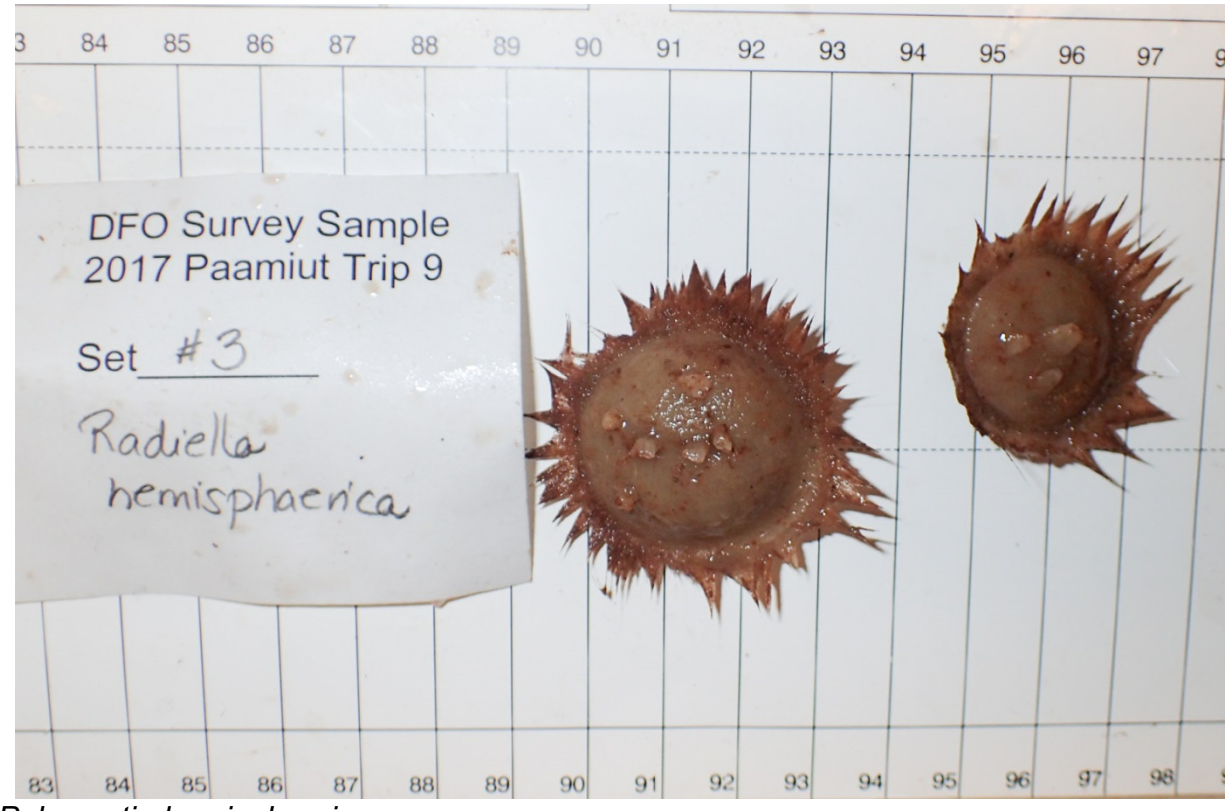
Lissodendoryx indistincta

Mycale lingua

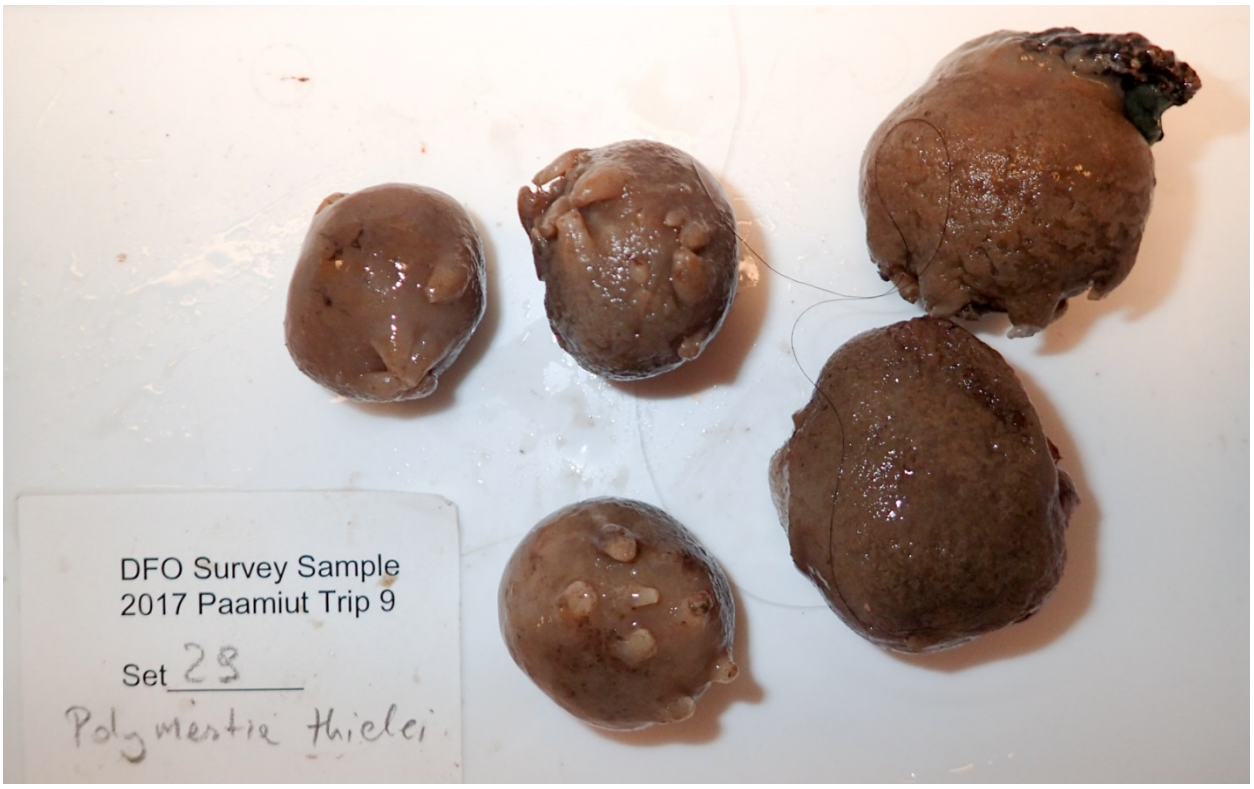
Phakellia (taxon under review; may be *Semisuberites cribrosa*)



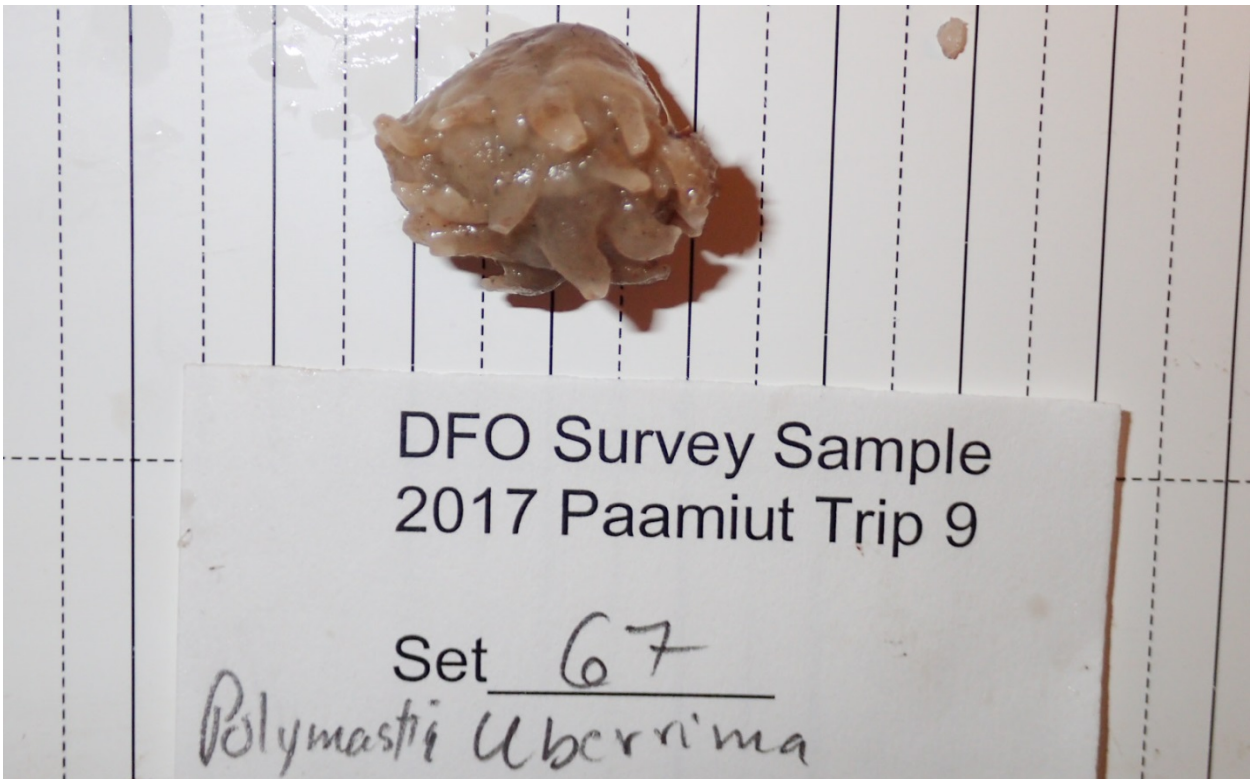
Polymastia grimaldii (right: lateral view)



Polymastia hemisphaerica

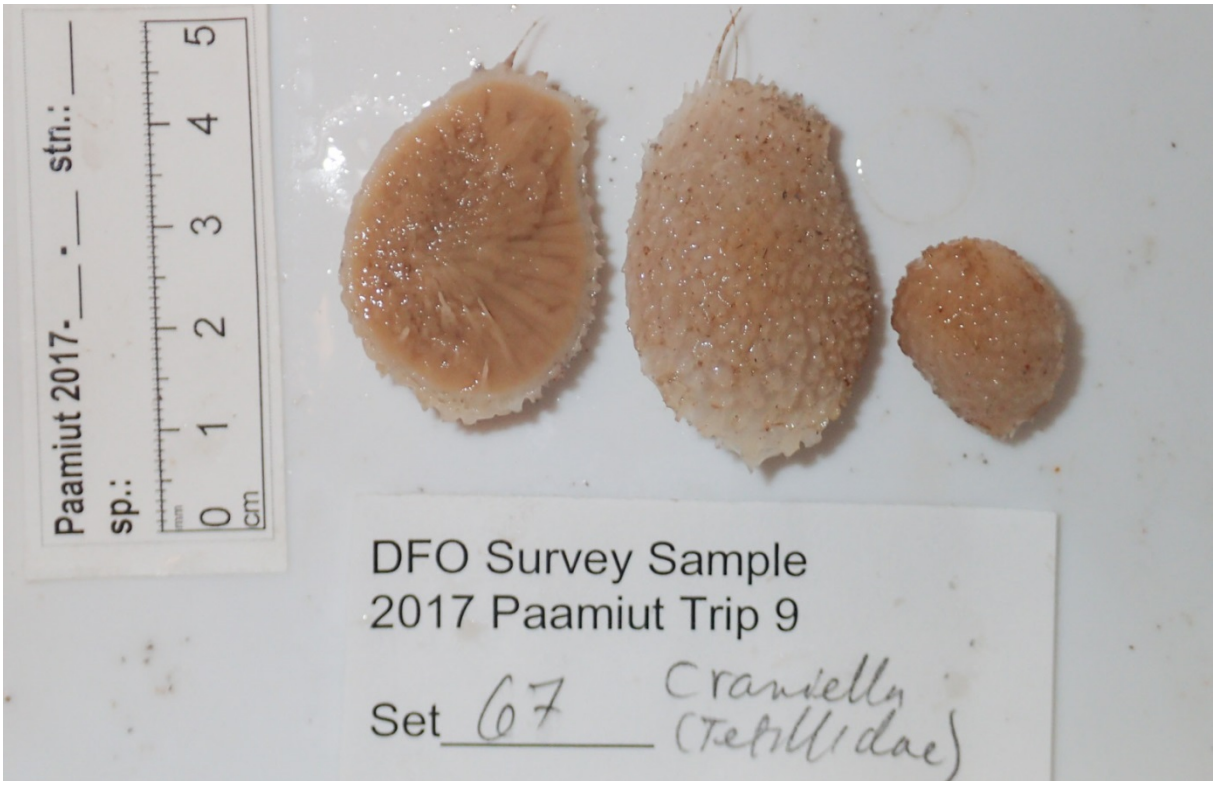


Polymastia thielei



Polymastia uberrima

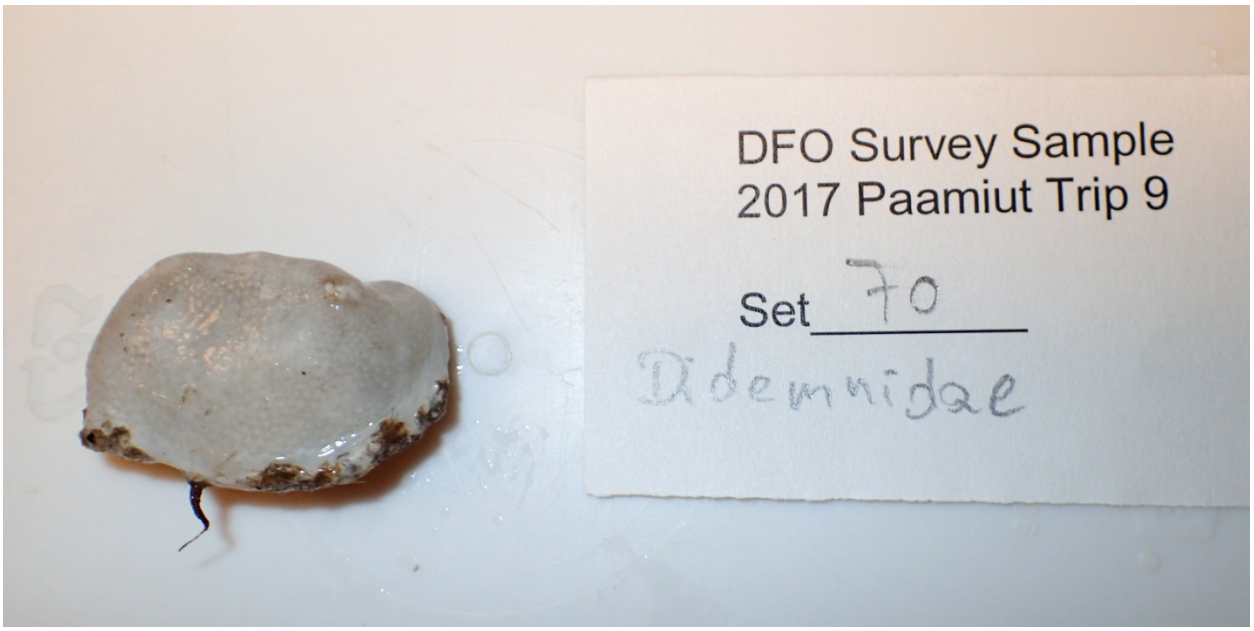
Stelletta



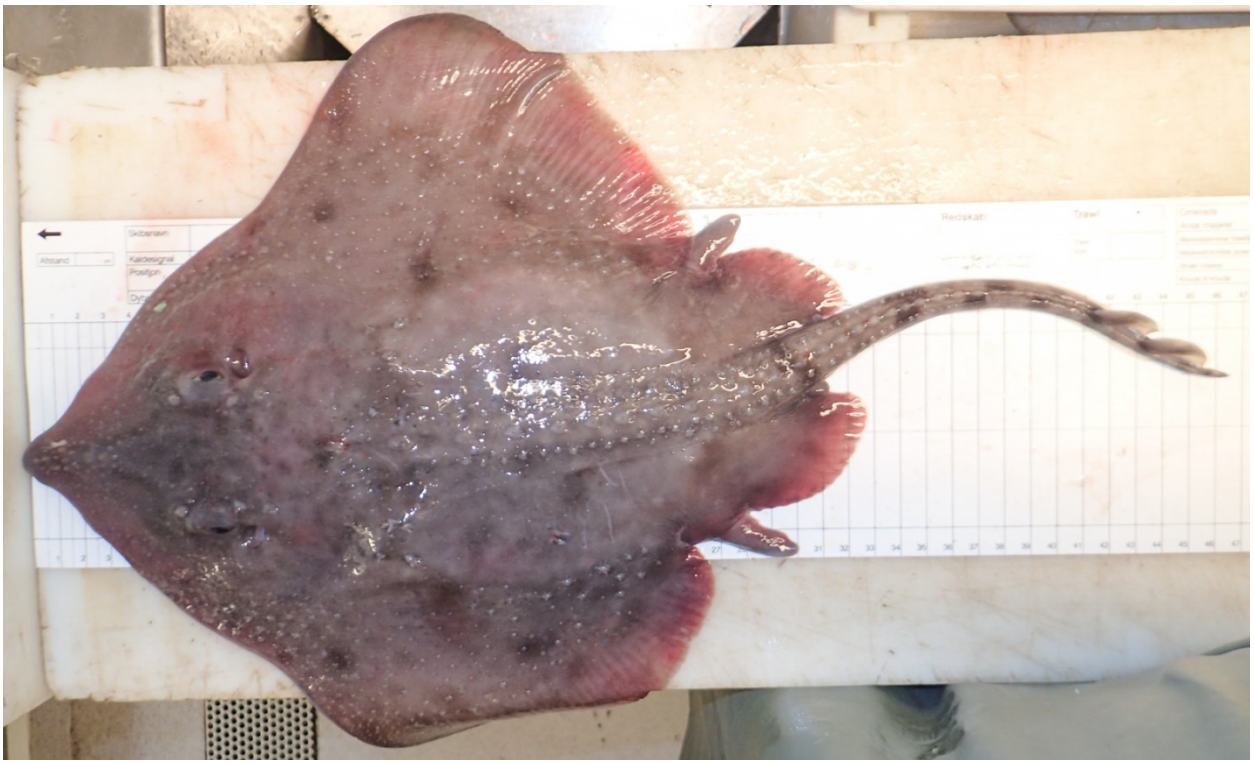
Tetillidae (*Craniella* or *Tetilla*)

Thenea

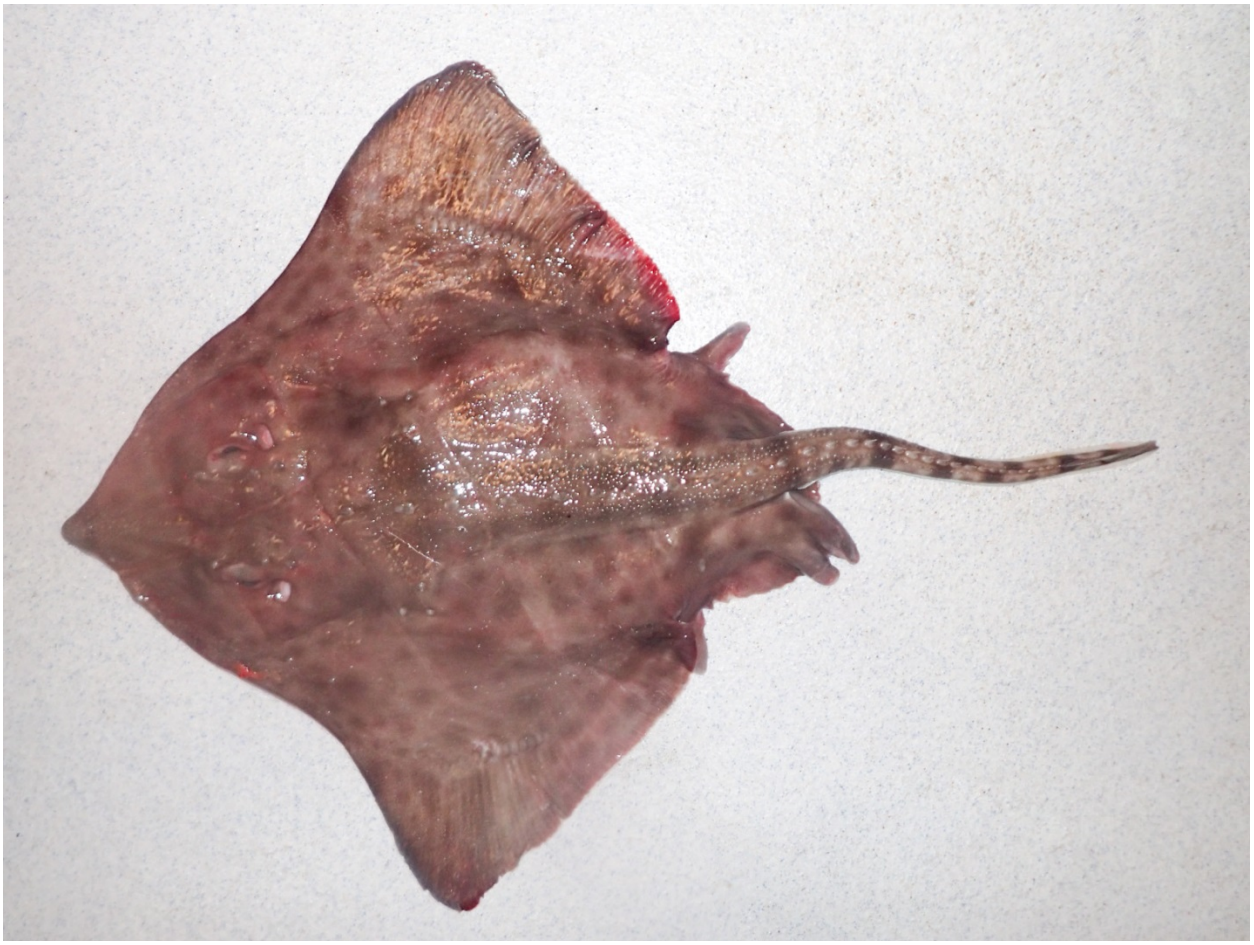
Weberella bursa



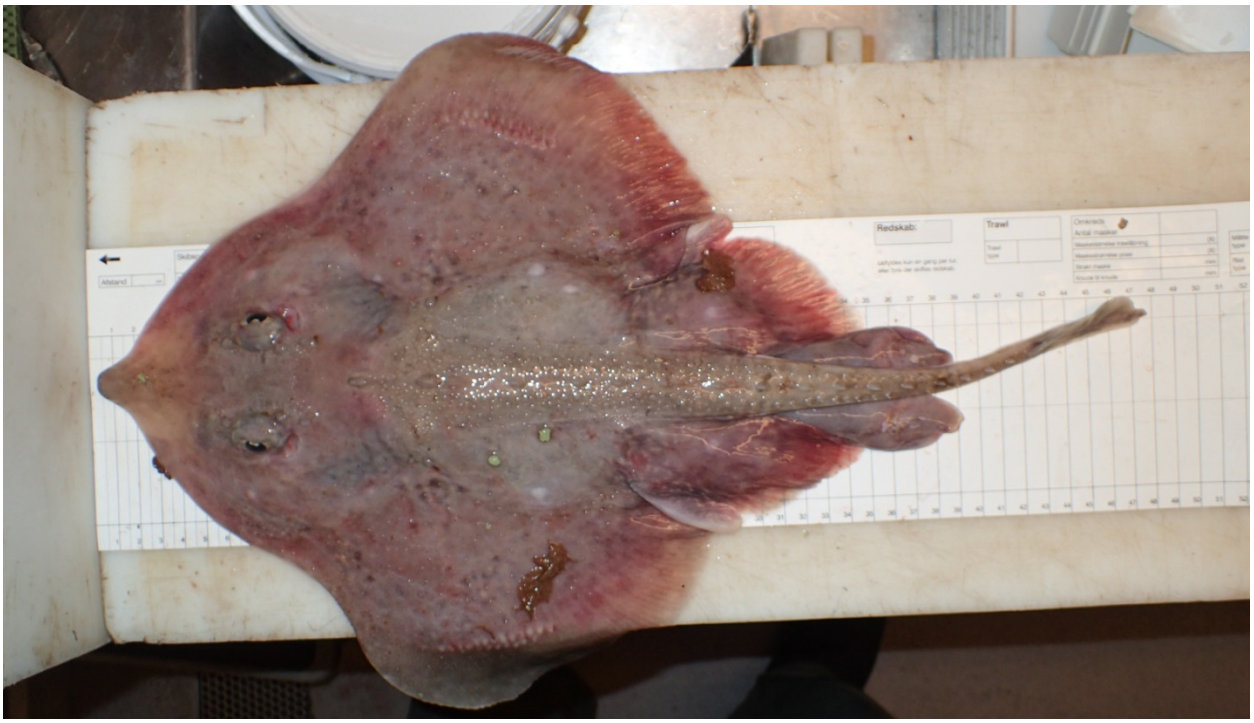
Didemnidae



Amblyraja hyperborea, Arctic skate (below: ventral view)



Amblyraja jenseni, Jensen's skate (below: ventral view)



Amblyraja radiata, thorny skate (below: ventral view)

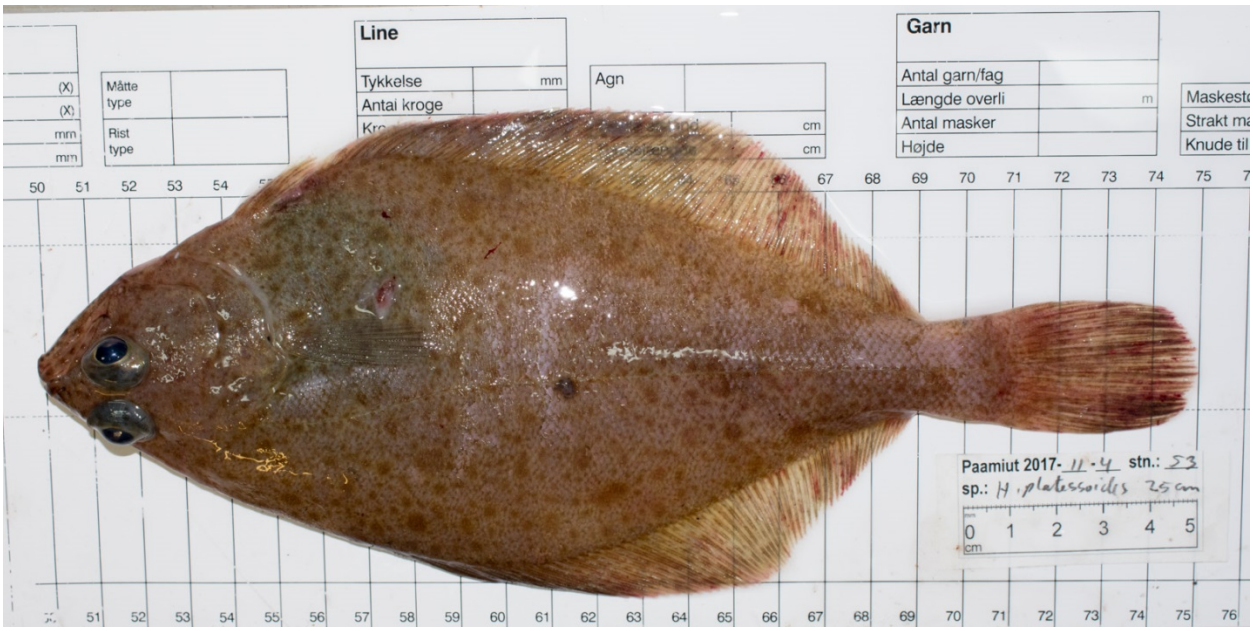
Somniosus microcephalus, Greenland shark (below: view of head)

Arctogadus glacialis, polar cod (North America) / Arctic cod (Europe)

Boreogadus saida, Arctic cod (North America) / polar cod (Europe)

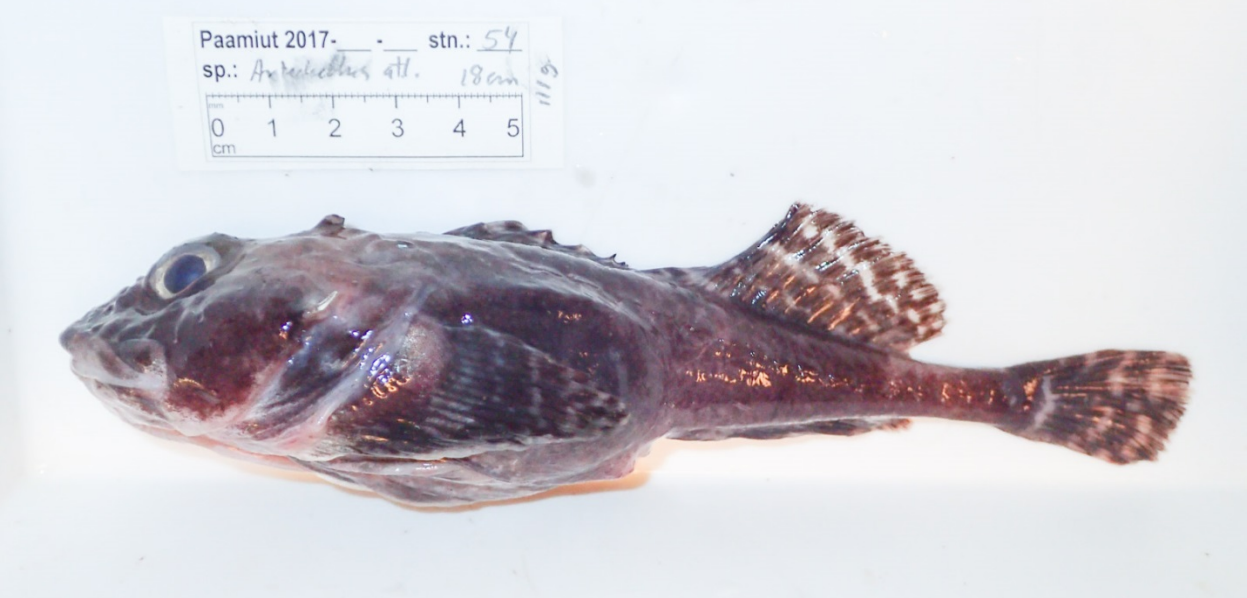
Gaidropsarus ensis, threadfin rockling

Macrourus berglax, roughhead grenadier



Hippoglossoides platessoides, American plaice

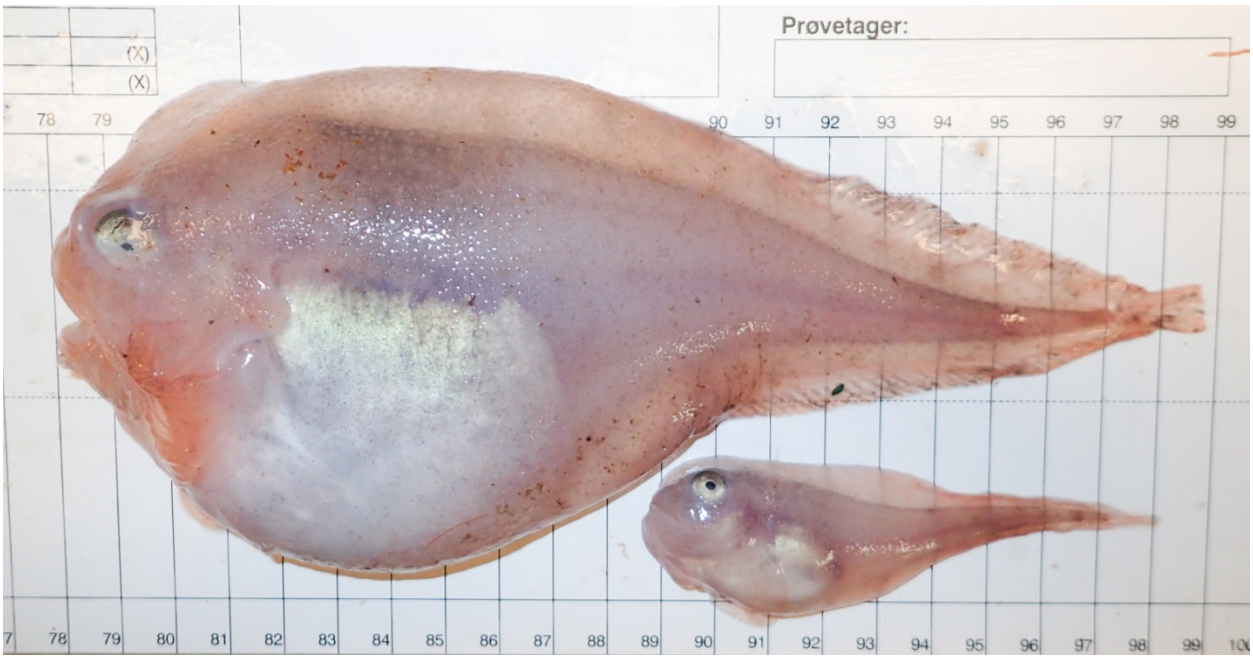
Reinhardtius hippoglossoides, Greenland halibut



Artediellus atlanticus, Atlantic hookear sculpin

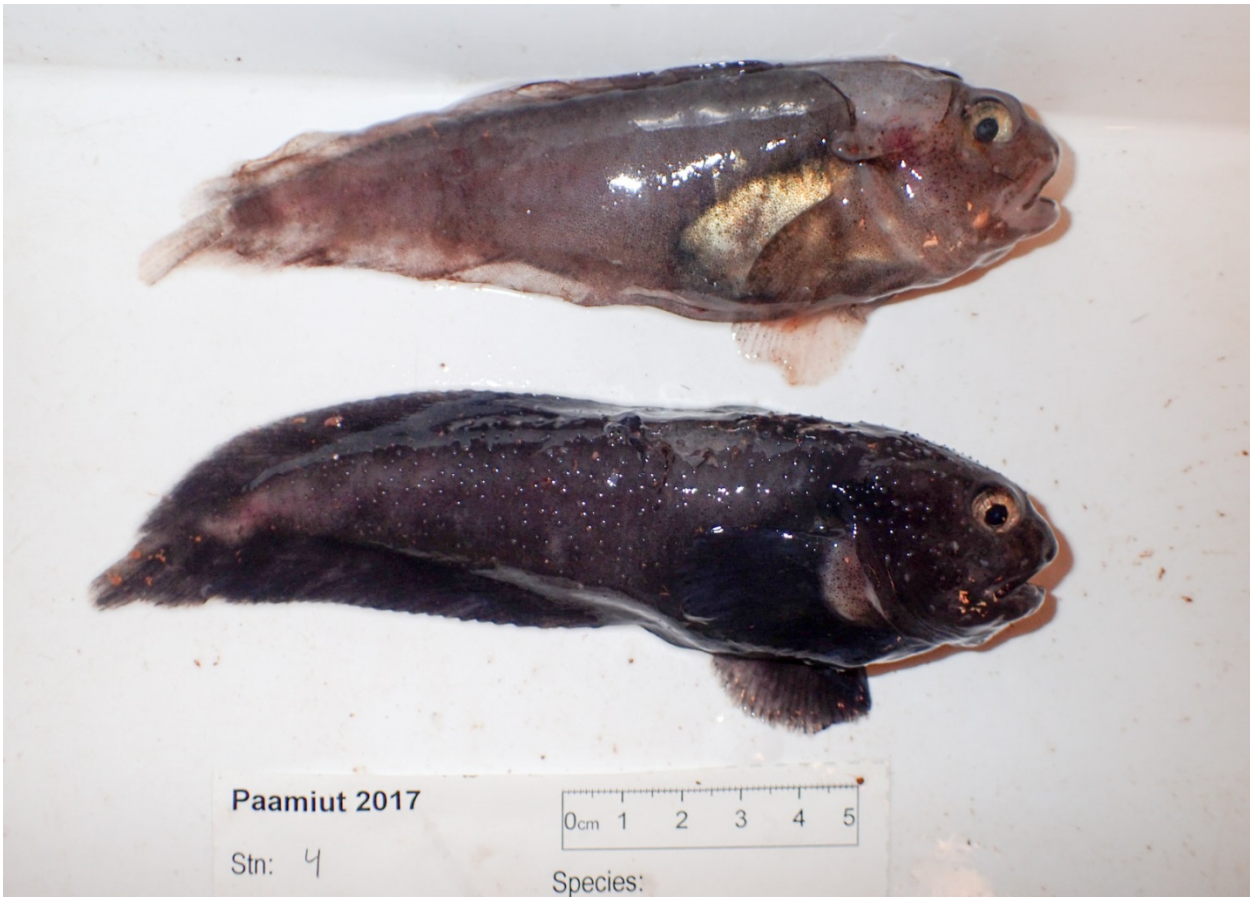
Triglops nybelini, bigeye sculpin

Cottunculus microps, polar sculpin



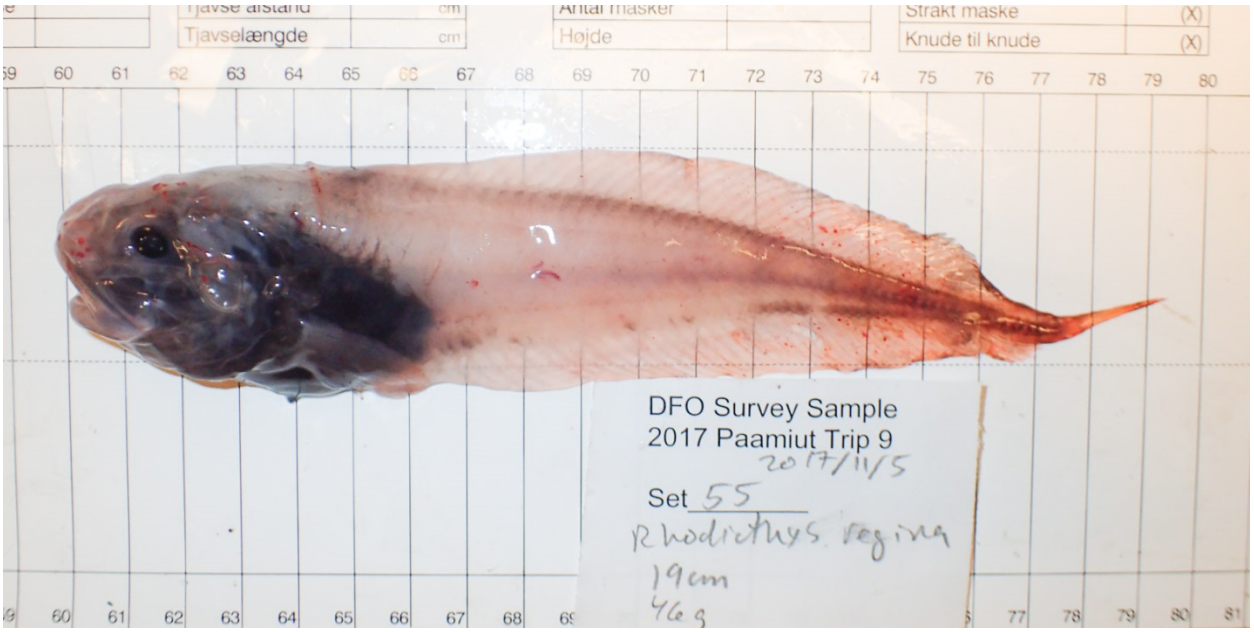
Careproctus reinhardti, sea tadpole

Liparis bathyarcticus, nebulous snailfish (recorded as *Liparis gibbus*)



Liparis fabricii, gelatinous snailfish (above: damaged specimen; below: intact male)

Paraliparis bathybius, black seasnail



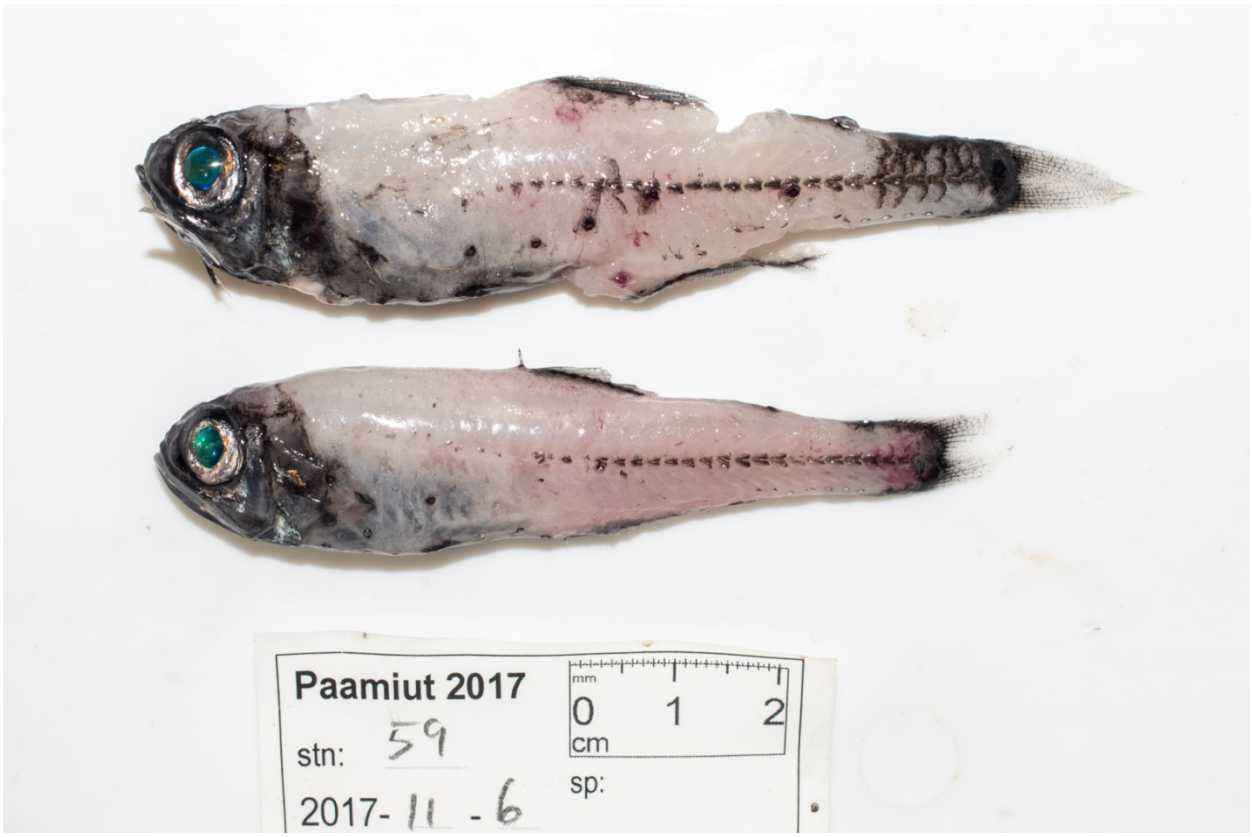
Rhodichthys regina, threadfin seasnail

Cyclopterus lumpus, lumpfish

Leptagonus decagonus, Atlantic poacher

Sebastes (cf. *mentella*, deepwater redfish)

Sebastes norvegicus, golden redfish (in records; photo shows a NW Atlantic specimen)



Benthosema glaciale, glacier lanternfish (recorded as Myctophidae)

Lampanyctus macdonaldi, rakery lanternfish (recorded as Myctophidae)

Bathylagus euryops, goiter blacksmelt

Cyclothone (cf. *microdon*), bristlemouth

Arctozenus risso, white barracudina

Notacanthus cheminitzii, snubnosed spiny eel

Lycodes eudipleurostictus, doubleline eelpout

Lycodes paamiuti, Paamiut eelpout

Lycodes reticulatus, Arctic eelpout

Lycodes rossi, threespot eelpout

Lycodes seminudus, longear eelpout