Biodiversity and habitat assessments in the coastal benthic ecosystems near Rankin Inlet 2023-2024

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Kozakewich, W., McNicholl, D., Gully, K., O'brien, J., and Dunmall, K. 2025. Biodiversity and habitat assessments in the coastal benthic ecosystems near Rankin Inlet 2023-2024. Can. Tech. Rep. Fish. Aquat. Sci. 3736: x + 47 p. https://doi.org/10.60825/wpp0-st35

Benthic habitats and species compositions across western Hudson Bay remain a knowledge gap, which is critical given the importance of this marine ecosystem to local communities. To address this, fieldwork took place during July 2023 and 2024 within Rankin Inlet at localized sites selected by the Kangiqłiniq Hunters and Trappers Organization (KHTO) to categorize the benthic habitat. Benthic grabs, dredges, and a non-invasive approach utilizing a remotely operated vehicle (ROV) were used to observe the benthos and obtain physical samples. Video footage was examined using BIIGLE, a web-based application designed for video and photo annotation, to identify taxa alongside varying habitats. In total, 47 faunal taxa were identified, alongside 11 macroalgal taxa. Sizes were measured across 20 individuals from the 2024 footage using a novel approach developed here to assess size dimensions within the image editing tool, GIMP. Among bottom grabs, 49 different taxa were identified with little overlap from the ROV footage. Arthropods, annelids, and molluscs were the only taxa caught, with varying relative abundances across sites and catch methods. Melvin Bay, had the highest relative abundance of caught invertebrate taxa. These data will contribute to a greater understanding of the benthic diversity and habitats in the nearshore waters of Rankin Inlet and surrounding islands. Moreover, the methods for analyzing underwater footage will provide options for future studies to gather baseline data using non-invasive measures.

Résumé

Kozakewich, W., McNicholl, D., Gully, K., O'brien, J., and Dunmall, K. 2025. Biodiversity and habitat assessments in the coastal benthic ecosystems near Rankin Inlet 2023-2024. Can. Tech. Rep. Fish. Aquat. Sci. 3736: x + 47 p. https://doi.org/10.60825/wpp0-st35

L'évaluation des habitats benthiques et de la composition taxinomique à proximité de Rankin Inlet demeure une lacune dans les connaissances. En juillet 2023 et 2024, des membres de la collectivité ont mené des travaux de terrain dans les eaux côtières à proximité de Rankin Inlet et des îles voisines, aux sites choisis par l'organisation de chasseurs et de trappeurs de Kangiqłiniq, en vue de catégoriser l'endofaune benthique. Ils ont utilisé des dragues et des pinces benthiques pour obtenir des échantillons physiques, ainsi qu'un véhicule sous-marin téléguidé pour observer l'environnement benthique de manière non invasive. Les séquences vidéo ont été examinées à l'aide de BIIGLE, une application Web pour l'annotation de vidéos et de photos, aux fins d'évaluation des diverses caractéristiques d'habitat, et d'identification des taxons d'invertébrés, de poissons et de macroalgues. À partir de ces séquences vidéo, 47 taxons fauniques et 11 taxons de macroalgues ont été identifiés. La taille de 20 individus a été mesurée à partir des séquences vidéo de 2024, grâce à une nouvelle approche, élaborée dans le cadre de la présente étude, visant à évaluer les dimensions dans l'outil de modification d'images GIMP. Parmi les échantillons prélevés au moyen de pinces et de dragues benthiques, 49 taxons différents ont été identifiés; il y a eu peu de chevauchement avec les résultats des séquences vidéo. Les individus capturés appartenaient à trois taxons seulement, soit les arthropodes, les annélides et les mollusques, et leur abondance relative variait en fonction des sites et des méthodes de prélèvement. Le site de la baie Melvin, le plus proche de Rankin Inlet, présentait la plus grande abondance relative de taxons d'invertébrés capturés. Ces données permettront de mieux comprendre la diversité benthique et les habitats des eaux côtières à proximité de Rankin Inlet et des îles voisines. De plus, grâce aux méthodes d'analyse de séquences vidéo élaborées dans le cadre de la présente étude, il y aura davantage d'options non invasives pour la collecte de données de référence lors des futures études.

1.0 Introduction

The benthic marine ecosystem plays a critical role in ecological coupling, transforming organic matter exported from the pelagic zone into food resources for a variety of invertebrates, fishes, and marine mammals (Griffiths et al. 2017). In the Arctic benthic organisms recycle nutrients, provide habitat structure, and act as a food source for higher trophic levels such as walrus, bearded seals, and seabirds (Loewen et al. 2020). Despite their importance, relatively little is known about the benthic communities in coastal ecosystems across the Canadian Arctic, including Hudson Bay. Limited sampling has constrained our understanding of benthic biodiversity, productivity, and the pathways of energy transfer in these coastal ecosystems (Kamula et al. 2016). Expanding knowledge in this area is therefore essential for understanding the functioning of Arctic marine food webs and the resilience of northern communities that rely on them, especially considering the impacts of climate change on Arctic ecosystems.

Accelerated environmental change in the Arctic is expected to alter benthic ecosystems in profound ways. Changes in sea ice dynamics may contribute to a shift from ice-associated algae (higher-quality food) towards mobile phytoplankton (Michel et al. 1993), altering the availability of food and feeding dynamics for many invertebrates(Combaz et al. 2025). As ice characteristics across the Arctic change with earlier break-ups and later freeze-ups(Stroeve et al. 2012; Gully et al. 2025), the habitats of many species may also change. Further, increased vessel traffic and shipping through Hudson Bay as a result of longer ice-free periods bring risks of disturbance, pollution, and invasive species (Bone et al. 2024). Changing freshwater inputs from river discharge and permafrost thaw due to rising temperatures can also reshape seafloor habitats and alter nutrient regimes (Amiraux et al. 2023). However, it is currently difficult to understand the impacts of these climate-related stressors as there is limited information available with respect to existing macroalgae and invertebrate biodiversity in many Arctic coastal ecosystems. Baseline studies provide the foundation for long-term monitoring, enabling the identification of ecological shifts and the development of adaptive strategies to safeguard the role of the benthos in sustaining Arctic food webs. Therefore, establishing ecological baselines is critical for assessing, predicting, and managing the effects of ongoing ecosystem-level changes across the Arctic.

Rankin Inlet (Kangiqłiniq), Nunavut (NU) is a coastal community situated along western Hudson Bay, and the largest community within the Kivalliq Region. As a result, Rankin Inlet is an epicenter for industry in the region and a major hub for numerous communities in the region (NCRI 2018). Therefore, it is a prime study area to assess benthic habitats given the potential for future climatic and anthropogenic impacts to these ecosystems, while also being positioned adjacent to the Southampton Island Area of Interest (Loewen et al., 2020). Local knowledge in the region conducted through interviews indicate the presence of a variety of bivalves, crabs, shrimp and some edible macroalgae (NCRI 2018), although the community composition and habitat associations of these species remain largely unexplored. The community composition of freshwater invertebrates near Rankin Inlet have been shown to be influenced by environmental gradients and sediment types (Namayandeh and Quinlan 2011), though this has been understudied in the marine environment.

Here, we focus on examining the benthic environment and biodiversity in the coastal ecosystem near Rankin Inlet, NU. Fisheries and Oceans (DFO) biologists worked in partnership with the Kangiqłiniq Hunters and Trappers Organization (KHTO) to identify research priorities and identify study locations. Our objectives were to: 1) identify benthic invertebrate and macroalgal taxa present using two complimentary methods, a minimally invasive remotely operated vehicle (ROV) to document biodiversity and benthic grabs (ponar and dredges) to obtain physical samples; 2) describe associated benthic environmental characteristics, such as substratum type, vegetation cover, and visibility; and 3) develop and use a novel, non-invasive approach for adequately measuring visible individuals from the ROV footage using the onboard scaling lasers. This information will establish a baseline benthic biodiversity assessment for the coastal area near Rankin Inlet, and establish methodologies which can then be applied elsewhere across nearshore coastal benthic environments.

2.0 Methods

2.1 Consultation with the KHTO

In 2021 the Arctic Coast monitoring program responded to a request by the KHTO to gather baseline information on key indicators relevant to the coastal areas of Rankin Inlet. Arctic Coast is a community-based, coastal field work program that was developed and guided by DFO and has been implemented in several communities throughout Inuit Nunangat to describe biodiversity (e.g., fishes, invertebrates) and habitat characteristics (e.g., temperature, depth, salinity) of localized Arctic coastal ecosystems (Christie et al. 2023; McNicholl et al. 2024; McNicholl et al. 2025). Using established protocols, a baseline study was designed to investigate the benthic environment, with a specific focus on mussels, marine vegetation, and salinity within Rankin Inlet. A virtual consultation was held on May 31, 2022 between Arctic Coast biologists and the KHTO to identify concerns and priorities, field sampling sites, and to request formal community support. As a result, three study areas were chosen with input from the KHTO (Melvin Bay, Thomson Island, and Barrier Islands), who highlighted Melvin Bay as the primary point of interest. A pilot project began in the summer of 2022, where community-based monitors and Arctic Coast biologists tested and revised coastal assessment protocols. During 2023 and 2024 fieldwork addressing research priorities was conducted through ROV and benthic sample collections at nine sites (Figure 1). Details of the sampling efforts conducted in 2023 and 2024 are summarized in Tables 1 and 2.

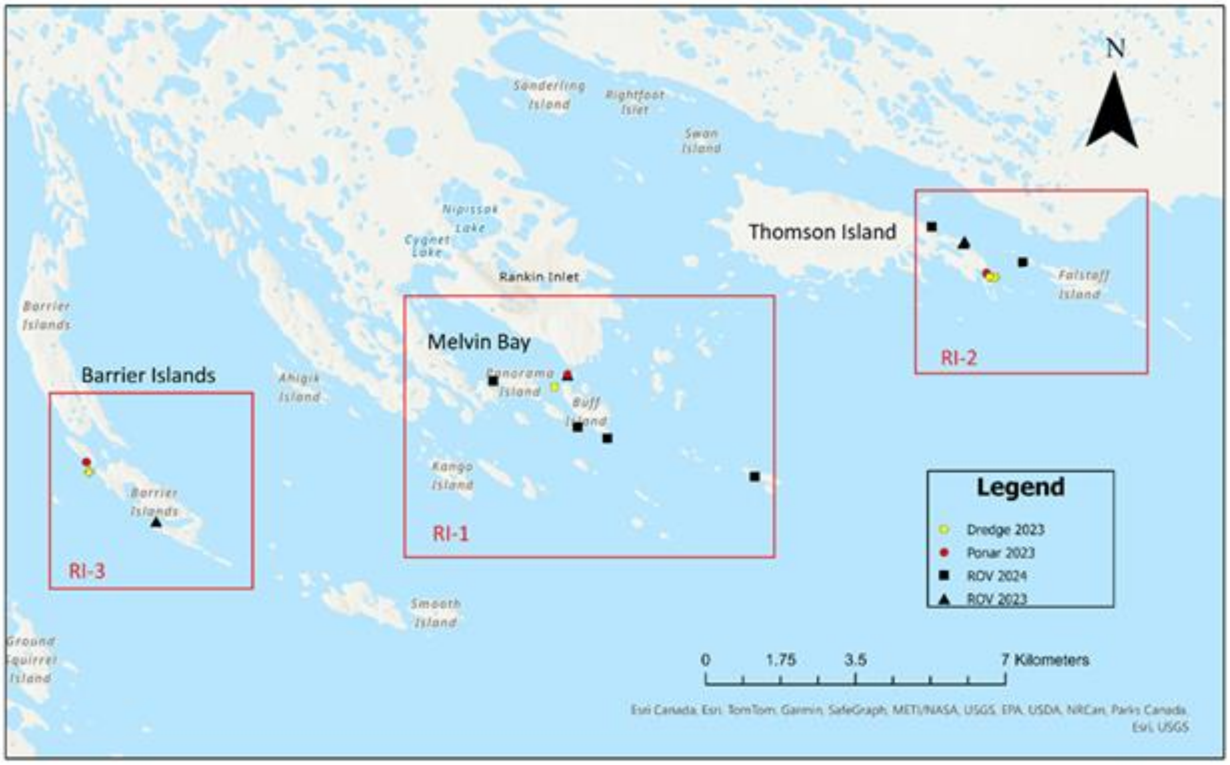

Figure 1. Arctic Coast Rankin Inlet community-based study areas are indicated within the red outlines. Within these areas, the specific sites where dredge and ponar grabs or ROV footage was collected in 2023 and/or 2024 are indicated.

2.2 ROV Deployment

To categorize nearshore benthic environments and biodiversity, video footage was taken of the coastal ecosystem near Rankin Inlet in 2023 and 2024 (Table 1). Video footage was collected with a FIFISH V6 Expert ROV operating at a frame rate of 30 frames per second, with a pixel resolution of 3840 x 2160. With the exception of East Thomson Island 2, the duration of footage for each site ranged between 7 to 47 minutes, dependent on the strength of the water current (Table 1). The ROV operator directed the camera towards features of interest as they were observed, rather than along a predetermined path, and hovered around individual specimens once they were spotted to assist with later identification efforts. The ROV was initially equipped with a depth (m) and temperature sensor (°C), and, in 2024, two scaling lasers were installed that operated with a visual separation distance of 10 cm. Maximum depth was determined by reading the depth sensor when the ROV was closest to the ocean floor at the lowest section observed at each site. For sites where the ROV did not get close enough to the seafloor, depth was estimated based on the visual distance from the ROV at its lowest elevation, to the seafloor below it.

Table 1. Coordinates and footage duration (minutes) from the ROV deployments of each study site, by year.

Location	Year	Latitude	Longitude	Depth (m)	Duration of Benthic Footage (min)
Melvin Bay	2023	62.792287	-92.080018	9.7	46.8
East Thomson Island 1	2023	62.821947	-91.906156	29.9	30.9
Barrier Islands	2023	62.759315	-92.260131	8.8	45.8
West Falstaff Island	2024	62.818353	-91.879462	13.1	36.2
East Thomson Island 2	2024	62.824914	-91.920426	27*	0.27
Panorama Island	2024	62.790429	-92.112953	42.0	32.7
West Buff Island	2024	62.781644	-92.074773	10.7	8.2
South Buff Island	2024	62.779606	-92.061375	30.2	27.3
Guillemot Island	2024	62.772858	-91.995284	11.0	7.7

*approximate value

2.3 Bottom Grabs (Ponar and Dredge)

To categorize the benthic infauna around Rankin Inlet, ponar grabs (Wildco® 15.2 x 15.2 cm sampling area) and dredges (15.2 cm x 20.3 cm sampling area) were performed at numerous locations in 2023 (Table 2) to collect sediments and specimens. These gear types were used to determine which method would be more suitable for sample collection in the environment near Rankin Inlet. Such sampling efforts allowed benthic infauna to be collected to supplement site-specific biodiversity with specimens that could not be obtained and observed with the ROV. Upon collection of a sediment sample, organisms were separated using a bucket sieve (500 µm mesh) and frozen at -20°C. Specimens were then sent to the University of Laval (Archambault Lab) in October 2023 to be identified to the lowest possible taxonomic level (Appendix A).

Table 2: Bottom grab (ponar) and dredge sampling effort conducted at various locations near Rankin Inlet in 2023, with their depth and coordinates.

	Date	Site	Depth (m)	Latitude (DD)	Longitude (DD)
Ponar	July 19 2023	Melvin Bay	12.4	62.792287	-92.080018
		Thomson Island	6.4	62.815853	-91.895424
Ponar	July 20 2023	Barrier Islands	13.5	62.770728	-92.292073
Dredge	July 21 2023	Thomson Island	12.5	62.815052	-91.891539
Ponar	July 26 2023	Thomson Island	9.2	62.815853	-91.895424
		Melvin Bay	13.6	62.792287	-92.080018
		Barrier Islands	11.4	62.770842	-92.291975
Dredge	July 26 2023	Melvin Bay	9.2	62.81519	-91.895879
Ponar	July 31 2023	Barrier Islands	14	62.770842	-92.291975
		Melvin Bay	12.7	62.792287	-92.080018
		Thomson Island	6.7	62.815853	-91.895424
Dredge	July 31 2023	Barrier Islands	12.8	62.768795	-92.288133
Ponar	August 5 2023	Thomson Island	9.4	62.815853	-91.895424
		Melvin Bay	13.5	62.792287	-92.080018
		Barrier Islands	13.5	62.770842	-92.291975
Ponar	August 11 2023	Thomson Island	7.4	62.815853	-91.895424
		Melvin Bay	12.4	62.792287	-92.080018
		Barrier Islands	8.9	62.770842	-92.291975

2.4 ROV Footage

2.4.1 Annotation

Footage was separated into videos (≤ three minutes) and loaded onto VLC Media Player 3.0.17.4. Stills were automatically taken using the Scene Video Filter function, at a recording ratio of 149 frames per still. This recording ratio allowed a still to be taken approximately every five seconds, and a final still prior to each video ending. Although individuals may have only been found in the gaps between stills, and thus missed by our sampling method, the five second interval was chosen to mitigate a loss of observed individuals. Additionally, upon locating specimens, the ROV operator lingered on individuals, increasing the likelihood individuals appeared within the stills without being missed. While the ROV operator was directing the device towards different areas and individuals, they also captured footage of the site's substratum for later annotation and cataloguing.

Once stills were taken, they were uploaded to BIIGLE 2.0 (BioImage Indexing, Graphical Labelling and Exploration), a web-based image and video annotation software(Langenkämper et al. 2020). Within the annotation software, an annotation label tree was created followingKozakewich et al. (2024). The label tree was composed of eight branches, six of which contained varying degrees of sub-labels. The eight main branches were labelled "Fauna", "Flora", "Habitat Notes", "Size Measured", "Substratum", "Unknown", "Vegetation Cover %", and "Visibility" (Figure 2). The branches "Fauna" and "Flora" contained sub-labels used to denote observed animals and macroalgae, respectively. While "Fauna" was disaggregated into relevant phyla and lower taxonomy, "Flora" was split between red and brown macroalgae. When macroalgae could not be identified, they were categorized into one of two functional groups that was differentiated foliose or filamentous macroalgae. "Habitat Notes" was used to describe particulars of the environment (e.g., shell hash, boulders, detritus; Appendix E). "Size Measured" marked individuals whose body size was measured using the onboard scaling lasers (Section 2.4.1). "Substratum" contained labels that described the type of benthic substrate present. As sub-labels, "Coarse Sediment" denoted the presence of gravel and small rocks, "Hard Substrate" indicated a hard surface, such as the cliff walls observed at several sites, and "Soft Sediments" was used for areas with fine particulate substratum (e.g., sand, silt). "Unknown" acted as a label for individuals that could not be identified (e.g., motion blur, water current, focus issues). "Vegetation Cover %" specified the amount of benthic floor in the field of view that was covered in macroalgae, with sub-labels covering intervals of 25% coverage (i.e., 0-1%, 1-25%, 25-50%, 50-75%, 75-100%). Lastly, "Visibility" represented the ability of the ROV camera to see through the water, affected by conditions including local turbidity or kicked up fine particulate substrate. In situations where the ROV kicked up sediment that obscured vision, the related stills were labelled "Equipment Related Visibility Reduction", and removed from the study if overall visibility was adversely impacted. The labeling scheme for "Substratum", "Vegetation Cover", and "Visibility" were adapted from Grégoire et al. (2022). The full label tree can be found in Appendix B, separated into fauna (Table B1), flora (Table B2), and habitat characteristics (Table B3).

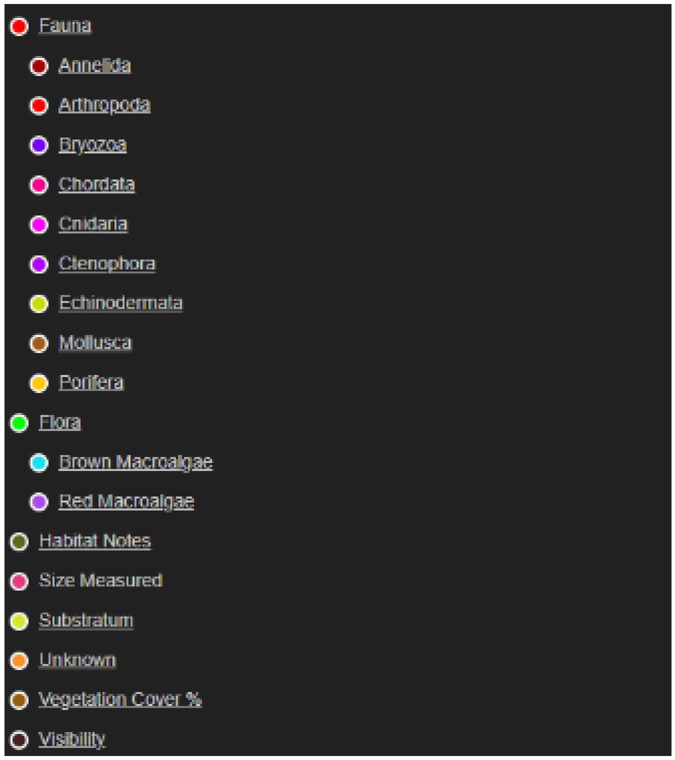

Figure 2. BIIGLE 2.0 label tree used for the identification and labeling of images taken with the ROV. The label tree was comprised of eight branches, six of which had varying degrees of sub-labels for further classification.

Within the stills, motion blur, poor angles of observation, sediment clouds kicked up by the ROV, or otherwise high turbidity had the potential to obscure specimens and individuals, preventing identification or obscuring presence altogether. To aid in observation and identification, video footage was viewed alongside the stills to increase the likelihood of observation and identification. Where individuals could not be identified to species level, they were identified to the lowest possible taxonomic level. To support the identification of each individual, numerous sources were used to confirm their identification, as well as their known presence within Hudson Bay: Marine Fishes of Arctic Canada(Coad and Reist 2018), Common Fishes of Nunavut(Government of Nunavut 2018), the Global Biodiversity Information Facility(GBIF 2025a), iNaturalist(iNaturalist 2025), and the World Register of Marine Species(WoRMS 2025). For many invertebrates, species-level identification was impossilbe due to a lack of observable visual characteristics; numerous distinguishing features require observation at a close range and with a steady, motionless view, which only close-up photography or in-person viewing can provide. For example, while counting the limbs and noting the colouration of sea stars aids in their identification, characteristics such as texture, presence of pedicellariae organs, and type of oral disc are more informative (Zhang et al. 2024) and thus provide a more accurate approach to species identification.

2.4.2 Measuring Method Development

To measure faunal individuals visible near the ROV onboard scaling lasers, a novel process was developed. For some faunal individuals, the ROV was unable to obtain a position that presented multiple measurable angles normally applicable to other members of the group (Figure 3); in such cases, a single measurement was taken. To ensure measurements were consistent among individuals, several conditions needed to be met to measure the size of an individual, namely:

1. Scaling lasers are directed at a surface on the same plane as the individual;
2. The lasers are positioned as close as possible to the individual to prevent distance distortion; and
3. At least one proper measurable dimension relative to each individual is clearly visible.

Figure 3. Example of a good angle for measurements, taken at a surface on the same plane as the individual at Panorama Island on July 19th, 2024.

To measure individuals, relevant stills were uploaded into GIMP 2.8.22. When measurable individuals appeared in the annotated stills but were not in a position to be measured, a screenshot was taken from the video footage that provided an ideal perspective. Since each species required different measurement locations to assess body size, their dimensions were measured on a species-specific basis outlined in Table 3. Within GIMP, the measure tool was used to compare the size of the individual to the separation between the lasers, using Equation 1:

$$\left(\frac{\#\ pixels\ along\ individual}{\#\ pixels\ between\ lasers}\right) \cdot 10cm = Size\ of\ dimension \qquad (1)$$

Table 3. Measurements taken of the six examined groups. NV is "Not Viable" as a measurement, and NA stands for "Not Applicable".

	Length	**Width**	**Height**
Crabs	The anterior tip to the posterior tip of the carapace	The widest portion of the carapace	NV
Pectinidae	Longest portion laterally along the shell	NV	The flat base to the opening of the shell
Fishes	Front of the head to the tail	Widest portion of the trunk	NV
Sea Anemone	NA	Diameter of the body column	NV
Sea Star	Tip of the longest arm to the middle of the center disc	NA	NV
Tunicates	NA	Diameter of the body	NV

For sea anemones, default measurements include the length of the tentacles and/or the pedal diameter (Angeli et al. 2016); however, these measurements could not be obtained with ROV footage as the pedal disc is obscured below the sea anemone, and the tentacles are constantly in motion and not in straight lengths, preventing the lasers from obtaining accurate measurements. To mitigate this, the diameter of the body column was measured, although these measurements should be taken with caution, as expansions and contractions of the body wall can change the measured value (Angeli et al. 2016).

Specific dimensions weren't measured for some taxa, either because they were viewed as redundant or because they weren't viable. For sea anemones and tunicates, width was recorded but length was not. As their body shapes resemble that of a cylinder, length and width would both measure the same diameter; for sea anemones, this would equate to repeated measurements of the body column diameter. For tunicates it would represent repeated measurements of the body diameter. To avoid redundancy of data, only one measurement was taken.

Height was not measured for most of the taxa due to the nature of the images taken with the ROV. In order to measure the height when possible, the ROV would need to be angled perpendicular to the surface the individual is on (i.e., either a cliff wall or the ocean floor). Additionally, there are operational risks associated with positioning the ROV flush against the surface to allow an accurate measurement, such as potential damage to the ROV or incidentally disturbing the local environment.

2.5 Data Analysis

Once footage was annotated, BIIGLE data was compiled within Microsoft Excel. Taxonomic data obtained from the ponar grabs and dredges were also sorted within Excel, and taxa per site was tabulated. Graphical figures were created in R (Version 4.4.3), using ggplot2 (Wickham 2016) within the tidyverse package (Wickham et al. 2019).

3.0 Results

3.1 ROV Observed Fauna

Across the nine sites sampled, 47 faunal taxa were identified, 17 of which were identified to genus or species level (Appendix C). Nine phyla were observed across the sites, with Chordata being the most diverse (12 taxa) and Bryozoa being the least prominent (1 taxon) (Figure 4). Of the observed sites, East Thomson Island 1 was the most diverse, with 27 different associated faunal taxa, while West Buff Island and Guillemot Island were the least diverse, with only three observed taxa at each site. The diversity of fauna observed is represented in (Figure 4; Figure 5). Within this study, six unidentified morphospecies were observed.

At East Thomson Island 2, limited footage was taken as a result of water currents, most of which captured the pelagic zone with only 16 seconds captured in the benthic zone. As a result, this footage was largely excluded from the analyses presented in this study. While observations made at this site are still valuable, taxonomic comparisons likely do not provide an accurate depiction of the site diversity, and it is possible that the footage does not accurately show the dominant habitat characteristics.

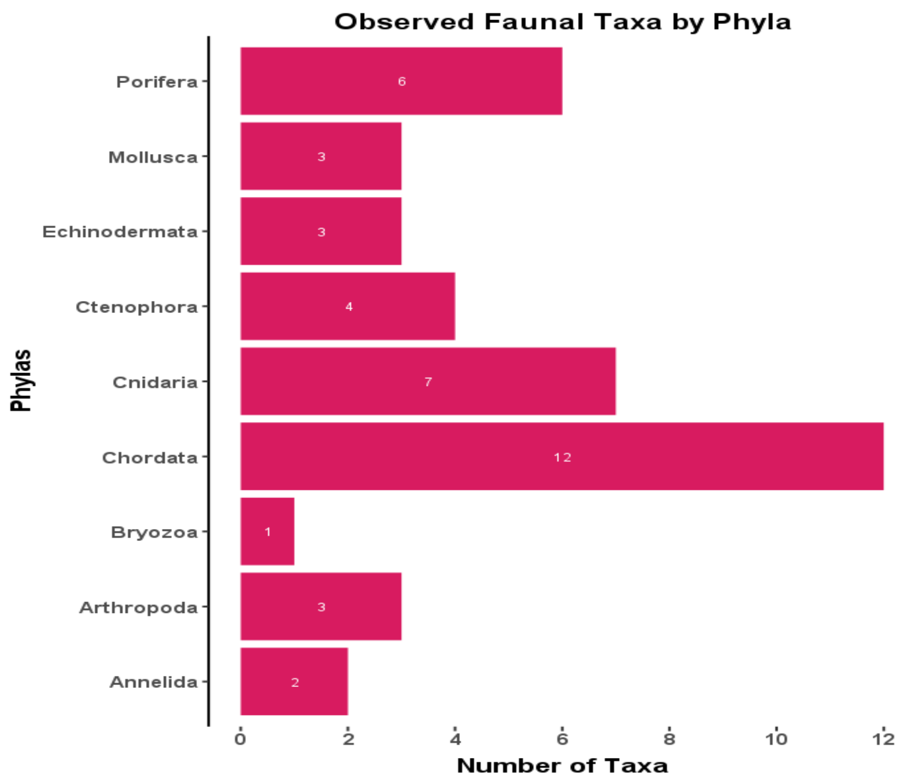

Figure 4. The number of faunal taxa observed in each phyla using ROV footage gathered in July 2023 and 2024 around Rankin Inlet.

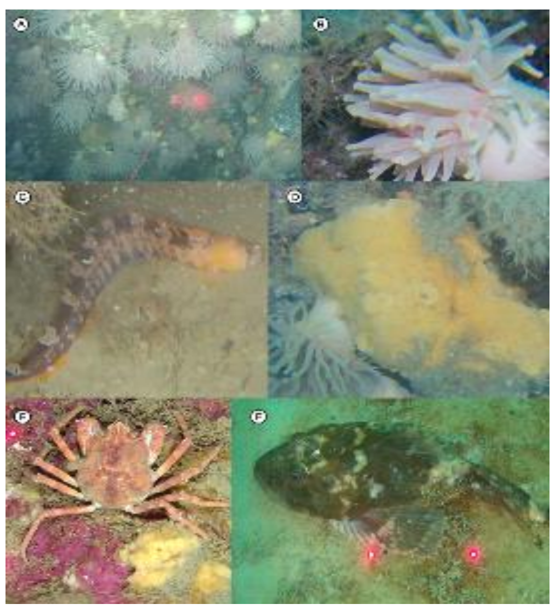

Figure 5. A composite of selected fauna observed in this study. 4A) cliffside covered in sea anemones at Panorama Island, 4B) close-up of *Urticina* sp. from East Thomson Island 1, 4C) banded gunnel (*Pholis fasciata*) from East Thomson Island 1, 4D) encrusting sponge, *Demospongiae* sp. 1 from East Thomson Island 1, 4E) Origoniidae crab from Panorama Island, 4F) shorthorn sculpin (*Myoxocephalus scorpius*) from South Buff Island. Note: The bright light from the ROV appears to wash out the colour bands on the tentacles of *Urticina* sp.

3.1.1 Annelida (segmented worms)
Two annelid taxa were observed, with the genus *Chone* occurring in East Thomson Island 1 and Panorama Island (Figure F1), and Sabellidae found at West Falstaff Island. Individuals identified as Sabellidae were unable to be identified further due to poor image quality.

3.1.2 Arthropoda (crustaceans)
Three taxa of arthropods were identified, with crabs, Oregoniidae, being observed across all sites (Figure F2), with the sole exception of Guillemot Island, where no arthropods were observed. Based on known distributions, there are four possible species the Oregoniid crabs may be: *Hyas araneus*, *H. alutaceus*, *H. coarctatus*, or *Chionoecetes opilio(Hjelset et al. 2021; Dahle et al. 2022)*. While they look very similar as larvae, they are easily identified as mature individuals. Despite this, to prevent misidentifications from poor camera angles or visibility, Oregoniid crabs were only identified to family level. Barnacles of family Balanidae were observed attached to the boulders and rock structures of East Thomson Island 1 (Figure F2). Barnacles were observed in clumps of roughly six individuals?, although they were often occluded by surrounded fauna, such as mats of hydrozoans, or the tentacles of sea anemones. Additionally, a taxon of arthropods were observed with a body shape similar to that of numerous zooplanktonic arthropod taxa, including amphipods and copepods. Unfortunately, since they appeared only briefly in the footage, and the footage could not be magnified, a more detailed identification could not be performed on these individuals (Appendix F13).

3.1.3 Bryozoa (moss animals)
At East Thomson Island 1, members of a taxon classified as an unidentified morphospecies (Cf. Cheilostamtida) were observed among the hydroid mats of the cliffside (Section 3.1.10). Further, at this site, individuals of *Flustrellida hispida* were observed on strands of filamentous algae and mat forming individuals (Cf. Bryozoa). These members were not clearly visible; however, characteristics were identified, such as their appearance in clumps and small distinct zooids.

3.1.4 Chordata (vertebrates and tunicates)
Chordata was the most diverse phylum among the study sites, with 13 identified taxa. Three tunicate taxa were observed, two could not be identified past Ascidiacea (Figure F4). Individuals from the taxon Stolidobranchia were observed in multitudinous quantities across East Thomson Island 1, Panorama Island, and South Buff Island, and were observed colonially or as isolated individuals. The shape of these individuals resembled *Halocynthia pyriformis*; however, the exact identification could not be provided, as numerous other species have a similar appearance. In addition, an unidentified morphospecies (Cf. Ascidiacea) was observed on the cliff face of Panorama Island (Section 3.1.10, Figure F8).

The remaining chordate taxa were fish, five were identified to genus or species level: *Gadus ogac* (Greenland cod), *Myoxocephalus scorpius* (shorthorn sculpin), *Triglops* sp., *Lumpenus fabricii* (slender eelblenny), and *Pholis fasciata* (banded gunnel; Figure F5). Further, a sculpin of family Cottidae was observed but, due to its obscuring position, it could not be fully identified. Additionally, an individual that resembled *Lumpenus* sp. was observed but due to poor image quality and obscuring position, it could not be positively identified as genus level. Schooling fish were observed in the pelagic zone of East Thomson Island 1; however, the ROV was too far away to accurately identify them. These unidentified forage fishes are likely to be either Arctic cod (*Boreogadus saida*) sandlance *Ammodytes sp*. and/or capelin (*Mallotus villosus*) since all three taxa may be present during the ice free period.

3.1.5 Cnidaria

Seven taxa of Cnidarians were found across the sites, including three taxa of sea anemones: *Urticina* sp., *Hormathia* sp., and Actiniaria (Figure F6). At East Thomson Island 1, Panorama Island, and South Buff Island, large quantities of *Urticina* sp. and Actiniaria were observed attached to the cliff walls. At East Thomson Island 1, the sea anemones were so numerous that they covered large portions of the cliff faces (Figure 6). In addition, an unidentified morphospecies (Cf. Actiniaria) was observed on the cliff face of East Thomson Island (Section 3.1.10, Figure F11).

Figure 6. The cliffside of East Thomson Island 1, where many sea anemones can be found attached to the rocks.

Across the Panorama Island and South Buff Island, large quantities of class Hydrozoa were observed. These were large and extensive mats of hydrozoans that covered large portions of cliff faces and the ocean floor, although they could not be identified further due to a lack of observed physical detailing. One observed taxa was discerned from class Hydrozoa, to the order Leptothecata, occurring at East Thomson Island. This taxa comprised large obscuring mats across either the ocean floor, or the rock walls and boulders of the area. One pelagic genus of hydrozoan, *Sarsi* sp., was observed across Melvin Bay, East Thomson Island 1, and South Buff Island. Another pelagic taxa of hydrozoan, unable to be more accurately identified, was identified at the Barrier Islands and Guillemot Island.

3.1.6 Ctenophora (jellies)
Four taxa of pelagic comb jellies were observed, three of which were able to be identified to species level: *Beroe cucumis*, *Mertensia ovum*, and *Bolinopsis infundibulum* (Figure F7). These individuals were distinguished from each other through the presence/absence of tentacles, and the length of said tentacles. *M. ovum* was the most observed comb jelly in this study, having been observed across all sites except East Thomson Island 1 and West Falstaff Island. In particular, *M. ovum* was present at the Barrier Islands site, drastically outnumbering the additionally observed *B. infundibulum*. They were also found in large numbers at South Buff Island, although they were notably fewer than at the Barrier Islands.

3.1.7 Echinodermata (sea stars)
Of the four echinoderm taxa present, three of them were sea stars. Unfortunately, one sea star was hidden in the crevice of a cliffside, and could not be clearly observed and identified. A member of an unidentified morphospecies (Cf. Asteroidea) was observed among the sands of East Thomson Island 1. A single member of genus *Henricia* was observed on the cliff face of Panorama Island, although it could not be further identified. An additional member of genus *Henricia* was seen in the sands of South Buff Island. The last taxon found was the sea cucumber genus *Psolus*, but similarities between *P. fabricii* and *P. phantapus* prevented any further identification.

3.1.8 Mollusca (bivalves)
The genus *Mya* was observed across three sites (Melvin Bay, Barrier Islands, West Falstaff Island), often in colonies. Whenever *Mya* sp. was observed, they were observed in large quantities. A single member of family Pectinidae was observed at West Buff Island, and the shell of another was found at East Thomson Island 1, although it was presumed dead. Moreover, the ocean floor around East Thomson Island 1 was littered with shell hash from numerous bivalves, and it was impossible to discern shell hash from living specimens due to shell hash density.

3.1.9 Porifera (sponges)
Of the six poriferan taxa observed, two were identified to Demospongiae, one of which was an orange encrusting sponge, and another was an encrusting yellow sponge. Additionally, one sponge was identified to Axinellida. The remaining three taxa were all observed exclusively at Panorama Island. Due to the variety of forms that sponges can take, even within a species, along with a lack of information on nearshore sponges in Hudson Bay, we were unable to identify these four taxa further.

3.1.10 Unidentified species
Throughout this study, six unidentified morphospecies were observed. They can be found in Appendix B, where they are classified within BIIGLE, and Appendix C, stating where they were observed. Additionally, Appendix F contains reference photos of the unidentified morphospecies. This section will categorize them in order of appearance within this paper:

- Unidentified species 1 had a moderately spherical shape with minor translucent properties, and was observed on strands of filamentous algae and mat forming individuals (Cf. Bryozoa) at East Thomson Island 1. It is unclear if these individuals were egg masses, sponges, or members of class Ascidiacea (Appendix F3).

- Unidentified species 2 is a taxon that resembled the Bryozoan order Cheilostomatida. Members of this taxon appeared in long filamentous strands. These were finely branched structures with short tips at each branch. Members of this taxon were found at East Thomson Island 1 (Appendix F4).
- Unidentified species 3 resembled individuals from phylum Bryozoa, although proper classification was not feasible due to poor image quality. Members of this taxon had short filamentous strands with short tips at the end of each strand, and they were found at both Melvin Bay and East Thomson Island 1 (Appendix F3).
- Unidentified species 4 resembled class Ascidiacea, although there were few identifiable features visible. Individuals in this taxa were found at Panorama Island and were found entirely occluding large segments of cliff face. These individuals were small and colonial, and they appeared as small spheres of a grey colour that resembled the cliff face (Appendix F8).
- Unidentified species 5 was found at East Thomson Island, and had some similarities to anemones of order Actiniaria. The top surface of this individual was disc-shaped, with small tentacles on the outer edges of the disc. It is possible this individual was a juvenile sea anemone with few identifiable characteristics available (Appendix F11).
- Unidentified species 6 was found in the sands of East Thomson Island 1. It was a large individual that was only visible at the edge of the video frame, and there was substantial distance between the ROV and this individual when observed. This individual was rather large, and appeared to have numerous arms indicative of sea stars. Further identification could not be determined, due to insufficient footage (Appendix F12).

3.2 ROV Observed Flora

Across study sites, eight algal taxa were identified, as well as four functional groups (Figure 7). Of the eight taxa, seven were identified to at least genus level. The four functional groups included: Brown Filamentous Algae, Brown Foliose Algae, Red Filamentous Algae, and Red Foliose Algae. Of these, the brown algal groups were common among the majority of sites, whereas the red filamentous group was only found at East Thomson Island 1, and the foliose group was only found at West Buff Island. The remaining taxon, coralline algae, was identified to the order Corallinales. When found, coralline algae often covered large portions of cliff faces and boulders.

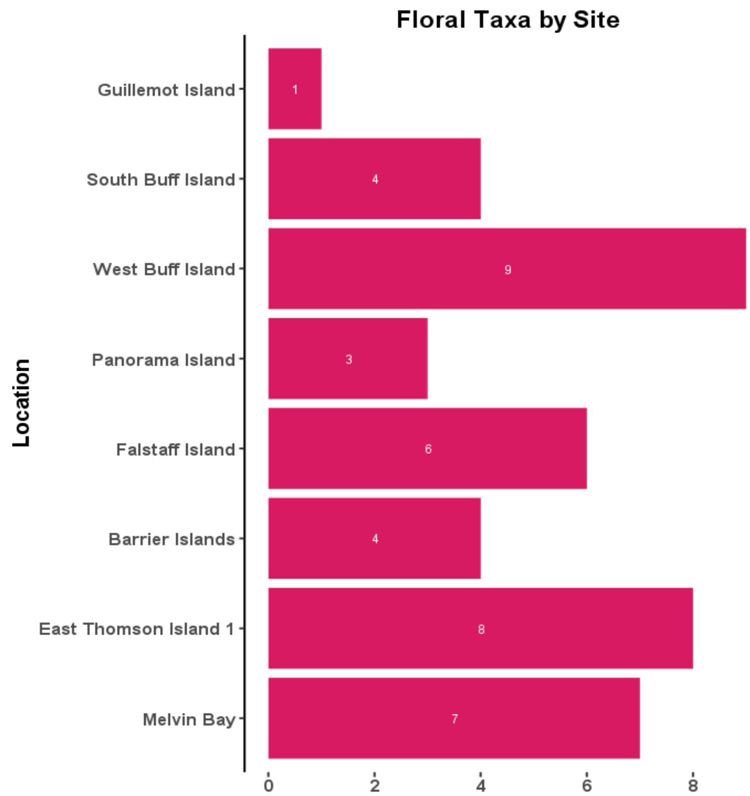

Figure 7. The floral taxa, including functional groups, observed at each site around Rankin Inlet.

Desmarestia, a genus found among four of the sites (Melvin Bay, Thomson Island Falstaff Island and Buff Island), could not always be differentiated between the two northern species, *D. aculeata* and *D. viridis*. For sites where both species were present and but could not be identified past genus level, the genus level label was determined redundant and was excluded. In contrast, fucoid algae were observed at every site except Guillemot Island, but could not be identified past the genus *Fucus*, due to similarities between different species. The Barrier Islands and South Buff Island had an especially high number of fucoids, with large mats covering the ocean floor.

Sugar kelp (*S. latissima*) and rockweeds, *Fucus* sp., were overall the dominant macroalgal taxa observed, with sugar kelp being observed at every study site, while rockweeds were only found at seven of the eight sites (Table C2). The kelp species *A. clathratum* was observed at half the study sites (Table C2), although it was not usually observed in large quantities. In contrast, *S. latissima* was observed at every site studied, and usually in large clumps. In particular, West Buff Island had a dense population of *S. latissima* that covered most of the benthic floor.

3.3 Faunal Measurements

Using the onboard scaling lasers, 20 different individuals belonging to 6 different taxa were measured in this study (Table 4). Most of the crabs had their lengths and widths measured, although occasionally the length could not be measured due to the lack of proper perspective. West Falstaff Island and West Buff Island had less individuals overall, with even less individuals in a good position to be measured. In contrast, most individuals were measured between

Panorama Island and South Buff Island, as the cliff faces contained large hubs of individuals. Panorama Island contained most of the crabs and all of the sea anemones, and South Buff Island contained all four tunicates. While comparisons between sites are limited due to low sample counts from the non-dominant sites, trends can still be assessed between individuals measured at Panorama Island and South Buff Island from the dominant measured taxa.

Table 4. A list of all the measured dimensions of the examined individuals, as well as the location (NV = Not a viable recording from the ROV).

Site	Individual	Length (cm)	Width (cm)	Height (cm)
West Falstaff Island	Oregoniidae	8	6.9	NV
Panorama Island	*Henricia* sp.	8.5	NA	NV
	Oregoniidae	7.3	6.1	NV
	Oregoniidae	5.8	5.4	NV
	Oregoniidae	6.6	4.7	NV
	Oregoniidae	NV	6.9	NV
	Oregoniidae	6.2	5.1	NV
	Urticina sp.	NA	4.4	NV
	Urticina sp.	NA	11.1	NV
	Urticina sp.	NA	8.1	NV
	Urticina sp.	NA	9.3	NV
	Urticina sp.	NA	10.1	NV
West Buff Island	Pectinidae	5.1	NV	5.5
	Oregoniidae	NV	4.6	NV
South Buff Island	Stolidobranchia	NA	5.4	NV
	Stolidobranchia	NA	4.5	NV
	Stolidobranchia	NA	4.0	NV
	Stolidobranchia	NA	4.4	NV
	Oregoniidae	5.4	4.5	NV
	Myoxocephalus scorpius	37.7	8.9	NV

Across the five crabs measured at Panorama Island, the mean length was 6.5 cm, with the mean width being 5.6 cm. One crab observed at West Falstaff Island was the largest, and likely the most mature crab among all measured individuals. In contrast, the two crabs viewed across West and South Buff Island were much smaller than the average size at Panorama Island, indicating these might have been younger and less developed.

Among the four stolidobranchian tunicates that were measured, the average width was 4.6 cm. Across the five sea anemones measured, the average width was 9.7 cm. One sea anemone was believed to be an immature individual, and in turn, was excluded from further analyses to prevent size distortions when comparing against adult speciments.

3.4 ROV Substrate and Vegetation

Across sites, different substrate compositions affected the cover of macroalgal vegetation, with areas of soft sedimentation having very little vegetation (Tables 5 and 6), and areas of hard substrate having higher vegetation cover. Three of the study sites had cliff faces within them, although while they provided a hard surface for macroalgae to attach to, they were often occluded by invertebrates, preventing much macroalgae from taking hold. South Buff Island was the only site with a large population of macroalgae growing on the cliff face. In regions of these sites without cliffs present, the benthic floor was predominately soft substrates similar to most other sites Appendix D2). A lack of hard surfaces prevented much macroalgae from growing, leading to predominately lower vegetation cover across these sites. West Buff Island was unique among these sites, as it was the only site where coarse sediment was found. Small rocks, present at the site, created a firm surface for macroalgae to attach creating a larger vegetation cover at this site compared to others.

Table 5. Substrate categories observed at each study site.

	Melvin Bay	East Thomson Island 1	Barrier Islands	West Falstaff Island	Panorama Island	West Buff Island	South Buff Island	Guillemot Island
Coarse Sediments						Y		
Hard Substrate		Y			Y		Y	
Soft Sediments	Y	Y	Y	Y	Y	Y	Y	Y

Table 6. Macroalgal percent cover at each study site.

	Melvin Bay	East Thomson Island 1	Barrier Islands	West Falstaff Island	Panorama Island	West Buff Island	South Buff Island	Guillemot Island
0-1% Cover	Y	Y	Y	Y	Y		Y	Y
1-25% Cover	Y	Y	Y	Y	Y		Y	Y
25-50% Cover	Y		Y			Y	Y	
50-75% Cover						Y	Y	
75-100% Cover						Y	Y	

3.5 Benthic Grabs and Dredges

A large variety of benthic infauna were collected in 2023 through a series of ponar grabs and dredges deployed in Melvin Bay, Thomson Island and the Barrier Islands. In Melvin Bay, the dredges and ponar grabs obtained the widest variety of invertebrate taxa, with a total of 34 different taxa obtained (Table 7), followed by Thomson Island with 25, and the Barrier Islands with 16 (Figure 9). In Melvin Bay, the dredge was able to obtain more instances of samples and a greater abundance of individuals overall than the benthic grabs; however, in Thomson Island and Barrier Islands, the dredge was unable to catch many individuals, with the ponar grabs consistently having more instances of samples, and a larger abundance of individuals overall (Table 7).

Three phyla were sampled in this study using both benthic dredges and ponar grabs (Figure 8). Arthropods were the dominant phyla caught, with the exception of Thomson Island, where the dominant phyla were molluscs (dredge) and annelids (ponar grab). Most of the arthropods caught were amphipods, while the annelids and molluscs were more evenly distributed among orders (Appendix A). Across all sites, a total of 49 different taxa were identified, with 35 identified to at least genus level. One taxa in particular, "Polychaeta (severed parts)" was a catch-all which encompasses polychaetes that could not be identified further, due to a lack of characteristic body parts. Each taxa's presence varied among sites, as 26 taxa were only caught at one site, 20 taxa at to two sites, and 3 found among all regions (Appendix A). The three taxa caught at each region were: "Polychaeta (parts)", *Pontoporeia femorata*, and the polychaete family Nephtyidae. A complete list of invertebrates caught at each site, along with their accompanying mass and counts are listed in Appendix A. Across the three study sites, physical samples were able to match or outperform ROV identifications (Figure 9), although they appear limited to only annelids, arthropods, and molluscs.

Table 7. Method used for each site, divided into phyla caught, the number of times they were sampled, and the abundance of individuals across the samples. Unique taxa are outlined for each site.

Method	**Site**	**Phylum**	**# of times sampled**	**Abundance Across Samples**	**Number of Unique Taxa**
Dredge	Melvin Bay	Annelida	9	13	34
		Arthropoda	8	53	
		Mollusca	10	22	
Benthic Grab	Melvin Bay	Annelida	6	30	
		Arthropoda	12	38	
		Mollusca	0	NA	
Dredge	Thomson Island	Annelida	0	NA	25
		Arthropoda	1	1	
		Mollusca	4	5	
Benthic Grab	Thomson Island	Annelida	11	24	
		Arthropoda	8	9	
		Mollusca	4	4	
Dredge	Barrier Islands	Annelida	1	1	
		Arthropoda	3	8	16
		Mollusca	1	2	
Benthic Grab	Barrier Islands	Annelida	9	13	
		Arthropoda	9	21	
		Mollusca	0	NA	

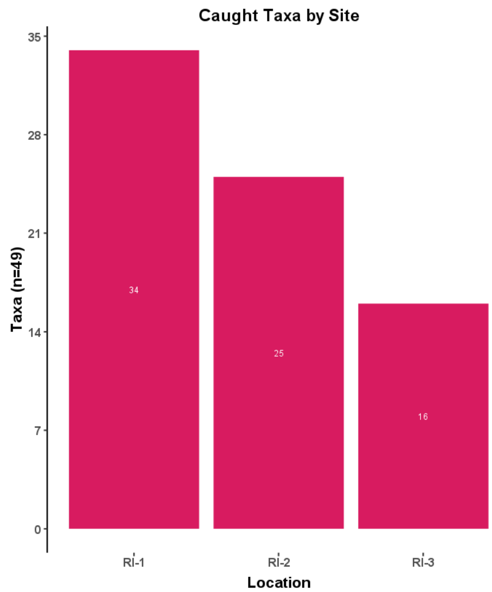

Figure 8. The number of taxa caught in dredges and ponar grabs at the three study sites in 2023 (RI-1=Melvin Bay, RI-2=Thomson Island, RI-3=Barrier Islands).

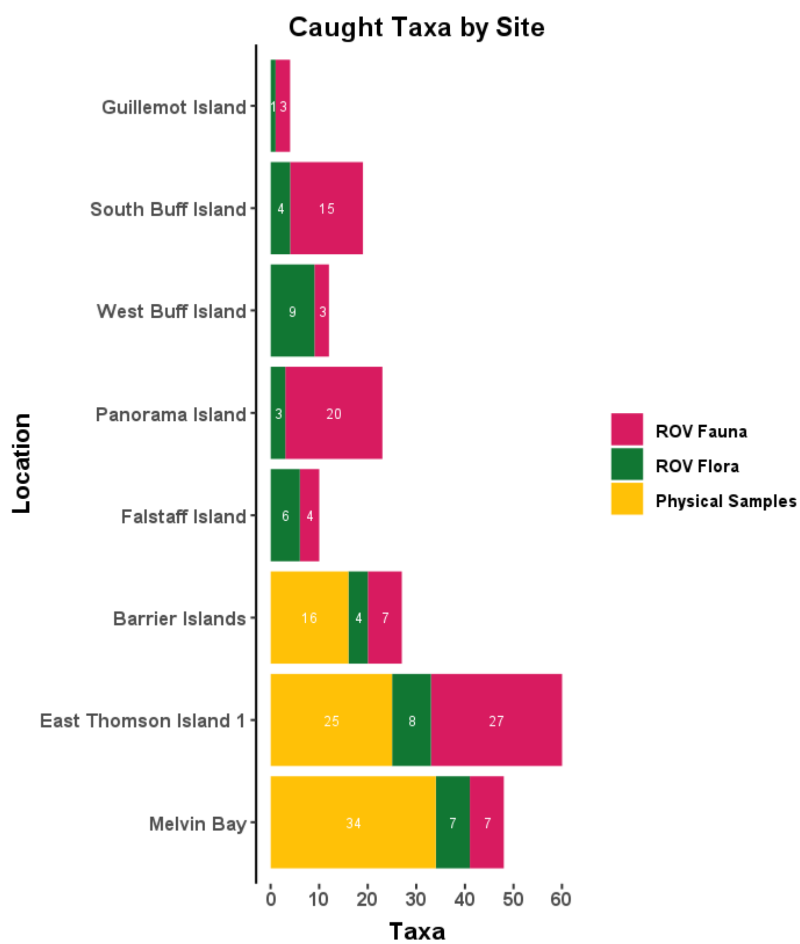

Figure 9. Number of taxa identified from benthic grabs and dredges, and the ROV in July 2023 and 2024.

3.6 Sites

Each site shared similar features, although they could be further identified by unique habitat characteristics. Different depths and temperatures were recorded for each site. Across sites, the temperature was often low (≤ 5°C; Table 8), although the maximum depth at each site varied greatly. This is exemplified by Panorama Island, where the max depth was 42.0 m and the temperature diminishing to 0°C (Table 8).

Table 8. The video footage start-time, temperature and depth for each site.

	Date	Start-Time	Temperature Range (°C)	Max Depth (m)
Melvin Bay	July 19 2023	10:37 AM	NA	9.7
East Thomson Island 1	July 19 2023	1:25 PM	NA	29.9
Barrier Islands	July 20 2023	10:57 AM	5 – 7	8.8
West Falstaff Island	July 18 2024	10:00 AM	2 – 3	13.1
East Thomson Island 2	July 18 2024	12:37 PM	3	~27*
Panorama Island	July 19 2024	8:27 AM	0 – 5	42.0
West Buff Island	July 19 2024	9:53 AM	4 – 6	10.7
South Buff Island	July 19 2024	10:17 AM	1 – 4	30.2
Guillemot Island	July 19 2024	11:16 AM	3	11.0

*~ = approximate value.

3.6.1 Melvin Bay

This site was largely a soft sedimented desert, with little macroalgae and invertebrates to be found (Figure D1). Various boulders littered the ground, each covered in a soft sedimentation mat supported either by filamentous algae or varying hydroid mats, providing the necessary hard surfaces that macroalgae need in order to attach and grow. While seven taxa of macroalgae were observed, their presence was scant, limited by poor substrate conditions. Shells present in the area could not be discerned as either living or shell hash due to their occlusion by the sediment; therefore, these were not included in species counts. Most faunal taxa observed in Melvin Bay were pelagic in nature. Two species of comb jelly were observed, the common northern comb jelly (*B. infundibulum*) and the Arctic comb jelly (*M. ovum*), along with *Sarsi sp*., a genus of pelagic cnidarians. Further, several Greenland cod were seen swimming at this location.

3.6.2 East Thomson Island 1

This site had substantially more faunal diversity observed with the ROV when compared to all other sites examined. In addition, this site was the second most diverse among benthic infauna and epifauna from the dredges and ponar grabs. This site featured a large cliffside covered in coralline algae, hydrozoans (Leptothecata), sea anemones, and an encrusting sponge (Demospongiae).

Despite being sparsely populated with macroalgae, this site contained the most diverse variety of macroalgae when compared to the other study sites. Dead mussel shells, known as shell hash, covered the benthic floor in large quantities (Figure 10). Due to the higher number of shells, it was not possible to distinguish between living and dead specimens, preventing addition to the species count. Notably, in addition to the site's soft sediments, the shell hash did not create an environment that was suitable for macroalgae. Boulders were scattered throughout the shell hash, providing opportunities for macroalgal growth, as well as places for coralline algae and barnacles to grow.

Figure 10. ROV from East Thomson Island 1 showing the ocean floor covered in shell hash (July 19th, 2023).

3.6.3 Barrier Islands

The substratum of the Barrier Islands was not favourable to a diverse macroalgal assemblage (Figure D1). The soft sedimentation and limited rocky terrain did not provide the physical conditions necessary for macroalgae to attach to. The several boulders were often covered in soft sedimentation mats, and like Melvin Bay, these mats were supported by either filamentous algae or hydroid mats. However, a large steep hill where the ocean floor met the coastline created a jagged and slightly rocky terrain, which promoted the presence of various macroalgae in the area.

The faunal assemblages were more varied, although their abundances were limited. While several crabs were seen throughout the site, only one tunicate (Ascidiacea sp.) was observed. Similarly, while Bivalvia were present at the site, very few specimens were observed throughout the benthos. In contrast, the soft-shell clams, *Mya* sp., were abundant throughout this site, littering the desert-like environment with their sediment holes (Appendix F9). The temperature at this site was the highest recorded, likely because it was also the shallowest of the sites sampled (< 9 meters).

3.6.4 West Falstaff Island

The biota around West Falstaff Island was largely limited by site characteristics (Figure D1). The substratum was comprised of soft sedimentation; however, boulders and larger stones were found around the site, which provided ideal habitat for macroalgal aggregation. As such, this site had one of the most diverse sets of macroalgae found among all eight sites despite them typically being clustered around small rock groupings with the rest of the site remaining barren. Detritus was plentiful among the barren portions at this site. Similarly, this site contained many instances of shell hash, although it was not in any quantities near what was observed at East Thomson Island 1.

Unlike the macroalgae, the fauna at this site were severely reduced. Only four taxa were found throughout the site, one of which was the shorthorn sculpin, (*M. scorpius*). It is currently unclear why this site had a low variety of fauna, but it is likely related to a lack of macroalgal food sources and shelter. The small areas of high macroalgal variety likely weren't large enough to offset the disadvantages their absence created.

3.6.5 East Thomson Island 2

Information regarding this site is limited, as there are only 16 seconds of benthic footage recorded. Within the footage, no fauna were observed, and the only flora found was *S. latissima*. The substratum of this site was entirely softly sedimented, with small boulders seen throughout (Figure D4).

3.6.6 Panorama Island

Panorama Island contained the second most diverse assemblage of fauna across all eight study sites, although it also contained the second least diverse assemblage of macroalgae. This site featured a large cliff face, similar to Thomson Island, which provided a strong habitat for a large variety of invertebrates, such as tunicates, crabs, cnidarians, Echinoderms, and sponges (Figure D2). Away from the cliff side, the site descended to the deepest point among any of the study sites, down to 42 m. At these depths, the ocean floor was more barren and highly sedimented, creating large clouds reducing visibility when the ROV approached the ground. As such, there was significantly reduced diversity, as the habitat became increasingly less productive.

Most of the macroalgae that were observed defied expectation, as instead of being attached to the rocky cliff side, they were largely found within the soft sediment of the benthic floor. It's possible that the lack of macroalgae on the cliff face is due to a lack of available space, as cliff surface area was primarily occupied by sea anemones and hydrozoan mats, or else encrusted with coralline algae and sponges. This site reached the coldest temperature recorded among all sites (0°C), likely because it was also the deepest site sampled at 42.0 m.

3.6.7 West Buff Island

This site was a flat zone of predominantly soft sediment, however the coarse sediment also found at this site allowed a large variety of macroalgae to be present in the largest assemblages seen across all sites (Figure D3). Macroalgal cover at this site was consistently very high, and was dominated by sugar kelp, (*S. latissima*).

Interestingly, despite the high macroalgal cover and diversity, the benthic fauna diversity observed at this site was slim. Only three faunal taxa were observed, with one of them, the Arctic comb jelly, (*M. ovum*), being pelagic in nature. Another, the bivalve taxa Pectinidae, was observed only once.

3.6.8 South Buff Island

South Buff Island had an entirely different environment to that of West Buff Island. This site had a cliff face that provided habitat for numerous different invertebrates, such as the large quantity of tunicates found, various cnidarian taxa, and sponges (Figure D2). Away from the cliffside, the benthic floor was softly sedimented, lacking any biota.

The majority of the observed macroalgae were found on the cliffside of South Buff Island. Unlike Panorama Island, this cliffside contained large quantities of sugar kelp (*S. latissima*), and sieve kelp, *A. clathratum*. On the benthic floor however, the barren ground did not provide much opportunity for macroalgal growth, and was mostly devoid of life altogether. This site also contained the only two instances of garbage found among all the study sites.

3.6.9 Guillemot Island

Observed fauna and flora was sparse at this site (Figure D1). No benthic invertebrates were observed at this site. However, 3 pelagic taxa were observed: a sculpin (*Triglops* sp.), a pelagic hydrozoan, and a pelagic comb jelly.

Only one taxon of macroalgae was found; sugar kelp (*S. latissima*). This is likely due to the soft sedimentation desert-like environment of the site, where there were few opportunities for macroalgae to attach and grow.

Note that the lack of observations at this site may be due to reduced footage time (7.7 minutes) compared to other sites. Of the time spent at this site, much of it was spent in the pelagic zone, severely limiting the ROV's ability to observe benthic individuals.

4.0 Discussion

4.1 Fauna and Flora Observations

This study summarizes baseline data on coastal benthic habitat and community composition in order to address knowledge gaps relevant to Rankin Inlet and, more broadly, western Hudson Bay. Benthic macroalgae were not common at most sites, likely due to a lack of adequate substrate conditions. Macroalgae tend to require hard surfaces to attach their holdfasts to, which was often unavailable in the soft sediment biomes found in our study (Hamm and Humm 1976; Coutinho and Seeliger 1984; Middelboe et al. 2002). Numerous invertebrate and fish taxa were observed from areas of depths between 9.7 and 42.0 meters. Using the ROV, 47 faunal taxa were identified, with 17 identified to at least genus level. Dredges and ponar grabs provided insight into 49 benthic taxa, of which 35 were to at least genus level. One taxon, the soft-shell clam genus, *Mya*, was observed in ROV footage and was also caught in the dredges and ponar grabs. Additionally, there may be overlap among the crabs observed by the ROV and the dredges and ponar, as the genus *Hyas* was caught several times, confirming its presence in the area. Evidently, ROV footage and physical sample collection are two complementary processes that reveal different information about the benthic environment and the individuals found within it.

This was the first field season among Arctic Coast programs that included scaling lasers, which allowed individual organisms to be measured from the video footage. Scaling lasers equipped to the ROV allowed the development of a protocol designed to measure the size of different faunal individuals, which was not possible with video footage alone (Kozakewich et al. 2024). A shorthorn sculpin (*Myoxocephalus scorpius*) was measured at South Buff Island, and was found to be approximately 38 cm long. Average lengths can change among locations, and the co-occurring fourhorn sculpin reaches a similar size (*Myoxocephalus quadricornis*), yet these measurements help to rule out smaller Cottidae species. Several sea anemones of genus *Urticina* were measured, with an average column diameter of 9.7 cm. Normal lengths for this species are around 9-10 cm(Mercier et al. 2017). While these measurements cannot confirm any identifications made, they are able to reduce the chances of a misidentification.

Crabs observed within the ROV footage could have been either spider crabs (*Hyas* sp.), or snow crabs (*Chionoecetes opilio*). The *Hyas* genus is common within Hudson Bay, and *C. opilio* can be found along the northwest coast of Newfoundland and Labrador, but their distribution in Hudson Bay is limited (GBIF 2025b). While unlikely, the geographic distribution of *C. opilio*, alongside the absence of available information for nearshore environments within Hudson Bay create a degree of uncertainty towards its presence in Hudson Bay. Mullowney et al. (2012) reports an average carapace length for males and females of *H. coarctatus* as 95 mm and 81 mm respectively. Similarly, Dvoretsky and Dvoretsky (2022) reports an average carapace width for *H. araneus* of around 60 mm, with a carapace length ranging from 41.0-78.8 mm. In contrast, (Mullowney et al. 2012) reports an average carapace width of 150 mm and 95 mm for *C. opilio* males and females respectively. Comparing those values to the measurements reported in this study, are consistent with the carapace sizes that align with published values for spider crabs, it is likely that the observed individuals were of genus *Hyas*.
The measured stolidobranchian tunicates resembled Sea Peaches (*Halocynthia pyriformis*), although no confirmations could be made. Unfortunately, size measurements for tunicates are less valuable, as physical dimensions are not as indicative of growth as individual mass is (Lee et al. 2020).

Ponar grabs and benthic dredges were deployed across three different regions (Barrier Islands, Melvin Bay, and Thomson Island), catching 75 identified taxa. While the ponar grabs had consistent catch efforts, the number of individuals caught in the dredges was only high at Melvin Bay. The variation in catches is likely due to differences in the substrates among the sites. The substrate here was much more conducive to dredges than other sites, likely indicative of a soft sediment substrate where the dredge did not catch on rocks or other objects that may interfere with its sampling productivity. Additionally, the dredge caught members from all three phyla observed, while the ponar grabs did not catch any molluscs. In contrast, substantially more individuals were caught with ponar grabs at Thomson Island and the Barrier Islands. Both methods were successful in catching large quantities of individuals, and while dredges benefit from sampling a larger area, they also disturb more of the benthic surface, while potentially catching fewer individuals in the process. Ponar grabs, however, are able to effectively sample a small area while disturbing little habitat outside their grab, although may not be as effective in capturing organisms such as molluscs.

4.2 Project Considerations

The benefits of non-invasive ROV footage cannot be understated; however, it does come with limitations that are not applicable to other sampling methods. Since capturing ROV footage does not disturb the benthic environment, there is minimal concern about habitat disruption or disturbance and alteration.

Conversely, an ROV cannot gather data on infaunal invertebrates such as annelid worms that live within the sediment and are not visible. Physical samples from the benthic environment provided an approach to confirm species based on specimens obtained from the substratum that could not be identified from video footage alone. In addition, ROV footage cannot obtain finer details of an individual's morphology. Characteristics, such as hydrozoan shape and structure, become entirely lost with video footage, preventing accurate identification. Bivalves are another taxa that are notoriously difficult to identify from video footage, as their shape and structure require careful observation, and often tactile examination for proper identification, which cannot currently be completed with an ROV. Moreover, ROV footage is difficult to standardize for anything other than presence and absence studies. The inability for a small ROV unit, such as the FIFISH, to travel on set transect lines for a set distance limits the potential for consistency between sites, and prevents the opportunity to collect abundance information. Additionally, the current at individual sites is different, which further affects the ability of the ROV operator to keep site footage consistent. It is useful for the ROV operator to linger on individuals and unique characteristics that are important to the site or otherwise need more footage to ensure a proper angle for identification. With the addition of scaling lasers, it becomes even more useful for the operator to linger on individuals to ensure they can be accurately measured.

4.3 Recommendations for Further Study

This study has provided useful insights into ROV use and how it can be applied in future studies. As such, this paper suggests the following to optimize future ROV studies, as well as how it can be utilized to improve physical sampling efforts:

1) A transect should be performed using the following practices:
    a) The path travelled is standardized to a set distance across all sites;
    b) The path travelled is as similar as possible between sites; and
    c) The time spent performing each transect should be standardized, as much as possible but taking into account currents and ocean topographical differences among sites.
2) While a transect allows for more standardized procedures and abundance studies to be performed, it does not allow for easy identification of various invertebrates. As such, time may be allotted to allow the operator to explore the site at their own discretion, providing opportunities for further presence/absence studies;
    a) For studies where transects and exploration time are both performed, the analyses for each should be separated, as the underlying methods are different and create different results.
3) As certain environmental parameters (e.g., wind, presence of ice, temperature) can affect the turbidity, these studies should be performed during periods, when turbidity is lowest.;

4) As currents can have a large impact on the operator's ability to operate the ROV, future studies should be performed when the water is calmest, such as when wind speeds are low, and between tides;
5) To ensure a more diverse and complementary dataset is obtained, sample collection using dredges and/or ponar grabs should be performed in tandem with the ROV footage;
    a) To best ensure an ample data set, multiple samples should be taken per site (and standardized among sites); and
    b) To improve the results of physical sampling, the ROV can be deployed to the ocean floor to determine the environment's substratum, which would assist in determining the most suitable method.

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6.0 References

Amiraux, R., Mundy, C. J., Pierrejean, M., Niemi, A., Hedges, K. J., Brown, T. A., Ehn, J. K., Elliott, K. H., Ferguson, S. H., Fisk, A. T., Gilchrist, G., Harris, L. N., Iken, K., Jacobs, K. B., Johnson, K. F., Kuzyk, Z., Limoges, A., Loewen, T. N., Love, O. P., Matthews, C. J. D., Ogloff, W. R., Rosenberg, B., Søreide, J. E., Watt, C. A., and Yurkowski, D. J. 2023. Tracing carbon flow and trophic structure of a coastal Arctic marine food web using highly branched isoprenoids and carbon, nitrogen and sulfur stable isotopes Ecol. Indic. 147: 109938. doi:10.1016/j.ecolind.2023.109938

Angeli, A., Zara, F.J., Turra, A., and Gorman, D. 2016. Towards a standard measure of sea anemone size:assessing the accuracy and precision of morphologicalmeasures for cantilever-like animals. Marine Ecology **37**: 1019-1026. doi:10.1111/maec.12315.

Christie, H., Andersen, G.S., Tveiten, L.A., and Moy, F.E. 2022. Macrophytes as habitat for fish. Journal of Marine Science **79**: 435-444. doi:10.1093/icesjms/fsac008.

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

Combaz, T., Witte, U., Brown, T.A., and Archambault, P. 2025. Importance of ice algae versus phytoplankton in the diet of megabenthic organisms under contrasting sea ice conditions (Canadian Arctic): a dual biochemical approach (SIA and HBIs). Front. Mar. Sci. **12**. doi:https://doi.org/10.3389/fmars.2025.1574292.

Coutinho, R., and Seeliger, U. 1984. The Horizontal Distribution of the Benthic Algal Flora in the Patos Lagoon Estuary, Brazil, in Relation to Salinity, Substratum and Wave Exposure. J. Exp. Mar. Biol. Ecol. **80**(3): 247-257. doi:10.1016/0022-0981(84)90153-9.

Dahle, G., Sainte-Marie, B., Mincks, S.L., Farestveit, E., Jørstad, K.E., Hjelset, A.M., and Agnalt, A.-L. 2022. Genetic analysis of the exploited snow crab (*Chionoecetes opilio*) in the Barents Sea—possibilities of origin. ICES Journal of Marine Science **79**(9): 2389-2398. doi:10.1093/icesjms/fsac172.

Dvoretsky, A.G., and Dvoretsky, V.G. 2022. Epibiotic Communities of Common Crab Species in the Coastal Barents Sea: Biodiversity and Infestation Patterns. Diversity **14**(1).

GBIF. 2025a. GBIF: The Global Biodiversity Information Facility (2025) What is GBIF? Available from https://www.gbif.org/what-is-gbif.

GBIF. 2025b. Occurrence Download. doi:10.15468/DL.RREZSM.

Government of Nunavut. 2018. Common Fishes of Nunavut. Inhabit Media.

Grégoire, B., Tétreault, A., Caron, L.P., and Nozéres, C. 2022. Visual Dictionary for Analyzing Underwater Images of the Coastal Environment in the Quebec Region.

Gully, K., McNicholl, D., Iacozza, J., and Dunmall, K. 2025. Sea Ice change in the Tarium Niryutait Marine Protected Area 1980-2022. Can. Tech. Rep. Fish. Aquat. Sci. **3685**: vi + 17 p. doi:10.60825/dmzw-we44.

Hamm, D., and Humm, H.J. 1976. Benthic Algae of the Anclote estuary II. Bottom-Dwelling Species. Fla. Sci. **39**(4): 209-229. Available from http://www.jstor.org/stable/24320051.

Hjelset, A.M., Danielsen, H.E.H., Westgaard, J.I., and Agnalt, A.L. 2021. Taxonomic and genetic confirmed findings of snow crab (*Chionoecetes opilio*) larvae in the Barents Sea. Polar Biology **44**(11): 2107-2115. doi:10.1007/s00300-021-02946-w.

iNaturalist. 2025. Available from https://www.inaturalist.org.

Kozakewich, W.M., McNicholl, D.G., Gully, K.R., O'Brien, J.M., and Dunmall, K.M. 2024. An Assessment of Benthic Species Richness and Macroalgal Habitat Near Igluligaarjuk (Chesterfield Inlet), Nunavut, Using ROV Exploration. Can. Tech. Rep. Fish. Aquat. Sci. 3623: viii + 43 p. doi:https://doi.org/10.60825/fk7t-mj52.

Langenkämper, D., Zurowietz, M., Schoening, T., and Nattkemper, T.W. 2020. Corrigendum: BIIGLE 2.0 - Browsing and Annotating Large Marine Image Collections [Correction]. Frontiers in Marine Science **7**. doi:10.3389/fmars.2020.617268.

Lee, Y.J., Wilberg, M.J., Han, E., Choi, K.-S., Lee, W.C., and Kang, C.K. 2020. Growth of the longline-cultured sea squirt Halocynthia roretzi in a temperate bay of Korea: Biochemical composition and physiological energetics. Aquaculture **516**: 734526. doi:https://doi.org/10.1016/j.aquaculture.2019.734526.

Mercier, A., Baillon, S., Daly, M., Macrander, J., and Hamel, J.-F. 2017. Biology of a deep-water sea anemone (Anthozoa: Actiniidae) from eastern Canada: Spawning, development, and growth. Deep Sea Research Part II: Topical Studies in Oceanography **137**: 359-367. doi:https://doi.org/10.1016/j.dsr2.2016.01.006.

Michel, C., Legendre, L., Therriault, J.-C., Demers, S., and Vandevelde, T. 1993. Springtime coupling between ice algal and phytoplankton assemblages in southeastern Hudson Bay, Canadian Arctic. Polar Biol. **13**: 441-449. doi:10.1007/BF00233135.

Middelboe, A.L., Sand-Jensen, K., and Krause-Jensen, D. 2002. Patterns of Macroalgal Species Diversity in Danish Estuaries. J. Phycol. **34**(3): 457-466. doi:10.1046/j.1529-8817.1998.340457.x.

Mullowney, D., Hynick, E., Dawe, E., and Coffey, W. 2012. Distribution and Habitat of Cold Water Crab Species on the Grand Bank of Newfoundland. pp. 49-70.

Stroeve, J.C., Serreze, M.C., Holland, M.M., Kay, J.E., Malanik, J., and Barrett, A.P. 2012. The Arctic’s rapidly shrinking sea ice cover: a research synthesis. Climate Change **110**: 1005-1027. doi:10.1007/s10584-011-0101-1.

Wickham, H. 2016. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York.

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T., Miller, E., Bache, S., Müller, K., Ooms, J., Robinson, D., Seidel, D., Spinu, V., Takahashi, K., Vaughan, D., Wilke, C., Woo, K., and Yutani, H. 2019. Welcome to the Tidyverse. Journal of Open Source Software **4**(43): 1686. doi:10.21105/joss.01686.

WoRMS. 2025. Available from https://www.marinespecies.org/aphia.php?p=idkeys.

Zhang, R., Fau, M., Mah, C., Eléaume, M., Zhang, D., Zhou, Y., Lu, B., and Wang, C. 2024. Systematics of deep-sea starfish order Brisingida (Echinodermata: Asteroidea), with a revised classification and assessments of morphological characters. Molecular Phylogenetics and Evolution **191**: 107993. doi:https://doi.org/10.1016/j.ympev.2023.107993.

Appendix A – Physical Samples

Table A1. Specimens caught in dredges across the three sites near Rankin Inlet in 2023. Individual counts of caught specimens and relevant biomasses are included.

Site	Phylum	Class	Scientific name	n	Biomass (g)
Collected by dredge					
Melvin Bay	Arthropoda	Copepoda	Harpacticoida	27	0.0004
	Annelida	Polychaeta	Eteone longa	1	0.0005
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0021
	Annelida	Polychaeta	Dysponetus pygmaeus	2	0.00001
	Annelida	Polychaeta	Erinaceusyllis erinaceus	1	0.00001
	Arthropoda	Malacostraca	Eualus gaimardii	3	0.2913
	Mollusca	Bivalvia	Arvella faba	4	0.1662
	Arthropoda	Malacostraca	Hardametopa carinata	6	0.0017
	Annelida	Polychaeta	Spirorbinae	3	0.0045
	Mollusca	Gastropoda	Margarites helicinus	5	0.0269
	Mollusca	Bivalvia	Mytilus edulis	3	0.0254
	Annelida	Polychaeta	Pholoe sp.	2	0.0009
	Annelida	Polychaeta	Cistenides sp.	1	0.0026
	Arthropoda	Malacostraca	Caprella sp.	1	0.00001
	Arthropoda	Ostracoda	Cytheroidea	5	0.00001
	Mollusca	Bivalvia	Hiatella arctica	1	0.00001
	Arthropoda	Copepoda	Cyclopoida	1	0.00001
	Mollusca	Bivalvia	Arvella faba	1	0.0721
	Arthropoda		Crustacea (parts)	1	0.0420
	Mollusca	Gastropoda	Buccinum ciliatum ciliatum	1	0.3393
	Annelida	Polychaeta	Scoletoma sp.	1	0.2041
	Arthropoda	Malacostraca	Pontoporeia femorata	9	0.0692
	Mollusca	Bivalvia	Serripes groenlandicus	2	0.7851
	Mollusca	Bivalvia	Ennucula tenuis	1	0.2734
	Mollusca	Bivalvia	Ciliatocardium ciliatum	2	0.1836
	Mollusca	Bivalvia	Mya sp.	2	0.1586
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0262
Thomson Island	Mollusca	Bivalvia	Mytilus edulis	1	1.1688
	Mollusca	Bivalvia	Ennucula tenuis	1	0.2660
	Mollusca	Bivalvia	Tridonta borealis	2	30.5240
	Mollusca	Bivalvia	Ciliatocardium ciliatum	1	9.3990
	Arthropoda	Malacostraca	Hyas coarctatus	1	2.1821

Site	Phylum	Class	Scientific name	n	Biomass (g)
Collected by dredge					
Barrier Islands	Arthropoda	Malacostraca	Pontoporeia femorata	5	0.0192
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0270
	Mollusca	Bivalvia	Mya pseudoarenaria	2	0.3516
	Arthropoda	Malacostraca	Protomedeia grandimana	2	0.0055
	Arthropoda	Malacostraca	Ampithoe rubricata	1	0.0055
Collected by ponar grab					
Melvin Bay	Arthropoda	Malacostraca	Protomedeia grandimana	19	0.0314
	Arthropoda	Malacostraca	Arrhis phyllonyx	1	0.0006
	Arthropoda	Malacostraca	Pontoporeia femorata	8	0.0279
	Arthropoda	Malacostraca	Quasimelita quadrispinosa	1	0.0028
	Arthropoda	Malacostraca	Lamprops fuscatus	1	0.0015
	Arthropoda	Malacostraca	Leucon (Leucon) nasica	1	0.0009
	Arthropoda	Malacostraca	Rostroculodes borealis	1	0.0021
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0103
	Annelida	Polychaeta	Nephtyidae	25	0.0208
	Annelida	Polychaeta	Polychaeta (parts)	1	0.6234
	Annelida	Polychaeta	Heteromastus filiformis	1	0.00001
	Annelida	Polychaeta	Polychaeta (parts)	1	0.112
	Arthropoda	Copepoda	Harpacticoida	1	0.00001
	Arthropoda	Malacostraca	Pontoporeia femorata	1	0.002
	Arthropoda	Malacostraca	Pontoporeia femorata	2	0.0288
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0250
	Arthropoda	Malacostraca	Protomedeia grandimana	1	0.0048
	Arthropoda	Malacostraca	Hyas araneus	1	0.0265
	Arthropoda	Malacostraca	Protomedeia grandimana	19	0.0314
	Arthropoda	Malacostraca	Arrhis phyllonyx	1	0.0006
	Arthropoda	Malacostraca	Pontoporeia femorata	8	0.0279
	Arthropoda	Malacostraca	Quasimelita quadrispinosa	1	0.0028
	Arthropoda	Malacostraca	Lamprops fuscatus	1	0.0015
	Arthropoda	Malacostraca	Leucon (Leucon) nasica	1	0.0009
	Arthropoda	Malacostraca	Rostroculodes borealis	1	0.0021
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0103
	Annelida	Polychaeta	Nephtyidae	25	0.0208
	Annelida	Polychaeta	Polychaeta (parts)	1	0.6234
	Annelida	Polychaeta	Heteromastus filiformis	1	0.00001
	Annelida	Polychaeta	Polychaeta (parts)	1	0.112
	Arthropoda	Copepoda	Harpacticoida	1	0.00001
	Arthropoda	Malacostraca	Pontoporeia femorata	1	0.002
	Arthropoda	Malacostraca	Pontoporeia femorata	2	0.0288
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0250
	Arthropoda	Malacostraca	Protomedeia grandimana	1	0.0048
	Arthropoda	Malacostraca	Hyas araneus	1	0.0265

Site	Phylum	Class	Scientific name	n	Biomass (g)
Collected by ponar grab					
Thomson Island	Annelida	Polychaeta	Harmothoe imbricata	5	0.1059
	Arthropoda	Malacostraca	Hyas araneus	1	0.0187
	Mollusca	Bivalvia	Mytilus edulis	1	0.0525
	Arthropoda	Malacostraca	Calliopius laeviusculus	1	0.0119
	Annelida	Polychaeta	Cistenides sp.	1	0.0036
	Annelida	Polychaeta	Cistenides sp.	4	0.0061
	Arthropoda	Malacostraca	Lamprops fuscatus	2	0.0030
	Arthropoda		Crustacea (parts)	1	0.0018
	Annelida	Polychaeta	Eteone longa	1	0.0004
	Arthropoda	Copepoda	Harpacticoida	1	0.00001
	Arthropoda	Ostracoda	Cytheroidea	1	0.0007
	Mollusca	Bivalvia	Mya pseudoarenaria	1	0.0204
	Annelida	Polychaeta	Aricidea sp.	2	0.0165
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0250
	Annelida	Polychaeta	Nephtyidae	2	0.0014
	Arthropoda	Malacostraca	Pontoporeia femorata	1	0.0112
	Annelida	Polychaeta	Scoletoma fragilis	2	0.4461
	Annelida	Polychaeta	Scoloplos armiger	2	0.0091
	Annelida	Polychaeta	Scoletoma sp.	1	0.0019
	Annelida	Polychaeta	Harmothoe imbricata	3	0.0968
	Mollusca	Bivalvia	Hiatella arctica	1	0.0467
	Mollusca	Bivalvia	Arvella faba	1	0.0209
	Arthropoda	Malacostraca	Caprella septentrionalis	1	0.0074
Barrier Islands	Annelida	Polychaeta	Praxillella sp.	1	0.5483
	Arthropoda	Malacostraca	Quasimelita quadrispinosa	1	0.0092
	Arthropoda	Malacostraca	Pontoporeia femorata	4	0.0420
	Arthropoda	Malacostraca	Leucon sp.	2	0.0024
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0347
	Annelida	Polychaeta	Scoloplos armiger	3	0.1912
	Annelida	Polychaeta	Chaetozone sp.	1	0.0096
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0015
	Arthropoda	Malacostraca	Rostroculodes borealis	2	0.0024
	Arthropoda	Malacostraca	Leucon (Leucon) nasica	1	0.0011
	Arthropoda	Malacostraca	Protomedeia sp.	1	0.0001
	Annelida	Polychaeta	Scoletoma fragilis	1	0.9363
	Annelida	Polychaeta	Scoloplos armiger	2	0.2162
	Arthropoda	Malacostraca	Pontoporeia femorata	7	0.0414
	Arthropoda	Malacostraca	Leucon (Leucon) nasicoides	1	0.0009
	Annelida	Polychaeta	Nephtyidae	2	0.0011
	Arthropoda	Malacostraca	Protomedeia grandimana	2	0.0050
	Annelida	Polychaeta	Polychaeta (parts)	1	0.0259

Appendix B – BIIGLE Label Trees

Table B1. A section of the BIIGLE label tree showing the flow-down of fauna labels used.

Annelida	Polychaeta	Sabellida	Sabellidae	Chone	
Arthropoda	Malacostraca	Decapoda	Oregoniidae		
	Thecostraca	Balanomorpha	Balanidae		
Bryozoa	Gymnolaemata	Ctenostomatida	Flustrellidridae	Flustrellidra	F. hispida
Chordata	Ascidiacea	Ascidiacea sp. 1			
		Ascidiacea sp. 2			
	Teleostei	Gadiformes	Gadidae	Gadus	G. ogac
		Perciformes	Cottidae	Myoxocephalus	M. scorpius
				Triglops	
			Lumpenidae	Lumpenus	L. fabricii
			Pholidae	Pholus	P. fasciata
		Teleostei sp. 1			
		Teleostei sp. 2			
Cnidaria	Hexacorallia	Actiniaria	Tealidae	Urticina	
			Hormathiidae	Hormathia	
	Hydrozoa	Anthoathecata	Corynidae	Sarsia	
		Hydrozoa sp. 1			
		Hydrozoa sp. 2			
		Leptothecata			
Ctenophora	Nuda	Beroida	Beroidae	Beroe	B. cucumis
	Tentaculata	Cydippida	Mertensiidae	Mertensia	M. ovum
		Lobata	Bolinopsidae	Bolinopsis	B. infundibulum
Echinodermata	Asteroidea	Forcipulatida	Asteriidae		
	Holothuroidea	Dendrochirotida	Psolidae	Psolus	
Mollusca	Bivalvia	Myida	Myidae	Mya	
		Pectinida	Pectinidae		
Porifera	Demospongiae	Axinellida			
	Demospongiae sp. 1				
	Demospongiae sp. 2				
	Porifera sp. 1				
	Porifera sp. 2				
	Porifera sp. 3				
Unidentified Morphospecies	Unidentified species 1				

	species 2	(Cf. Cheilostomatida)
	species 3	(Cf. Bryozoa)
	species 4	(Cf. Ascidiacea)
	species 5	(Cf. Actiniaria)
	species 6	(Cf. Asteroidea)

Table B2. A section of the BIIGLE label tree showing the flow-down of flora labels that were used.

Brown Macroalgae	B. Filamentous			
	B. Foliose			
	Desmarestiales	Desmarestiaceae	Desmarestia	D. aculeata
				D. viridis
	Fucales	Fucaceae	Fucus	
	Laminariales	Agaraceae	Agarum	A. clathratum
		Laminariaceae	Saccharina	S. latissima
Red Macroalgae	Florideophyceae	Corallinales		
	R. Filamentous			
	R. Foliose			

Table B3. A section of the BIIGLE label tree showing the flow-down of habitat characteristics labels that were used.

Habitat Notes	Boulders
	Detritus
	Litter
	Shell Hash
	Shells – Condition Unknown
	Soft Sedimentation Mat
	Worm Casts
Size Measured	
Substratum	Coarse Sediment
	Hard Substrate
	Soft Sediments
Unknown	
Vegetation Cover %	0-1% Vegetation
	1-25% Vegetation
	25-50% Vegetation
	50-75% Vegetation
	75-100% Vegetation
Visibility	Equipment Related Visibility Reduction
	Excellent Visibility
	Fair Visibility
	Good Visibility
	Low Visibility
	No Visibility

Appendix C – Fauna and Flora ROV Observations

Table C1. Fauna observed from ROV footage across all eight sites in 2023 and 2024.

Observations	Melvin Bay	East Thomson Island 1	Barrier Islands	West Falstaff Island	Panorama Island	West Buff Island	South Buff Island	Guillemot Island
Sabellidae				Y				
Chone sp.		Y			Y			
Arthropoda		Y						
Oregoniidae	Y	Y	Y	Y	Y	Y	Y	
Balanidae		Y						
Flustrellida hispida		Y						
Ascidiacea sp. 1			Y					
Ascidiacea sp. 2					Y			
Stolidobranchia		Y			Y		Y	
Teleostei 1		Y						
Teleostei 2		Y						
Gadus sp.		Y						
Gadus ogac	Y							
Cottidae		Y					Y	
Myoxocephalus scorpius		Y		Y			Y	
Triglops sp.		Y			Y			Y
Lumpenus fabricii		Y						
Pholis fasciata		Y					Y	
Actiniaria		Y			Y		Y	
Urticina sp.		Y			Y			
Hormathia sp.		Y						
Hydrozoa sp. 1					Y		Y	
Hydrozoa sp. 2			Y					Y
Sarsia sp.	Y	Y					Y	
Leptothecata		Y						
Beroe cucumis					Y		Y	
Tentaculata							Y	
Mertensia ovum	Y		Y		Y	Y	Y	Y
Bolinopsis infundibulum	Y		Y					
Asteroidea					Y			
Henricia sp.					Y		Y	
Psolus sp.		Y			Y			
Bivalvia			Y					
Mya sp.	Y		Y	Y				
Pectinidae		Y				Y		
Axinellida					Y		Y	
Demospongiae sp. 1		Y			Y		Y	
Demospongiae sp. 2					Y		Y	
Porifera sp. 1					Y			
Porifera sp. 2					Y			

Observations	Melvin Bay	East Thomson Island 1	Barrier Islands	West Falstaff Island	Panorama Island	West Buff Island	South Buff Island	Guillemot Island
Porifera sp. 3					Y			
Unidentified Morphospecies		Y						
Morphospecies 2 (Cf. Cheilostomatida)		Y						
Morphospecies 3 (Cf. Bryozoa)	Y	Y						
Morphospecies 4 (Cf. Ascidiacea)					Y			
Morphospecies 5 (Cf. Actiniaria)		Y						
Morphospecies 6 (Cf. Asteroidea)		Y						

Table C2. Flora observed from ROV footage across all eight sites near Rankin Inlet in 2023 and 2024.

Observations	Melvin Bay	East Thomson Island 1	Barrier Islands	West Falstaff Island	Panorama Island	West Buff Island	South Buff Island	Guillemot Island
Brown Filamentous Algae	Y	Y	Y	Y		Y		
Brown Foliose Algae	Y		Y	Y		Y		
Desmarestia sp.	Y							
Desmarestia aculeata		Y		Y		Y		
Desmarestia viridis	Y	Y		Y		Y		
Fucus sp.	Y	Y	Y	Y	Y	Y	Y	
Agarum clathratum	Y	Y				Y	Y	
Saccharina latissima	Y	Y	Y	Y	Y	Y	Y	Y
Corallinales		Y			Y	Y	Y	
Red Filamentous Algae		Y						
Red Foliose Algae						Y		

Appendix D – Site Photos

Figure D1. Images showing the habitat of: A) Melvin Bay, B) Guillemot Island, C), the Barrier Islands, and D) West Falstaff Island from July 2023 and 2024.

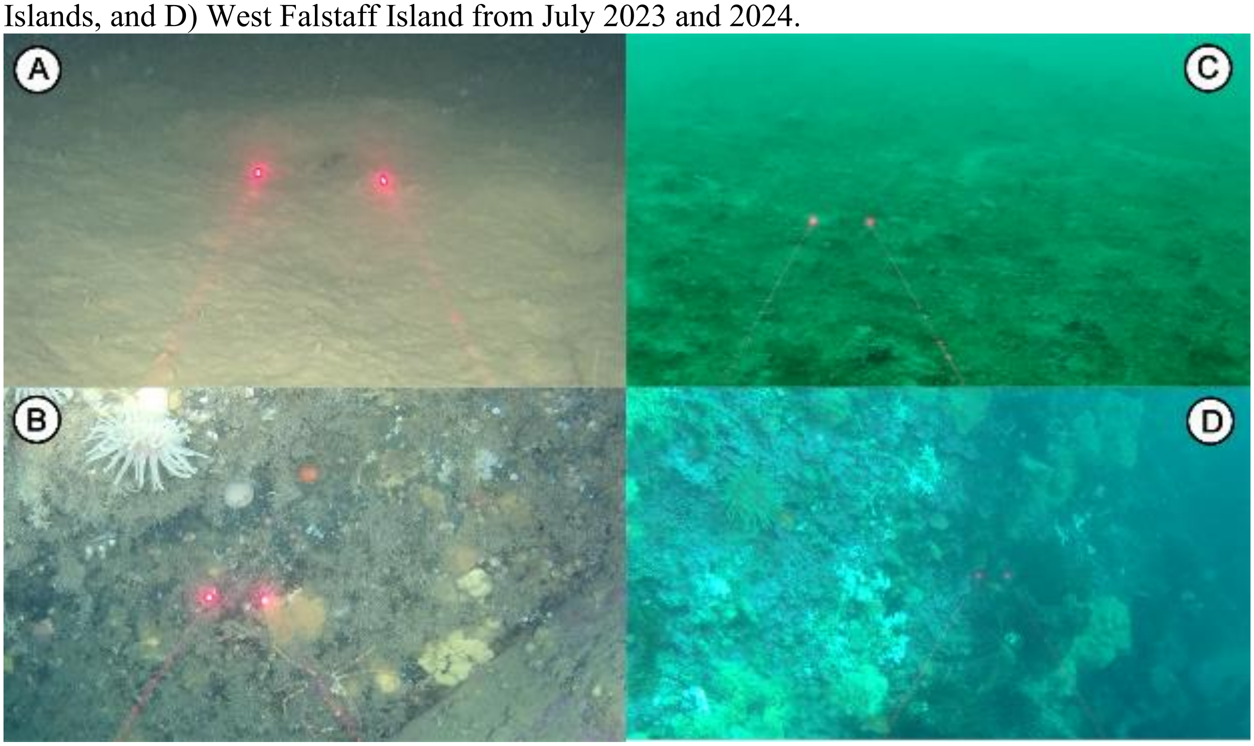

Figure D2. Softly sedimented areas from: A) Panorama Island and C) South Buff Island, and their associated cliff environments (B and D, respectively) from July 2024.

Figure D3. An image of West Buff Island, where sugar kelp (*S. latissima*) are very prominent, obscuring most of the benthic floor.

Figure D4. An image of East Thomson Island 2, showing predominately barren soft sediment environment.

Appendix E – Habitat Characteristics

Table E1. Habitat characteristics observed from ROV footage across the three study sites from 2023.

Categories	Descriptor	Melvin Bay	East Thomson Island 1	Barrier Islands
Habitat Notes	Boulders	Y	Y	Y
	Detritus			Y
	Litter			
	Shell Hash	Y	Y	Y
	Shells - Condition Unknown	Y	Y	
	Soft Sedimentation Mat	Y		Y
	Worm casts	Y		
Substratum	Coarse Sediments			
	Hard Substrate		Y	
	Soft Sediments	Y	Y	Y
Vegetation Cover %	0-1% Cover	Y	Y	Y
	1-25% Cover	Y	Y	Y
	25-50% Cover	Y		Y
	50-75% Cover			
	75-100% Cover			
Visibility	Excellent Visibility			
	Good Visibility		Y	Y
	Fair Visibility	Y	Y	Y
	Low Visibility	Y	Y	Y
	No Visibility	Y	Y	Y
	Equipment Related Visibility Reduction	Y	Y	

Table E2. Habitat characteristics observed from ROV footage across the five study sites from 2024.

Categories	Descriptor	West Falstaff Island	Panorama Island	West Buff Island	South Buff Island	Guillemot Island
Habitat Notes	Boulders	Y				
	Detritus	Y	Y		Y	
	Litter				Y	
	Shell Hash	Y	Y	Y	Y	
	Shells - Condition Unknown					
	Soft Sedimentation Mat					
	Worm casts	Y			Y	
Substratum	Coarse Sediments			Y		
	Hard Substrate		Y		Y	
	Soft Sediments	Y	Y	Y	Y	Y
Vegetation Cover %	0-1% Cover	Y	Y		Y	Y
	1-25% Cover	Y	Y		Y	Y
	25-50% Cover			Y	Y	
	50-75% Cover			Y	Y	
	75-100% Cover			Y	Y	
Visibility	Excellent Visibility	Y		Y		
	Good Visibility	Y		Y	Y	
	Fair Visibility	Y	Y		Y	Y
	Low Visibility	Y	Y		Y	
	No Visibility					
	Equipment Related Visibility Reduction	Y	Y			

Appendix F – Fauna Photos

Figure F1. The feather duster worm, *Chone* sp., from East Thomson Island 1 in July 2023.

Figure F2. Two arthropod taxa, barnacles (left), and crabs (right), seen at East Thomson Island 1 in July 2023.

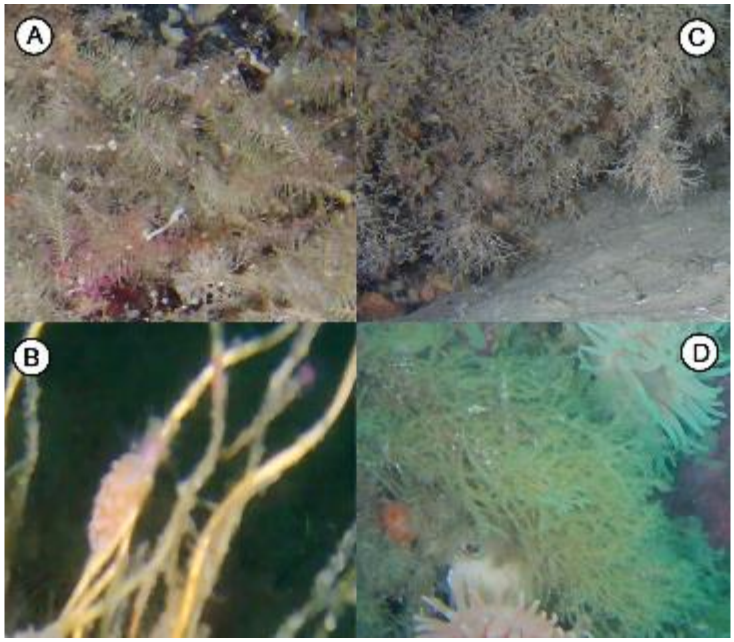

Figure F3. The mat forming taxa of: A) Leptothecata, B) the bryozoan *Flustrellida hispida*, C) a member of an unidentified species (Cf. Bryozoa), and D) an unidentified species (Cf. Cheilostomatida) all seen at East Thomson Island 1 in July 2023.

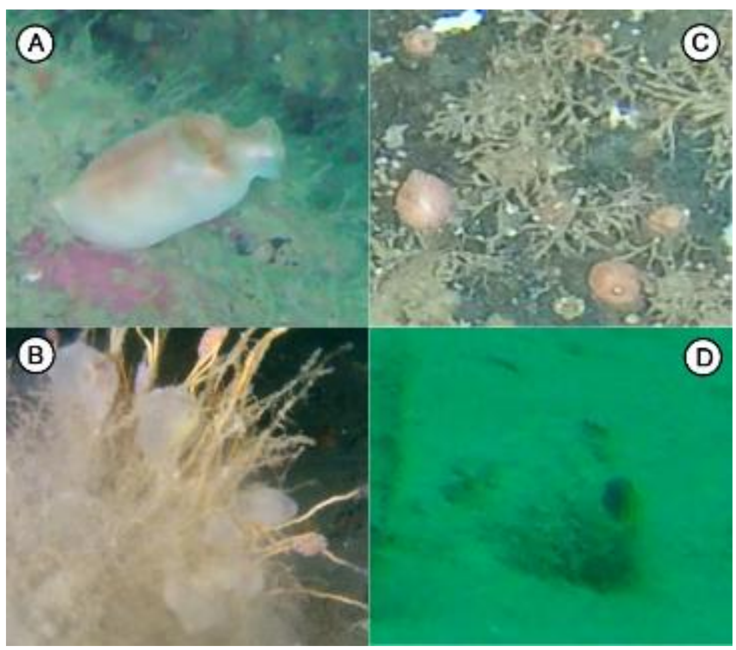

Figure F4. A) Stolidobranchia from East Thomson Island 1, B) members of unidentified species 1 resembling potential tunicates from East Thomson Island 1, C) Ascidiacea sp. 2 from Panorama Island, and D) Ascidiacea sp. 1 from the Barrier Islands from July 2023 and 2024.

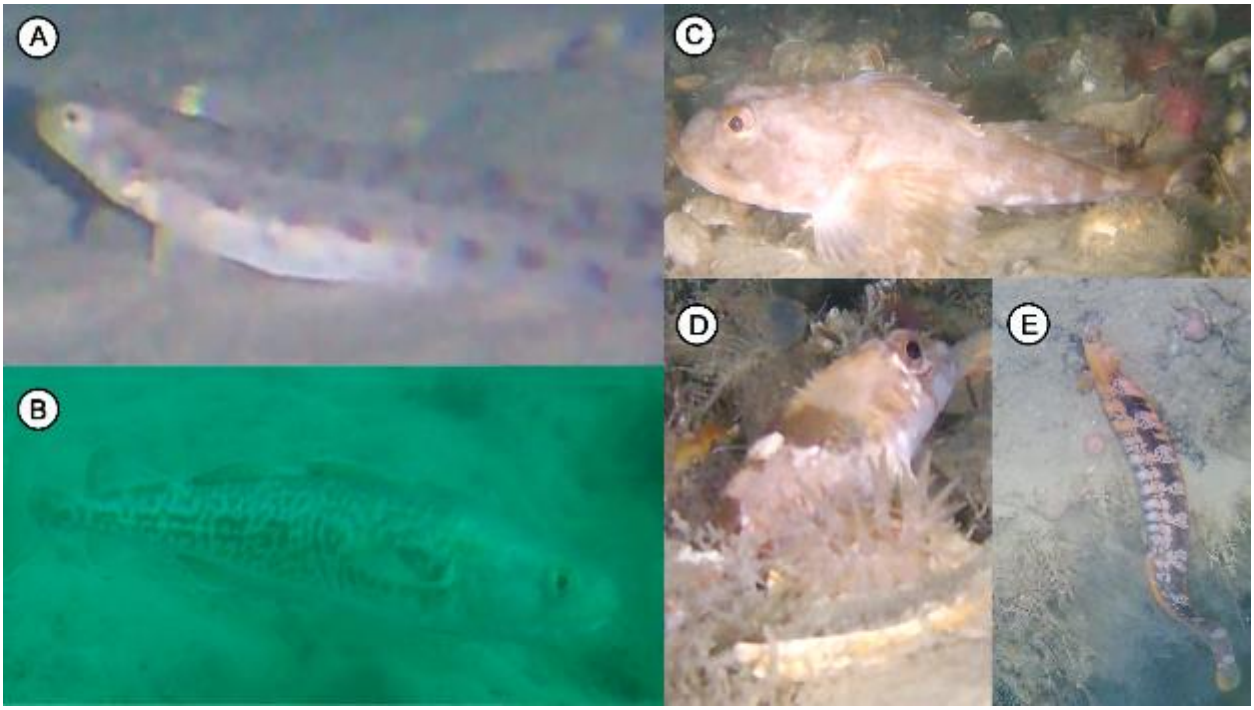

Figure F5. Observed fish: A) the slender eelblenny, *Lumpenus fabricii* from East Thomson Island 1, B) Greenland cod *Gadus ogac* from Melvin Bay, C) shorthorn sculpin (*Myoxocephalus scorpius*) from East Thomson Island 1, D) *Triglops* sp. from East Thomson Island 1, and E) banded gunnel (*Pholis fasciata*) from East Thomson Island 1.


Figure F6. The anemones, *Hormathia* sp. (left), and *Urticina* sp. (right), both seen at East Thomson Island 1 in July 2023.

Figure F7. Four taxa of pelagic jellies: A) the northern comb jelly, *Beroe cucumis* from South Buff Island in July 2024, B) the common northern comb jelly (*Bolinopsis infundibulum*) from Melvin Bay in July 2023, C) the Arctic comb jelly, (*Mertensia ovum*) from South Buff Island in July 2024, and D) *Sarsi* sp., a taxa of pelagic cnidarians observed in Melvin Bay in July, 2023.

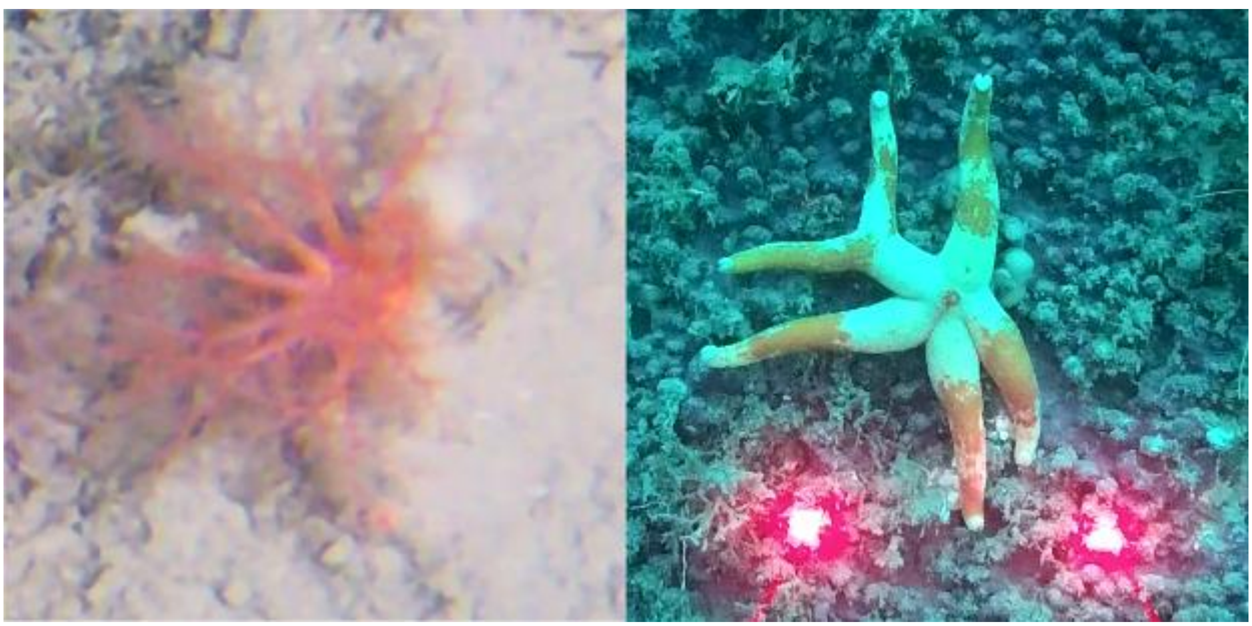
Figure F8. Two echinoderm taxa, sea cucumbers, *Psolus* sp. (left), and a sea star, *Henricia* sp. (right), seen at Panorama Island in July 2024. The sea star is beside the potential tunicate taxa unidentified species 4 (bumps on wall).

Figure F9. The mussel taxa, scallops (left), observed in West Buff Island in July, 2024, and the soft-shelled clams, *Mya* sp. (right) found at the Barrier Islands in July, 2024.

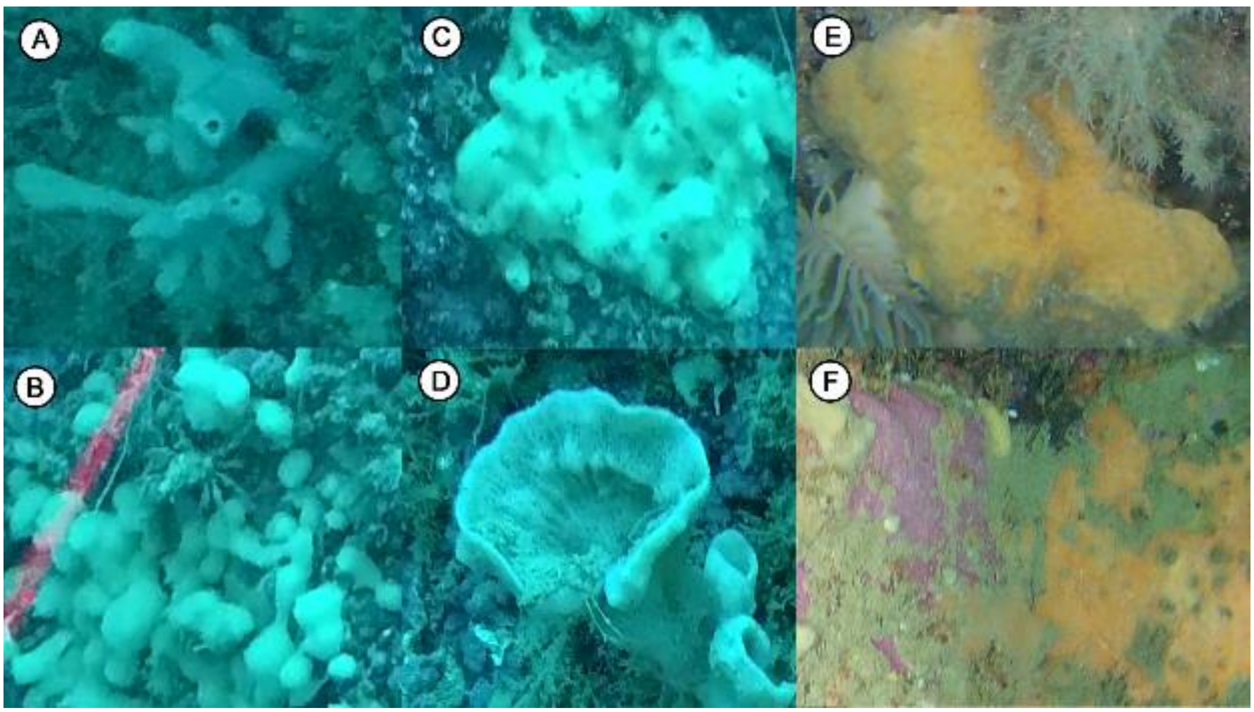

Figure F10. The six different sponge taxa: Poriferan sp. 1 (A), sp. 2 (B), sp. 3 (C), D) Axinellida, E) Demospongiae sp. 1, and F) the orange Demospongiae sp. 2. A-D photos were taken at Panorama Island in July 2024, E was taken at East Thomson Island 1 in July 2023, and F was taken at South Buff Island in July 2024.


Figure F11. The member of unidentified species 5 that was observed at East Thomson Island 1 in July 2023.

Figure F12. The individual of unidentified species 6 that was observed at East Thomson Island 1 in July 2023.

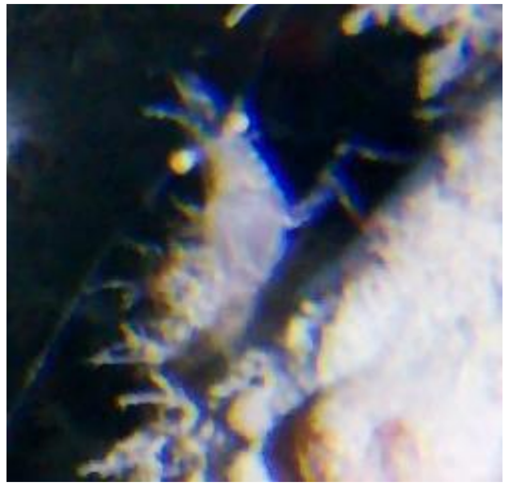

Figure F13. ROV image of the zooplanktonic arthropod that could not be further identified.