

Near-seafloor imagery surveys in 2016 and 2017 of three Ecologically and Biologically Significant Areas in Southwest New Brunswick, Canada (Head Harbour/West Isles/the Passages, The Wolves Islands, and Southern Grand Manan)

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by

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ABSTRACT

Lawton, P., Teed, L.L., Miles, L., Mireault, C., and Brydges, T. 2026. Near-seafloor imagery surveys in 2016 and 2017 of three Ecologically and Biologically Significant Areas in Southwest New Brunswick, Canada (Head Harbour/West Isles/the Passages, The Wolves Islands, and Southern Grand Manan). Can. Tech. Rep. Fish. Aquat. Sci. 3782: x + 88 p. <https://doi.org/10.60825/46ac-ge46>

Near-seafloor imagery surveys were conducted in 2016 and 2017 across three coastal Ecologically and Biologically Significant Areas (EBSAs) in Southwest New Brunswick, including the Head Harbour/West Isles/Passages (HH/WI/P) EBSA, The Wolves Islands EBSA, and the Southern Grand Manan EBSA. Objectives were to document key benthic taxa occurrences and associated substrates in coastal EBSAs, report abundance of select conservation priority and commercially important species, and compare occurrence using two techniques: continuous video and digital still imagery. Target locations were selected based on available bathymetry data and limited by the ~85-m deployment capability of the camera system. A total of 150 transects were completed, covering a distance of 79 km, across depths ranging from 5 to 89 m, resulting in over 48 hours of high-definition video and 5047 digital still images. Both video and still images were analyzed to document occurrence and abundance of select taxa ($n=41$) across 8 phyla (9 biotic groups). Video was subdivided into 30-s increments, where occurrence of taxa and overall visibility was reported once for every 30-s interval. Seafloor substrates were also analyzed as the dominant cover in each still image and video interval. A total of 19216 and 16827 taxa occurrences were recorded in the video intervals and still images respectively, predominately on fine grain and pebble substrates. Common taxa include unknown sponges, ascidians, algae, sea scallops, *Cancer* crabs, anemones, and sea stars. The HH/WI/P EBSA was particularly diverse, with an average of 15 and 17 taxa in the video intervals and still images respectively. *Boltenia ovifera* and *Modiolus modiolus* were observed forming biogenic fields and reefs within this EBSA, while sea urchins were also observed in sporadic high abundances.

RÉSUMÉ

Lawton, P., Teed, L.L., Miles, L., Mireault, C., and Brydges, T. 2026. Near-seafloor imagery surveys in 2016 and 2017 of three Ecologically and Biologically Significant Areas in Southwest New Brunswick, Canada (Head Harbour/West Isles/the Passages, The Wolves Islands, and Southern Grand Manan). Can. Tech. Rep. Fish. Aquat. Sci. 3782: x + 88 p. <https://doi.org/10.60825/46ac-ge46>

Des relevés par imagerie près du fond marin ont été effectués en 2016 et en 2017 dans trois zones côtières d'importance écologique et biologique (ZIEB) du sud-ouest du Nouveau-Brunswick, à savoir la ZIEB de Head Harbour/West Isles/Les Passages, la ZIEB des îles Wolves et la ZIEB du sud de Grand Manan. Les objectifs consistaient à documenter la présence des principaux taxons benthiques et les substrats qui y sont associés dans les ZIEB côtières, à rapporter l'abondance de certaines espèces prioritaires aux fins de la conservation et commercialement importantes, et à comparer les occurrences en utilisant deux techniques : la vidéo en continu et l'imagerie numérique fixe. Les emplacements cibles ont été sélectionnés en fonction des données bathymétriques accessibles et ont été limités par la capacité de déploiement du système de caméra, c'est-à-dire environ 85 m. Au total, 150 transects ont été réalisés, couvrant une distance de 79 km, à des profondeurs allant de 5 à 89 m, ce qui a permis d'enregistrer plus de 48 heures de vidéo haute définition et 5 047 images numériques fixes. Des images vidéo et fixes ont été analysées pour documenter la présence et l'abondance de taxons sélectionnés ($n = 41$) dans huit phylums (neuf groupes de biotique). La vidéo a été sous-divisée en intervalles de 30 secondes, où la présence des taxons et la visibilité globale ont été rapportées une fois pour chaque intervalle de 30 secondes. Les substrats du fond marin ont également été analysés comme couverture dominante dans chaque image fixe et intervalle vidéo. Au total, 19 216 et 16 827 présences de taxons ont été enregistrées dans les intervalles vidéo et les images fixes, respectivement, principalement sur des substrats de grains fins et de cailloux. Les taxons courants comprennent des éponges inconnues, des ascidies, des algues, des pétoncles, des crabes (*Cancer*), des anémones et des étoiles de mer. La ZIEB de Head Harbour/West Isles/Les Passages était particulièrement diversifiée, avec une moyenne de 15 et 17 taxons dans les intervalles vidéo et les images fixes, respectivement. Les espèces *Boltenia ovifera* et *Modiolus modiolus* ont été observées formant des récifs et champs biogéniques dans cette ZIEB, et des oursins ont également été observés en grande abondance de façon sporadique.

1 INTRODUCTION

In Southwestern New Brunswick (hereafter SWNB), on the western side of the Scotian Shelf-Bay of Fundy (SS-BoF) marine bioregion, the Quoddy Region of the Bay of Fundy, extends from Point Lepreau over to Quoddy Head, Maine (Thomas 1983). The whole of the region was recognized as a key coastal Ecologically and Biologically Significant Area (EBSA) in a literature review and synthesis by Buzeta and Singh (2008). EBSAs, established by the federal Department of Fisheries and Oceans Canada (DFO) under national guidelines (DFO 2004), undergo attention by ocean managers when considering marine development permits and the conduct of fishery and other activities. Though EBSAs are not subjected to formal conservation measures, this regard by ocean managers acts to protect marine ecosystem structure and function. They may also become part of Canada's Marine Conservation Network (DFO 2018; King et al. 2021). EBSAs include areas of high benthic biodiversity and structural habitat features such as rocky outcrops and sponge reefs (Buzeta 2014; Kenchington 2014). In 2008, several sub-areas within the Quoddy Region were selected as priorities for inclusion in the development of the SS-BoF conservation network plan, including the "Head Harbour/West Isles/Passages" (HH/WI/P) EBSA and The Wolves Islands EBSA (Figure 1). Further south, at the mouth of the Bay of Fundy, the waters off the coast of Southern Grand Manan were also designated as an EBSA (Buzeta 2014; Figure 1). Historical research supported these designations, and subsequent work has reaffirmed them, including SCUBA dive surveys (*e.g.*, MacKay et al. 1978a, b, c, 1979; MacKay and Bosien 1979; Lawton et al. 2024), benthic trawl surveys (*e.g.*, Cooper 2020; Denton 2020), benthic imagery surveys (*e.g.*, Lawton 2022; Mireault et al. 2023; Teed et al. 2024), and more recently, environmental DNA (eDNA) surveys (*e.g.*, He et al. 2023; Teed et al. 2024).

The Quoddy Region is special for its benthic ecosystems (Buzeta 2008), particularly in the HH/WI/P EBSA, where numerous broad to narrow channels surround Deer Island and Campobello Island, as well as scattered small islands within the EBSA. Complex bottom topography, along with moderate to strong near-seafloor current velocities, promotes high productivity and biodiversity, particularly of benthic filter-feeding organisms (Buzeta and Singh 2008; Buzeta 2014). Two biogenic habitat-forming species of bioregional conservation priority, the stalked tunicate *Boltenia ovifera* and the horse mussel *Modiolus modiolus*, have been found in abundance within the EBSA (DFO 2015; Mireault et al. 2025). Numerous commercial fisheries, including scallops (*Placopecten magellanicus*), lobsters (*Homarus americanus*), sea urchins (*Strongylocentrotus droebachiensis*), sea cucumbers (*Cucumaria frondosa*), and groundfish (Pleuronectiformes) operate within the EBSA and surrounding

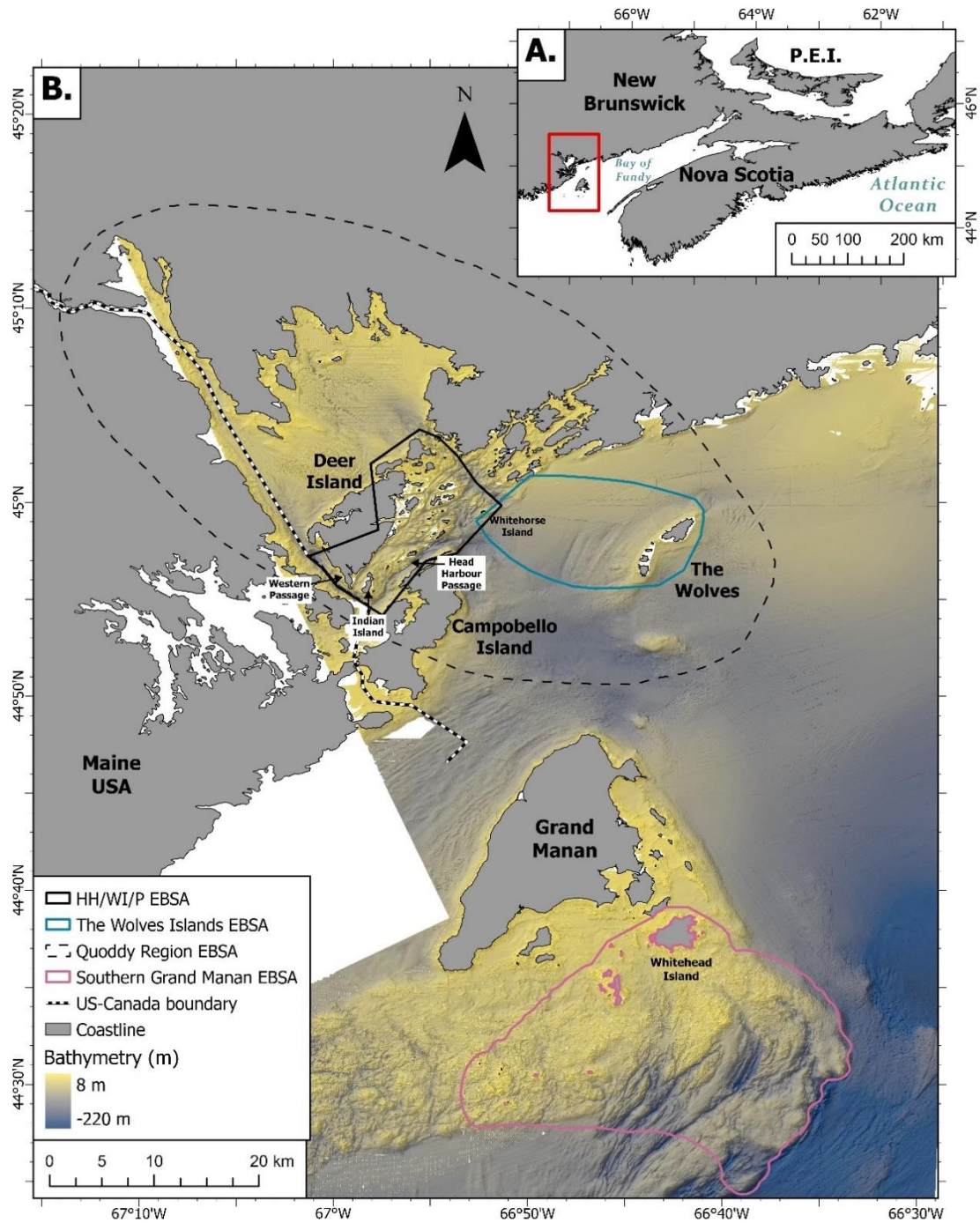


Figure 1 (A) Study area in the Bay of Fundy (outlined in red). (B) Waters off Southwest New Brunswick, locating the Quoddy Region EBSA, and HH/WI/P, Wolves, and Southern Grand Manan EBSAs (as designated prior to the 2016-2017 survey), with underlying bathymetry data.

areas, along with finfish aquaculture farms (Rozalska and Coffen-Smout 2020; Government of New Brunswick 2025). Considering the economic importance of local marine industries, conservation proposals for the HH/WI/P EBSA have been controversial among stakeholders.

The Wolves Islands EBSA was originally proposed to include the northern tip of Grand Manan and White Horse Island at the edge of the HH/WI/P EBSA (Figure 1; Buzeta 2014). Designation was based on the high diversity of benthic fauna and aggregations of marine birds and mammals (including the critically endangered North Atlantic Right Whale), as well as several fish species known to occur around these islands (AECOM Canada Ltd. 2011). Complex seafloor features and potentially extensive horse mussel reefs are thought to exist nearby, due in part to the moderate to strong currents and mixed substrates in the region (MacKay and Bosien 1979; DFO 2015).

The Southern Grand Manan EBSA included Old Proprietor Shoal, Murr Ledges, Clark's Ground and Kent Island (Figure 1). This EBSA was designated based on its consideration as a wildlife hotspot. In particular, upwellings and tidal rips attract large aggregations of seabirds and marine mammals, that feed on or near the surrounding islands (Buzeta 2014). Huettmann et al. (2005) suggested that fine-scale complex shallow seafloor topography concentrate seabird aggregations, with this topography also generally associated with higher benthic biodiversity. Moreover, Southeastern Grand Manan is a known scallop spat settling area (CCRM 1999) and houses other commercially important species including lobster, herring (*Clupea harengus*), crab (*Cancer* spp.), and dulse (*Palmaria palmata*). Originally designed adjacent to the southern island coast, conservation polygon delineations changed over time, with the EBSA polygon shifting to the southeastern coast of Grand Manan in 2016 (Buzeta 2014; DFO 2023a). As with the HH/WI/P EBSA, the economic and social importance of the commercial fisheries off Southern Grand Manan, particularly for sea scallop, led to strong resistance to the retention of the full scope of the proposed EBSA within bioregional conservation network planning discussions.

Following the designation of the three EBSAs in 2008, it became evident that while there was significant historical information on benthic habitat characteristics, much of the available information derived from coastal SCUBA diving investigations (*e.g.*, as referenced above) with much less documentation on the range of benthic habitat types and characteristic fauna to be found within these EBSAs at depths beyond 20 – 30 m. Some prior near-seafloor imaging surveys were conducted by DFO from the 1990's to early 2000's (*e.g.*, Strong and Lawton 2004; Lawton et al. 2005), but were not regionally extensive

projects, and survey objectives were primarily related to understanding the distribution of lobster nursery and spawning areas, rather than benthic diversity *per se*.

The DFO Strategic Program for Ecosystem-based Research and Advice (SPERA), focused on furthering national priorities for managing ecosystems in domestic waters, subsequently became available for funding research projects to assess human impacts on ecosystems, report on current ecosystem conditions, and to develop tools for ecosystem based management. Under SPERA, a multi-year benthic survey was conducted in the summer and fall of 2016 and 2017 in SWNB, using several sampling approaches: SCUBA diving transects, benthic grab sampling, and extended near-seafloor imaging surveys using a custom DFO surface-deployed camera system, which we report on here. Imagery from the near-seafloor imaging system was also used in a linked research project within the Canadian Healthy Oceans Network (CHONe; a Natural Sciences and Engineering Research Council strategic research network). The CHONe project, led by Callum Mireault (deceased 2018), focused on the distribution and abundance of two biogenic habitat-forming species, *M. modiolus* and *B. ovifera*, with findings subsequently published as Mireault et al. (2025), whereas the SPERA project focus was on general benthic species assemblage patterns.

We summarize the spatial coverage of near-seafloor imaging transects conducted in 2016 and 2017 under the SPERA project, and present analyses using both digital still images and continuous video, reporting on occurrences and abundance estimates for key benthic taxa encountered. Three research objectives form the basis for the present report:

- 1) Document select taxa occurrences and associated substrates across three SWNB EBSAs;
- 2) Document abundance of select conservation priority and commercially important taxa;
- 3) Compare occurrence of taxa using two simultaneously collected imagery types: continuous video and digital still imagery.

Select taxa were chosen to document occurrence and abundance, differing from some other benthic imagery analysis approaches which attempt a more complete benthic assemblage profile by noting presence of all visible taxa (but not necessarily abundances; *e.g.*, Paulin et al. 2025; Teed et al. 2025a). While those approaches can inform a more comprehensive baseline of overall benthic community attributes, due to time restraints and annotator confidence in full taxa identification, an *a priori* selection of 41 key taxa was made across nine groups of biota. Additionally, while abundance of all 41 taxa was recorded, only six species were chosen to document and discuss abundance in this report. These six species are of high conservation priority and commercial importance and include: *B. ovifera*, *M. modiolus*, *H. americanus*, *P. magellanicus*, *C. frondosa*, and *S. droebachiensis*.

2 MATERIALS AND METHODS

From July to October 2016 and June to September 2017, 150 drift camera transects were undertaken in the Head Harbour/West Isles/Passages, The Wolves Islands, and Southern Grand Manan EBSAs (Figure 2). Due to the extreme tidal range found in the Bay of Fundy, as well as high near-seafloor currents during flood and ebbing tides, most transects were conducted around low tide slack periods during daylight hours. Some transects were conducted around slack periods of high tides, allowing for the camera system to be used over shallow depths below chart datum (BCD).

High-resolution (1-100 m horizontal resolution) bathymetric data collected using multibeam echosounder systems (MBES) from earlier regional projects (OMG 2007), along with more recent coastal multibeam and LiDAR surveys conducted by the Canadian Hydrographic Service (CHS), provided a near-complete coverage of the areas of interest (Figure 1). Bathymetric data were used to first stratify the study area by depth (shallow: 10-85 m and deep: >85 m). The deep category (>85 m) could not be surveyed in 2016-2017 due to camera system depth limit restrictions. As the study objective was to provide baseline characterization of the range of benthic habitats within the three EBSAs, localized sub-areas of 1 – 2 km² were evaluated with respect to derived bathymetric data (*e.g.* slope, specific depth range) and associated acoustic backscatter information (where available; providing for general discrimination of sediment- versus bedrock-dominated substrates). Within the EBSAs, target sites were then selected to cover a range of physical benthic attributes ranging from locations with low slope variability, likely with sediment-dominated substrates, through to locations with high variability in local slopes, and presumed bedrock-dominated substrates.

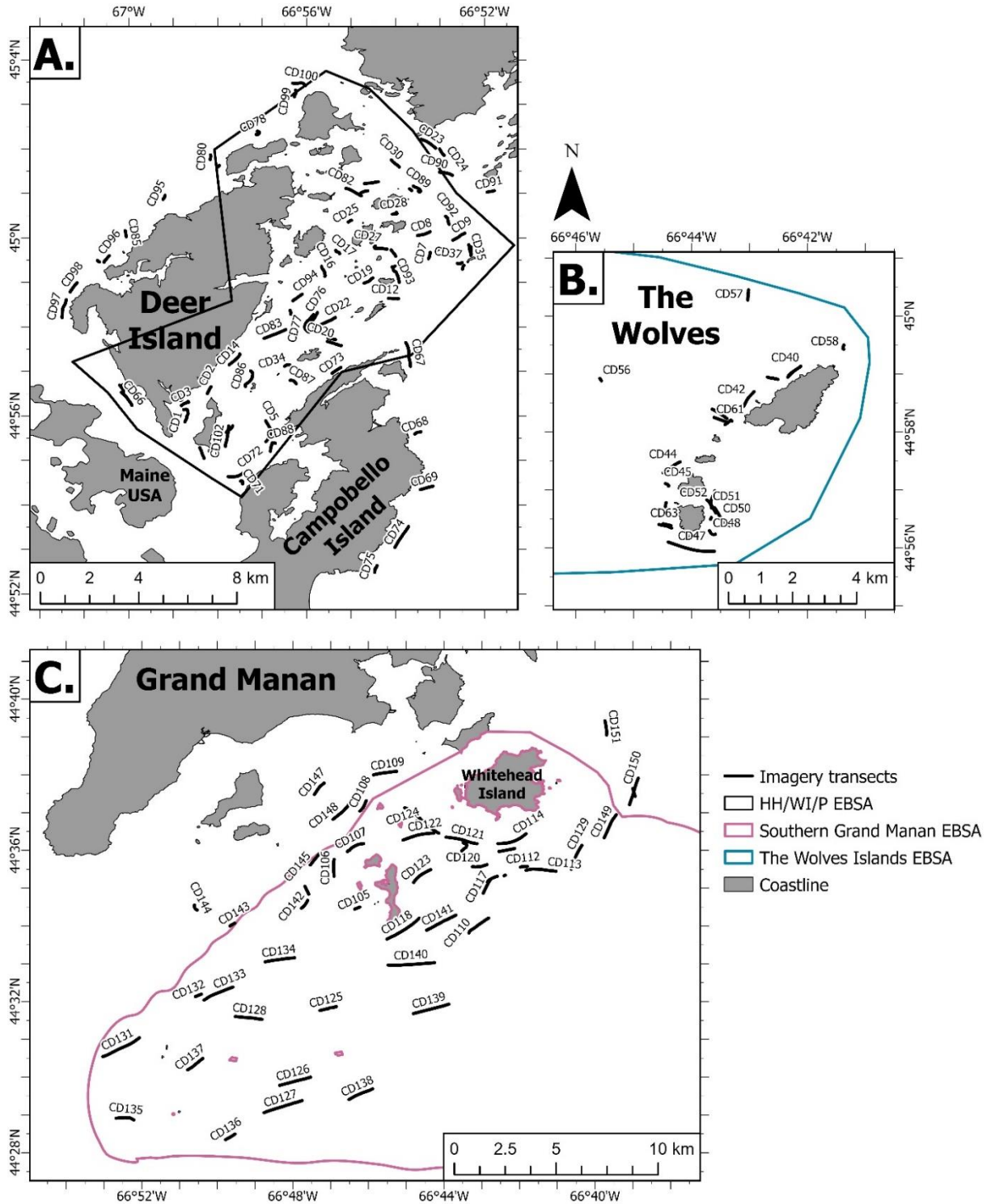


Figure 2 (A) Transect locations within and surrounding (*i.e.*, sub-area) the HH/WI/P EBSA. (B) The Wolves Islands EBSA. (C) Southern Grand Manan EBSA.

2.1 NEAR-SEAFLOOR IMAGING SYSTEM

A DFO near-seafloor imaging system, previously developed to capture digital still imagery, was modified to also collect continuous video. The multipurpose system was co-designed by DFO staff (Kelly Bentham and Kirk Phelan, Bedford Institute of Oceanography); lead project scientist, Peter Lawton, Torben Brydges, Darryl Haughn (Biological Station, Saint Andrews), and Callum Mireault (Memorial University of Newfoundland). Due to the lack of a suitable deck video cable winch, the system (Figure 3) was deployed using a hydrographic winch on the starboard side of the 18 m-length Canadian Coast Guard Ship (CCGS) *Viola M. Davidson*. An 85-m deployment limit was set to ensure reliable HD video signal transmission over the copper-based video cable (Dive and See, Torrance, CA, USA). An ultra-HD (4K) capable digital video camera (Production Camera 4K; Blackmagic Design, Freemont, CA, USA) was fitted with a wide angle lens and housed in an underwater housing with a dome port (NA-BMCC; Nauticam USA, Florida, USA). The video camera was positioned on the camera frame to take downward-facing continuous video, with a set of video lights providing high illumination (up to 50,000 lumens, depending on configurations used in 2016 and 2017). Surface monitoring of the continuous video feed helped the camera system operator to maintain a height of ~ 1 m above the seabed. A 36.1-megapixel digital still camera (D800; Nikon, Mississauga, ON, Canada) equipped with a studio strobe was positioned to take downward-facing digital still images (4912 x 7360 pixel resolution).

The camera system was operated in a near-seafloor, drift transect mode. Fluctuating tidal currents did not allow for set target distances across transects. Instead, transect time restrictions were adopted to ensure more complete spatial coverage over the limited tidal periods the system could be deployed. A maximum of 25 minutes of drift transect sampling effort was conducted per location with HD video (1920 x 1080 pixels) recorded at the surface (Hyperdeck Studio Pro; Blackmagic Design). Three discrete three-minute segments of 4K video (4000 x 2640 pixels) were recorded internally on the Blackmagic camera at four-minute intervals; however, 4K video was not analyzed for the present report. The Nikon camera was not under electronic control from the surface. Digital stills were captured at ~ 30 -s intervals when a 10-cm diameter trigger weight suspended 100 cm below the camera frame touched the seafloor (Figure 3). When visible in images, the trigger weight provided for estimating field of view (FOV); no laser scaling devices were available in 2016-2017 for use with the system. Camera location was tracked by an ultra-short baseline acoustic positioning system with a transponder on the camera frame (Tracklink 1500HA transceiver, Tracklink 1505B transponder; Linkquest Inc., San Diego, USA).

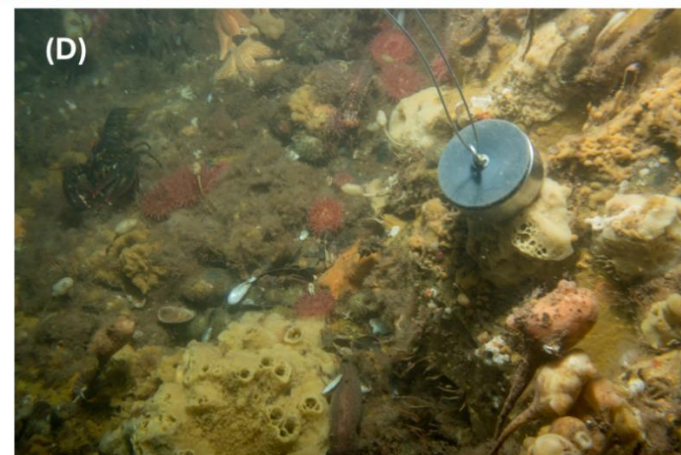
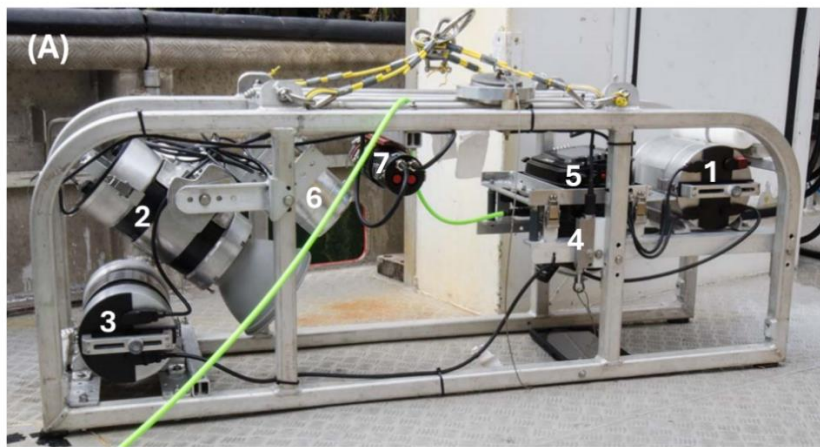


Figure 3 (A) DFO multipurpose camera system. (1) Nikon D800 in custom housing, (2) studio flash and (3) battery pack in custom housings, (4) trigger mechanism (trigger weight on top of frame while on deck), (5) Blackmagic video camera in Nauticam housing, (6) LED video lighting, and (7) power pack. (B) Camera package deployment off starboard side of CCGS *Viola M. Davidson*. (C) Full frame digital still image from D800 showcasing *Modiolus modiolus* turf, sea stars, green sea urchins, sandfan worms, anemones, sponges, and *Hyas coarctatus* (CD020, image file name: 20160715-150451.jpg). (D) Digital still image with trigger weight (providing 10-cm diameter scale); camera frame lodged against seafloor giving perspective view of *Boltenia ovifera*, sponges, sea cucumbers, sea stars, anemones, and American lobster (CD005, image file name: 20160712-160141.jpg).

2.2 VIDEO AND IMAGERY ANALYSIS

For this report, the HD video and digital still images were analyzed for video quality, primary bottom-type and select taxa presence, extending the procedures described in Sameoto et al. (2008). Video recordings were analyzed by 30-second (s) intervals starting at time 00:00. Object discernability in the video (related to video quality for taxa interpretation) was defined as the smallest object identifiable over the majority of the 30-s interval, and classified into three categories: <5 cm, 5-10 cm, >10 cm. The primary bottom-type was defined as the grain size with the highest percent cover for each video interval. For the still images, each image was overlain with a 3x3 grid where the dominant bottom-type was reported in each grid cell and the primary substrate for that image was the bottom-type most common across the nine grid cells. Grain size limits were determined using a modified Wentworth scale (Wentworth 1922) including bedrock, boulders, cobbles, pebbles, and fine-grained sediment (*i.e.*, gravel, sand and silt). In some instances, bottom-type was obscured due to biogenic formations of mussel beds or debris, and in these cases, 'mussel bed' or 'shell hash' (for still images only) was assigned the primary bottom-type. The 10-cm diameter trigger weight was used for scale to determine both visibility and grain size. Priority biota were selected *a priori* and recorded to the family, genus, or species level while all other taxa were classified as 'unknown' for each taxa group. Anthropogenic debris observed across the video was also noted.

A total of 32 key and common taxa/labels (Figure 4) were specified while all other observed taxa were recorded in higher level biotic groupings ($n=9$) such as Algae as 'Algae unknown' (Table 1). Identification was made to the lowest possible taxonomic level where possible (often genus or species), limited by the near-seafloor conditions (lighting, turbidity) and the still image or video features (resolution, focus, etc.). Considering no physical samples were taken, occurrences are limited to taxa visible on the surface of the seafloor, leading to few priority burrowing (endobenthic) taxa. Uncertain identifications not at the species level were either labelled using higher classification levels (*e.g.*, genus, family) or grouped as a morphotype (*e.g.*, encrusting coralline algae). Due to limitations in discernability of shell and claw morphology, rock and Jonah crabs (*Cancer irroratus* and *C. borealis*) were combined into *Cancer* spp. Similarly, difficulty in distinguishing between the sponges *Haliclona oculata* and *Isodictya* spp., the sea stars *Asterias* and *Leptasterias* spp., and the anemones *Urticina* and *Cribrinopsis* spp., led to one combined label/taxa type for each of these three instances (Table 1). Taxonomic names were obtained from the World Register of Marine Species (WoRMS 2025), and were confirmed using public and internal working image guides and resources based on visual resemblance and known distributions

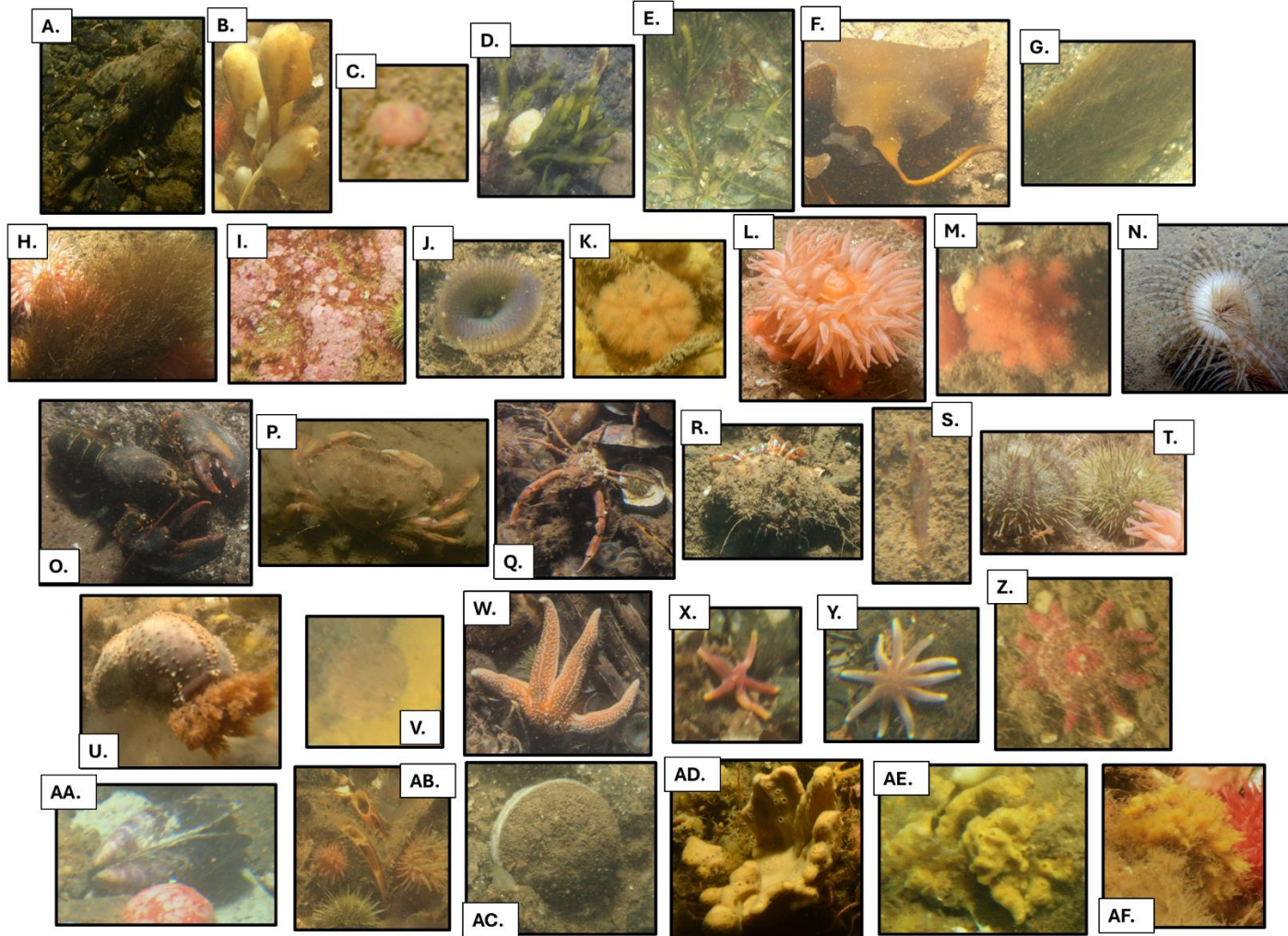


Figure 4 Example cropped images of each of the 32 select taxa including (A) Cottoidei, (B) *Boltenia ovifera*, (C) *Dendrodoa carnea*, (D) *Fucus* spp., (E) *Ascophyllum nodosum*, (F) *Laminaria* spp., (G) *Chorda filum*, (H) *Desmarestia* spp., (I) Encrusting coralline algae, (J) *Myxicola* spp., (K) *Metridium senile*, (L) *Urticina/Cribrinopsis* spp., (M) *Gersemia rubiformis*, (N) *Pachycerianthus borealis*, (O) *Homarus americanus*, (P) *Cancer* spp., (Q) *Hyas coarctatus*, (R) *Pagurus* spp., (S) Shrimp, (T) *Strongylocentrotus droebachiensis*, (U) *Cucumaria frondosa*, (V) *Echniarachnius parma*, (W) *Asterias/Leptasterias* spp., (X) *Henricia* spp., (Y) *Solaster endeca*, (Z) *Crossaster papposus*, (AA) *Mytilus edulis*, (AB) *Modiolus modiolus*, (AC) *Placopecten magellanicus*, (AD) *Haliclona/Isodictya* spp., (AE) *Halichondria panicea*, (AF) *Halichondria sitiens*.

Table 1 Labels of priority taxa (n=41) and debris according to biotic taxa group with occurrence recorded (number and proportion - %) in both the video intervals and digital still images. When not identified to species level, notes on suggested species, genus, etc., along with common names are provided.

Biotic group	Taxa/Label	Notes/Suggested taxa	Number of video occurrences (proportion - %)	Number of still image occurrences (proportion - %)
Actinopterygii	Cottoidei	likely mixture of shorthorn and longhorn sculpins (<i>Myoxocephalus</i> spp.), sea raven (<i>H. americanus</i>), and Atlantic alligatorfish (<i>A. monopterygius</i>)	236 (4%)	80 (2%)
	Fish – unknown		483 (9%)	156 (3%)
	Total		719 (13%)	236 (4%)
Ascidacea	<i>Boltenia ovifera</i>	Stalked tunicate	778 (14%)	587 (12%)
	<i>Dendrodoa carnea</i>	Blood drop sea squirt	0 (0%)	23 (0.5%)
	Ascidians - unknown		51 (1%)	1860 (37%)
	Total		829 (15%)	2470 (49%)
Algae	<i>Fucus</i> spp.	likely mixture of <i>F. distichus</i> (rockweed), <i>F. vesiculosus</i> (bladder wrack)	35 (0.6%)	18 (0.4%)
	<i>Ascophyllum nodosum</i>	Knotted wrack	5 (0.1%)	15 (0.3%)
	<i>Laminaria</i> spp.	likely mixture of <i>L. digitata</i> (oarweed) and <i>Saccharina latissimi</i> (sugar kelp)	422 (8%)	85 (2%)
	<i>Chorda filum</i>	Mermaid's tresses	237 (4%)	142 (3%)
	<i>Desmarestia</i> spp.	either <i>D. aculeata</i> or <i>D. viridis</i>	105 (2%)	8 (0.2%)
	Encrusting coralline algae	likely mixture of Hapalidiacea or <i>Lithophyllum</i> spp. (Corallinales)	565 (10%)	350 (7%)
	Algae - unknown		1852 (33%)	1526 (30%)
	Total		3221 (58%)	2144 (42%)
Annelida	<i>Myxicola</i> spp.	emerging neotypes, sand fan worms	215 (4%)	526 (10%)
	Annelids - unknown		10 (0.2%)	215 (4%)
	Total		225 (4%)	741 (15%)
Cnidaria	<i>Metridium senile</i>	Frilled anemone	63 (1%)	4 (0.1%)
	<i>Urticina/Cribrinopsis</i> spp.	likely <i>U. crassicornis</i> (Dahlia anemone) or <i>C. similis</i>	1801 (32%)	724 (14%)
	<i>Gersemia rubiformis</i>	Soft coral – sea strawberry	19 (0.3%)	24 (0.5%)
	<i>Pachycerianthus borealis</i>	previously <i>Cerianthus borealis</i>	756 (14%)	431 (9%)
	Cnidarians - unknown		226 (4%)	1240 (25%)
	Total		2865 (52%)	2423 (48%)
Crustacea	<i>Homarus americanus</i>	American lobster	1014 (18%)	98 (2%)
	<i>Cancer</i> spp.	either rock or Jonah crab	2051 (37%)	348 (7%)
	<i>Hyas coarctatus</i>	Toad crab	21 (0.4%)	7 (0.1%)
	<i>Pagurus</i> spp.	Hermit crabs, either <i>P. acadianus</i> or <i>P. arcuatus</i>	129 (2%)	253 (5%)
	Shrimp	Shrimp, likely mixture of Pandalidae and Thoridae	104 (2%)	415 (8%)

Biotic group	Taxa/Label	Notes/Suggested taxa	Number of video occurrences (proportion - %)	Number of still image occurrences (proportion - %)
	Crustaceans – unknown		3 (0.1%)	11 (0.2%)
	Total		3322 (60%)	1132 (22%)
Echinodermata	<i>Strongylocentrotus droebachiensis</i>	Green sea urchin	579 (10%)	488 (10%)
	<i>Cucumaria frondosa</i>	Orange-footed sea cucumber	592 (11%)	224 (4%)
	<i>Echniarachnius parma</i>	Sand dollar	1 (0%)	9 (0.2%)
	<i>Asterias/Leptasterias</i> spp.	Common sea stars, either <i>A. rubens</i> , <i>A. forbesi</i> , or <i>Leptasterias</i> spp.	1442 (26%)	744 (15%)
	<i>Henricia</i> spp.	Blood stars	735 (13%)	1319 (26%)
	<i>Solaster endica</i>	Purple sun star	50 (1%)	36 (0.7%)
	<i>Crossaster papposus</i>	Rose sun star	111 (2%)	69 (1%)
	Echinoderms – unknown		18 (0.3%)	298 (6%)
	Total		3635 (65%)	3187 (63%)
Mollusca	<i>Mytilus edulis</i>	Blue mussel	19 (0.3%)	82 (2%)
	<i>Modiolus modiolus</i>	Horse mussel	157 (3%)	139 (3%)
	<i>Placopecten magellanicus</i>	Atlantic sea scallop	2033 (36%)	960 (19%)
	Molluscs – unknown	mostly comprised of gastropoda	124 (2%)	1142 (23%)
	Total		2333 (42%)	2623 (52%)
Porifera	<i>Haliclona/Isodictya</i> spp.	either <i>H. oculata</i> or <i>Isodictya</i> spp. (<i>I. palmata</i>)	104 (2%)	2 (0%)
	<i>Halichondria panicea</i>	Breadcrumb sponge	112 (2%)	6 (0.1%)
	<i>Halichondria sitiens</i>		129 (2%)	8 (0.2%)
	Sponges - unknown	mostly encrusting species	1829 (33%)	1855 (37%)
	Total		1464 (26%)	1871 (37%)
None	Debris	anthropogenic	36 (0.6%)	2 (0%)

Table 1 cont.

(Nozères et al. 2010; iNaturalist 2025; WoRMS 2025; C. Goodwin, Huntsman Marine Science Centre, *pers. comm.*). As only taxa selected *a priori* are documented here, rather than all visible taxa, our observations on taxa ‘richness’ are not formal species richness indices, but a proxy based on the number of taxa in each video interval and still image, of the 41 analyzed; hereafter referred to as taxa count.

Abundance of the 32 key taxa, not including ‘unknown’ taxa groups, was also recorded using the still imagery. Abundance was recorded based on the number of individual occurrences (count) within a still image. For colonial or mat-forming organisms such as encrusting sponges and calcareous algae, each individual colony/mat encountered in an image was counted, as percent cover was not attempted. For algae such as *Desmarestia* spp. and *Laminaria* spp., individuals were distinguished based on visible stipes or holdfasts. For other algal species including *Fucus* spp. and *Ascophyllum nodosum*, algal cover was usually too dense to distinguish visible holdfasts, and thus counts are attributed to obvious clumps. Count/abundance data for all 32 key taxa is available as open source data (Lawton 2022; Teed and Lawton 2026); here, we describe key taxa that have been designated as conservation priorities, namely, *M. modiolus* and *B. ovifera*, along with commercially important species, including *P. magellanicus*, *C. frondosa*, *S. droebachiensis*, and *H. americanus*. Counts were binned into the following categories for visualization purposes; 1: 1 individual (ind.) image⁻¹, 2: 2-5 ind. image⁻¹, 3: 6-10 ind. image⁻¹, 4: 11-20 ind. image⁻¹, 5: 21-50 ind. image⁻¹, 6: 51-100 ind. image⁻¹, 7: 101-200 ind. image⁻¹, and 8: >200 ind. image⁻¹. These count categories were derived, in part, from prior experience in assessment of abundances of two biogenic habitat-forming species, as described by Mireault et al. (2025). Counts in bins 4 through 8 reflect particularly high abundances, supporting biogenic habitat provision (*e.g.*, for *M. modiolus* and *B. ovifera*).

Image FOV was not available for all images, in part due to the lack of laser scaling devices on the camera system frame. The 10-cm diameter trigger weight was viewable in many images, but due to the need to lower the system frame towards the seafloor to activate the camera, particularly in highly sloped environments, images had variable FOVs, including some that were oblique to the seafloor (*e.g.*, compare Figure 3c and d). However, we did calculate and report density estimates by dividing the count of each species by an average still image field of view (~0.375 m² – calculated from a subset of 200 still images), to generate the number of individuals – ind. m⁻².

Near-seafloor imagery survey data (both still imagery and continuous seafloor video) from the 2016 and 2017 HH/WI/P, The Wolves, and Southern Grand Manan surveys are

stored in an archive (duplicate versions of the imagery on two 50 TB desktop RAID devices) managed by P. Lawton, L.L. Teed, and the DFO Coastal Ecosystems Science Division data management team at the St. Andrews Biological Station, New Brunswick, Canada. Survey summary data and image locations along with select taxa abundances are currently published on Canada's open data portal (Lawton 2022), which was subsequently published online to the Ocean Biodiversity Information System (OBIS; Teed and Lawton 2026).

2.2.1 VIDEO AND STILL IMAGERY COMPARISON

Occurrence data was extracted from the time-stamped digital still imagery dataset to match with associated video time-interval data to compare detectability of the selected taxa across the two sampling techniques. To accomplish this, the start and end time of the 30-s video intervals were recorded, with each video interval given an identification number (from 1 to 5561), and any still image that was taken within any given 30-s video interval was assigned the same identification number. Given that several still images were often taken within one 30-s video interval, taxa occurrence data across these still images were pooled, thereby prioritizing presences over absences. Substrate data was also compared, and in instances where several images were taken within one 30-s video interval, the most commonly occurring primary bottom-type was assigned to the still image record for the specified video interval identification number. Once in this format, with one still image taxonomic record for every matching video interval identification number, taxa occurrence and substrate were compared across both techniques of video and still imagery using paired comparisons. For taxa occurrences, a paired comparison was chosen to test whether detectability of taxa in the lower-resolution, but continuous video intervals and the higher-resolution, periodic digital still imagery at the relatively same location was equal.

3 RESULTS

A total of 150 drift-camera transects were completed across the HH/WI/P, The Wolves Islands, and Southern Grand Manan sub-areas across 29 days from July to October 2016 and from June to September 2017. Of these, only 136 transects reliably recorded continuous video and 134 transects contained high-resolution still images to be able to distinguish taxa, comprising the main analysis of this report (142 transects analyzed in total – Table 2). The HD video camera continuously recorded the seafloor over periods of 2 to 32 minutes per transect, while the digital still camera captured 2 to 74 images per transect. When combined, the drift transects produced ~48 hours of downward-facing continuous video, and between 4 to 59 30-s intervals per transect, with 5561 video intervals in total, and 5047 still images. Highly variable current speeds caused fluctuating drift speeds, generating variable distance travelled; transect lengths ranged from 62 m to 1.6 km, for a total survey distance of ~79 km (Table 2). Due to the operational depth rating for the camera system (to sample to ~85-m depths), transect depths ranged from 5 to 89 m.

3.1 VIDEO VISIBILITY

The quality of the video imagery analyzed was generally good, with a 5-10 cm (object discernability) visibility range for 50% of the 30-s video intervals (Figure 5). In this visibility range, most taxa of interest were easily identifiable. The highest quality visibility (<5 cm) comprised only 8% of the intervals, while the lowest quality visibility (>10 cm) accounted for 41%. Less than 1% of the video intervals had extremely poor visibility, as when the seafloor was obscured due to very high turbidity. Transects conducted earlier in the summer such as July had the most intervals of the highest quality visibility and were in the northern region of the Deer Island Passage (Figure 5). Factors that affected video quality included: altitude from the bottom, turbidity in the water column, camera focal distance, and light intensity.

Table 2 Summary information for 142 analyzed near-seafloor imagery transects (of a total set of 150 transects) conducted in SWNB in summer and fall 2016 and 2017. Transect numbers are consecutive Camera Deployment numbers (CD#) assigned to each camera deployment across the three study sub-areas/general EBSA regions: HH/WI/P (HHWIP), The Wolves, and Southern Grand Manan (GM). Start locations are provided in decimal degrees. The primary bottom type refers to the dominant primary bottom type across each transect (*i.e.*, most common across analyzed video intervals and still images), using a modified Wentworth (1922) scale including: bedrock, boulder, cobble, pebble, fine grain and mussel bed. Media analyzed refers to what media was analyzed; video intervals, still images, or both. Blank cells correspond to where no video intervals or still images were analyzed. Total number of observed taxa (of the 41 taxa selected) is also provided. Additional imagery metadata and full transect track lines are available on Canada's open data portal (see Lawton 2022).

Transect	Sub-area	Date	Start latitude	Start longitude	Transect time (min)	Distance travelled (m)	Minimum depth (m)	Mean depth (m)	Maximum depth (m)	Primary bottom type	Media analyzed	Number of video intervals	Number of stills	Total taxa observed
CD001	HHWIP	2016-07-12	44.93109	-66.9789	25	510	-30	-40	-48	pebble	both	50	58	29
CD002	HHWIP	2016-07-12	44.94166	-66.9705	25	310	-33	-42	-48	cobble	both	50	74	21
CD003	HHWIP	2016-07-12	44.93843	-66.9775	25	312	-8	-18	-33	cobble	both	50	57	22
CD004	HHWIP	2016-07-12	44.92961	-66.961	25	368	-21	-26	-34	pebble	both	50	54	23
CD005	HHWIP	2016-07-12	44.92373	-66.9486	25	958	-23	-42	-62	bedrock	both	50	34	21
CD006	HHWIP	2016-07-12	44.91742	-66.9718	17	477	-10	-20	-38	cobble	both	34	35	24
CD007	HHWIP	2016-07-13	44.99221	-66.8877	25	312	-63	-65	-68	fine grain	both	50	53	6
CD008	HHWIP	2016-07-13	45.00232	-66.8871	25	451	-40	-53	-72	fine grain	both	50	57	22
CD009	HHWIP	2016-07-13	45.00173	-66.8741	24	510	-10	-35	-52	fine grain	both	48	52	25
CD010	HHWIP	2016-07-13	44.9959	-66.8836	5	117	-58	-60	-64	fine grain	both	10	12	3
CD011	HHWIP	2016-07-13	44.98945	-66.9002	25	189	-47	-55	-65	bedrock	both	50	54	26
CD012	HHWIP	2016-07-13	44.97726	-66.8989	25	314	-23	-32	-43	fine grain	both	33	51	22
CD013	HHWIP	2016-07-13	44.97721	-66.9021	6	63	-19	-33	-38	fine grain	video	12		16
CD014	HHWIP	2016-07-14	44.95247	-66.9623	25	645	-28	-31	-37	pebble	both	50	49	18
CD015	HHWIP	2016-07-14	44.97141	-66.9393	25	210	-24	-26	-30	pebble	both	50	48	20
CD016	HHWIP	2016-07-14	44.98557	-66.9265	25	482	-28	-41	-45	cobble	both	50	46	17
CD017	HHWIP	2016-07-14	44.99407	-66.9209	25	294	-24	-34	-47	cobble	both	50	48	21
CD018	HHWIP	2016-07-15	44.99309	-66.8999	25	369	-44	-50	-56	fine grain	both	50	46	17
CD019	HHWIP	2016-07-15	44.9831	-66.9118	25	397	-24	-50	-71	pebble	both	50	51	25
CD020	HHWIP	2016-07-15	44.96121	-66.9255	20	485	-44	-47	-89	pebble	both	39	35	25
CD021	HHWIP	2016-07-15	44.96256	-66.9254	7	249	-17	-23	-26	bedrock	both	14	17	14

Transect	Sub-area	Date	Start latitude	Start longitude	Transect time (min)	Distance travelled (m)	Minimum depth (m)	Mean depth (m)	Maximum depth (m)	Primary bottom type	Media analyzed	Number of video intervals	Number of stills	Total taxa observed
CD022	HHWIP	2016-07-15	44.9665	-66.9306	25	806	-41	-47	-54	pebble	both	50	49	18
CD023	HHWIP	2016-08-22	45.03359	-66.885	17	625	-19	-25	-43	fine grain	both	34	28	20
CD024	HHWIP	2016-08-22	45.03092	-66.8818	9	331	-59	-64	-73	fine grain	both	18	41	17
CD025	HHWIP	2016-08-22	45.00595	-66.9178	25	163	-48	-52	-55	fine grain	both	50	11	12
CD026	HHWIP	2016-08-22	45.01763	-66.9104	25	329	-14	-22	-28	pebble	video	50		19
CD027	HHWIP	2016-08-23	44.99695	-66.9076	25	507	-38	-58	-68	fine grain	both	50	51	20
CD028	HHWIP	2016-08-23	45.00959	-66.8997	25	222	-21	-24	-29	cobble	both	50	47	21
CD029	HHWIP	2016-08-23	45.01773	-66.894	25	130	-18	-27	-29	pebble	both	50	48	22
CD030	HHWIP	2016-08-23	45.02657	-66.8986	26	414	-27	-38	-44	fine grain	both	51	50	17
CD032	HHWIP	2016-08-23	44.99335	-66.8724	12	396	-24	-47	-74	fine grain	video	24		15
CD033	HHWIP	2016-08-24	44.95372	-66.9404	9	127	-17	-23	-25	pebble	video	18		13
CD034	HHWIP	2016-08-24	44.95193	-66.9416	25	209	-8	-16	-19	pebble	both	50	46	24
CD035	HHWIP	2016-08-24	44.9941	-66.8717	25	398	-38	-56	-68	fine grain	both	50	57	18
CD036	HHWIP	2016-08-25	44.98967	-66.8744	10	175	-22	-33	-46	fine grain	both	20	17	13
CD037	HHWIP	2016-08-25	44.99076	-66.875	25	332	-31	-45	-63	fine grain	both	50	46	19
CD038	HHWIP	2016-08-25	44.99346	-66.8718	15	397	-21	-48	-67	fine grain	both	31	31	15
CD041	Wolves	2016-09-19	44.98245	-66.7056	10	342	-29	-31	-32	fine grain	both	20	9	9
CD042	Wolves	2016-09-19	44.97409	-66.7183	25	582	-23	-35	-41	fine grain	both	50	49	18
CD043	Wolves	2016-09-19	44.96983	-66.7217	25	284	-19	-22	-26	fine grain	both	50	52	16
CD044	Wolves	2016-09-19	44.9581	-66.7366	25	591	-35	-39	-41	pebble	both	50	52	15
CD045	Wolves	2016-09-19	44.95111	-66.7399	25	153	-31	-34	-38	fine grain	both	50	48	17
CD046	Wolves	2016-09-20	44.9439	-66.7406	9	285	-28	-29	-32	fine grain	both	19	18	8
CD047	Wolves	2016-09-20	44.93503	-66.74	19	1150	-34	-43	-71	pebble	both	40	51	16
CD048	Wolves	2016-09-20	44.93831	-66.7281	25	286	-34	-41	-48	pebble	both	50	50	21
CD049	Wolves	2016-09-20	44.9421	-66.7276	4	68	-21	-32	-33	pebble	both	7	7	11
CD050	Wolves	2016-09-20	44.94497	-66.7267	21	839	-34	-47	-68	pebble	stills		49	15
CD051	Wolves	2016-09-20	44.94713	-66.7289	25	510	-23	-29	-37	pebble	both	50	50	16
CD052	Wolves	2016-09-20	44.94978	-66.7266	25	582	-27	-31	-32	cobble	both	50	50	17
CD053	Wolves	2016-09-20	44.94487	-66.7276	2	62	-35	-39	-40	fine grain	video	4		6

Transect	Sub-area	Date	Start latitude	Start longitude	Transect time (min)	Distance travelled (m)	Minimum depth (m)	Mean depth (m)	Maximum depth (m)	Primary bottom type	Media analyzed	Number of video intervals	Number of stills	Total taxa observed
CD056	Wolves	2016-10-18	44.98142	-66.7593	15	173	-64	-66	-69	fine grain	stills		2	1
CD057	Wolves	2016-10-18	45.00465	-66.7172	16	930	-49	-54	-57	fine grain	stills		3	0
CD058	Wolves	2016-10-18	44.99052	-66.6895	10	231	-32	-35	-37	pebble	both	20	16	11
CD059	Wolves	2016-10-18	44.98185	-66.7085	25	365	-36	-42	-47	fine grain	both	50	41	13
CD060	Wolves	2016-10-18	44.97055	-66.7231	15	503	-27	-40	-45	fine grain	both	31	29	14
CD061	Wolves	2016-10-18	44.96955	-66.7233	10	353	-23	-35	-44	fine grain	both	20	21	16
CD062	Wolves	2016-10-18	44.93977	-66.7392	15	217	-15	-23	-28	bedrock	both	30	14	16
CD063	Wolves	2016-10-18	44.93905	-66.7391	25	367	-17	-26	-29	fine grain	both	50	47	15
CD064	HHWIP	2016-10-19	44.94466	-67.003	7	62	-21	-26	-29	pebble	both	14	13	13
CD065	HHWIP	2016-10-19	44.94191	-67.0021	11	360	-28	-29	-32	boulder	both	23	21	13
CD066	HHWIP	2016-10-19	44.93728	-66.9988	20	644	-32	-50	-57	pebble	both	40	34	17
CD067	HHWIP	2016-10-19	44.95191	-66.8945	20	1030	-30	-39	-67	pebble	both	40	36	18
CD068	HHWIP	2016-10-19	44.92656	-66.8929	25	314	-33	-48	-75	pebble	both	50	50	13
CD069	HHWIP	2016-10-19	44.90574	-66.8907	25	450	-28	-33	-38	fine grain	both	50	48	19
CD071	HHWIP	2016-10-20	44.90891	-66.9581	25	194	-20	-23	-29	cobble	both	50	51	17
CD072	HHWIP	2016-10-20	44.91322	-66.9556	25	700	-32	-43	-54	boulder	both	50	41	17
CD073	HHWIP	2016-10-20	44.95151	-66.9205	9	372	-35	-43	-51	pebble	both	18	18	18
CD074	HHWIP	2016-10-20	44.88406	-66.9003	30	1031	-22	-31	-35	pebble	both	59	52	15
CD075	HHWIP	2016-10-20	44.87478	-66.9078	30	334	-19	-24	-26	pebble	both	59	53	15
CD076	HHWIP	2016-10-21	44.96809	-66.932	15	536	-28	-37	-45	pebble	both	31	27	15
CD077	HHWIP	2016-10-21	44.96475	-66.9324	25	923	-21	-38	-51	pebble	both	50	46	18
CD078	HHWIP	2017-06-26	45.03874	-66.9523	24	241	-27	-28	-30	pebble	both	22	49	11
CD079	HHWIP	2017-06-26	45.02664	-66.9664	6	64	-27	-29	-29	fine grain	both	12	9	6
CD080	HHWIP	2017-06-26	45.02935	-66.9695	18	195	-24	-28	-33	fine grain	video	36		12
CD082	HHWIP	2017-06-27	45.01579	-66.9128	25	559	-14	-21	-32	pebble	both	50	49	22
CD083	HHWIP	2017-06-27	44.96567	-66.9412	25	732	-34	-37	-42	cobble	both	50	52	16
CD084	HHWIP	2017-06-27	44.991	-67.011	10	94	-42	-46	-48	fine grain	both	19	21	15
CD085	HHWIP	2017-06-27	45.00043	-67.0009	10	254	-40	-42	-43	fine grain	both	20	23	11
CD086	HHWIP	2017-06-28	44.95017	-66.9543	19	726	-20	-26	-33	pebble	both	36	38	19

Transect	Sub-area	Date	Start latitude	Start longitude	Transect time (min)	Distance travelled (m)	Minimum depth (m)	Mean depth (m)	Maximum depth (m)	Primary bottom type	Media analyzed	Number of video intervals	Number of stills	Total taxa observed
CD087	HHWIP	2017-06-28	44.94666	-66.9395	15	245	-23	-26	-32	bedrock	both	31	28	23
CD088	HHWIP	2017-06-28	44.92008	-66.9469	25	440	-31	-41	-46	pebble	both	50	32	21
CD089	HHWIP	2017-06-29	45.01939	-66.8934	27	415	-34	-43	-66	pebble	both	34	54	23
CD090	HHWIP	2017-06-29	45.02344	-66.8787	25	411	-53	-62	-70	pebble	both	50	50	23
CD091	HHWIP	2017-06-29	45.01713	-66.8657	25	212	-21	-28	-34	fine grain	both	50	48	25
CD092	HHWIP	2017-06-29	45.00507	-66.8799	25	359	-22	-33	-45	fine grain	both	50	46	19
CD093	HHWIP	2017-06-29	44.98338	-66.8986	12	601	-13	-31	-66	bedrock	both	22	21	19
CD094	HHWIP	2017-06-29	44.97894	-66.935	25	379	-34	-43	-47	fine grain	both	50	47	17
CD095	HHWIP	2017-08-01	45.01593	-66.9864	25	181	-30	-32	-35	fine grain	both	50	32	8
CD096	HHWIP	2017-08-01	44.99331	-67.0073	25	307	-22	-31	-33	fine grain	both	50	52	15
CD097	HHWIP	2017-08-02	44.97685	-67.0234	25	765	-33	-50	-66	pebble	video	50		16
CD098	HHWIP	2017-08-02	44.98318	-67.0194	16	431	-41	-43	-45	pebble	both	33	33	19
CD099	HHWIP	2017-08-02	45.05284	-66.9379	25	294	-31	-35	-36	fine grain	both	50	50	17
CD100	HHWIP	2017-08-02	45.05699	-66.9338	25	431	-41	-48	-53	pebble	both	50	4	12
CD101	HHWIP	2017-08-03	45.02102	-66.9065	20	419	-14	-28	-36	fine gain	both	37	39	15
CD102	HHWIP	2017-08-03	44.92195	-66.9638	25	843	-24	-27	-31	pebble	both	50	50	23
CD104	GM	2017-08-15	44.58069	-66.793	25	410	-24	-29	-31	fine grain	both	50	52	10
CD105	GM	2017-08-15	44.57405	-66.7727	26	210	-19	-22	-26	pebble	both	50	48	15
CD106	GM	2017-08-15	44.58861	-66.7818	25	823	-15	-23	-29	bedrock	both	50	7	9
CD107	GM	2017-08-15	44.59947	-66.7759	25	718	-12	-19	-22	fine grain	both	50	40	8
CD108	GM	2017-08-15	44.6173	-66.7705	21	563	-12	-16	-17	fine grain	both	42	37	9
CD109	GM	2017-08-15	44.63328	-66.7644	25	824	-15	-17	-18	fine grain	both	50	15	8
CD110	GM	2017-08-16	44.57012	-66.7136	26	1009	-29	-41	-52	bedrock	both	50	52	18
CD112	GM	2017-08-16	44.5926	-66.6996	7	247	-20	-24	-26	pebble	both	14	14	11
CD113	GM	2017-08-16	44.59117	-66.6971	25	1067	-18	-25	-29	bedrock	video	50		13
CD114	GM	2017-08-16	44.60299	-66.7095	17	1140	-11	-14	-16	cobble	both	35	28	14
CD115	GM	2017-08-16	44.59954	-66.7092	8	576	-12	-18	-21	pebble	both	16	15	12
CD116	GM	2017-08-16	44.58625	-66.7144	9	443	-19	-30	-35	pebble	both	17	15	10
CD117	GM	2017-08-16	44.58105	-66.716	18	775	-31	-36	-38	pebble	both	36	25	10

Transect	Sub-area	Date	Start latitude	Start longitude	Transect time (min)	Distance travelled (m)	Minimum depth (m)	Mean depth (m)	Maximum depth (m)	Primary bottom type	Media analyzed	Number of video intervals	Number of stills	Total taxa observed
CD118	GM	2017-08-17	44.57015	-66.7442	25	1539	-19	-22	-26	bedrock	both	50	14	13
CD119	GM	2017-08-17	44.60335	-66.7249	25	511	-13	-24	-29	pebble	both	41	46	13
CD120	GM	2017-08-17	44.5928	-66.7208	25	533	-21	-23	-24	bedrock	both	51	38	17
CD121	GM	2017-08-17	44.60582	-66.7324	32	1134	-21	-26	-28	pebble	both	50	33	15
CD122	GM	2017-08-17	44.60451	-66.7514	25	1142	-16	-19	-24	pebble	both	50	50	18
CD123	GM	2017-08-17	44.58587	-66.7467	25	879	-19	-26	-30	cobble	both	50	50	16
CD124	GM	2017-08-17	44.61197	-66.7474	25	1158	-17	-20	-23	pebble	both	50	44	9
CD125	GM	2017-08-18	44.53109	-66.7808	25	604	-23	-26	-30	pebble	both	50	19	14
CD126	GM	2017-08-18	44.49999	-66.7922	25	1159	-34	-43	-56	bedrock	both	50	7	10
CD127	GM	2017-08-18	44.48965	-66.7959	25	1460	-37	-52	-74	bedrock	both	17	52	12
CD128	GM	2017-08-18	44.52546	-66.8136	25	950	-24	-45	-59	fine grain	both	50	51	14
CD129	GM	2017-08-18	44.6022	-66.6725	25	1232	-16	-20	-23	cobble	both	50	8	14
CD130	GM	2017-08-18	44.62728	-66.6501	9	392	-38	-50	-54	pebble	both	18	18	13
CD131	GM	2017-09-12	44.50907	-66.8839	6	1582	-16	-17	-19	bedrock	stills		17	8
CD132	GM	2017-09-12	44.53551	-66.843	5	228	-27	-28	-30	bedrock	stills		2	3
CD133	GM	2017-09-12	44.53401	-66.8392	25	1185	-19	-30	-41	fine grain	both	50	45	13
CD134	GM	2017-09-12	44.55084	-66.8123	25	1046	-15	-20	-40	bedrock	both	50	45	14
CD135	GM	2017-09-13	44.48111	-66.8702	25	654	-40	-49	-57	pebble	both	50	49	18
CD136	GM	2017-09-13	44.47493	-66.8255	25	436	-39	-47	-52	bedrock	both	50	45	15
CD137	GM	2017-09-13	44.50321	-66.8465	9	776	-26	-35	-48	pebble	stills		45	12
CD138	GM	2017-09-13	44.49014	-66.7753	25	985	-20	-48	-82	bedrock	both	21	48	13
CD139	GM	2017-09-13	44.52802	-66.7469	25	1328	-33	-41	-48	pebble	both	50	45	16
CD140	GM	2017-09-13	44.54941	-66.758	25	1633	-18	-24	-30	pebble	both	50	45	16
CD141	GM	2017-09-14	44.57143	-66.7281	25	1263	-24	-30	-45	bedrock	both	50	46	15
CD142	GM	2017-09-14	44.57452	-66.7962	25	445	-29	-30	-32	fine grain	both	43	51	9
CD143	GM	2017-09-14	44.56786	-66.8256	25	221	-25	-26	-27	pebble	both	50	47	14
CD144	GM	2017-09-14	44.57369	-66.8423	25	277	-24	-25	-28	fine grain	both	50	45	14
CD145	GM	2017-09-14	44.59356	-66.7924	25	609	-18	-20	-22	pebble	both	24	47	13
CD146	GM	2017-09-14	44.61873	-66.7507	25	1126	-15	-17	-20	pebble	both	50	44	13

Transect	Sub-area	Date	Start latitude	Start longitude	Transect time (min)	Distance travelled (m)	Minimum depth (m)	Mean depth (m)	Maximum depth (m)	Primary bottom type	Media analyzed	Number of video intervals	Number of stills	Total taxa observed
CD147	GM	2017-09-14	44.62462	-66.7905	25	656	-5	-10	-14	fine grain	both	50	9	5
CD148	GM	2017-09-14	44.61368	-66.7823	25	944	-13	-17	-40	fine grain	both	50	43	10
CD149	GM	2017-09-15	44.61571	-66.6573	15	1207	-22	-30	-40	bedrock	both	31	27	15
CD150	GM	2017-09-15	44.63187	-66.6476	25	1334	-35	-46	-54	pebble	both	50	47	17
CD151	GM	2017-09-15	44.65717	-66.6623	24	695	-37	-44	-49	fine grain	both	42	49	19

Table 2 cont.

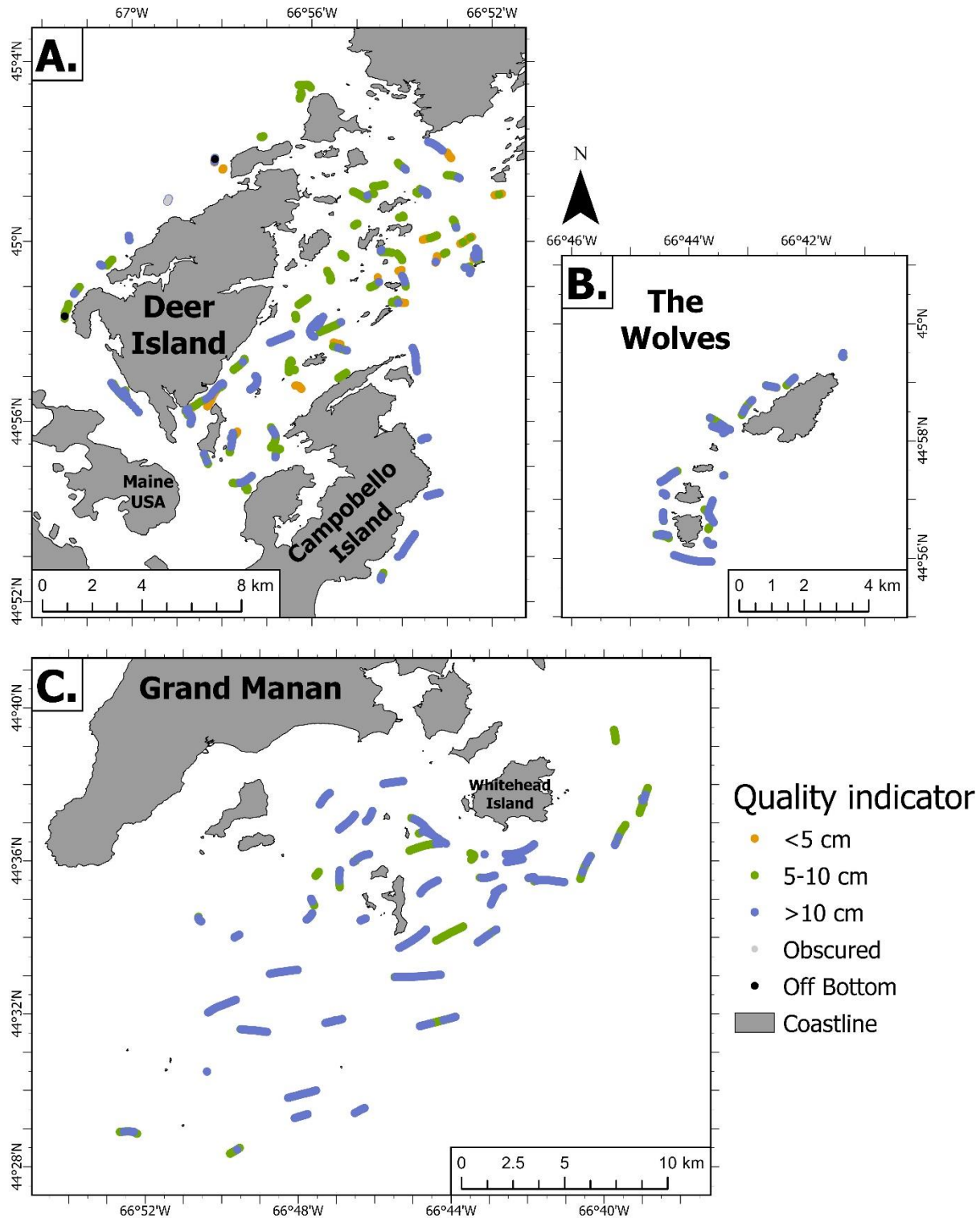


Figure 5 Quality of the underwater 30-s video intervals according to visibility (*i.e.*, view obscured, camera off-bottom, etc.) and the ability to identify taxa of a given size (<5 cm, 5-10 cm, and >10 cm) across transects within and surrounding (A) the HH/WI/P EBSA, (B) The Wolves Islands EBSA, and (C) Southern Grand Manan EBSA.

3.2 PRIMARY SUBSTRATES

Transects covered areas of both hard (*e.g.*, bedrock) and soft (*e.g.*, fine grain) bottom-types (Figure 6). From the continuous video, soft substrates were present in only 33% of the video intervals and hard substrates (*i.e.*, bedrock, boulder, cobble and pebble) comprised 66% of the area surveyed. Soft substrates that could not be distinguished between sand and silt were classified as fine-grained bottom-types, which was the most common bottom-type observed (33%). Pebble primary bottom-types were the second-most common bottom-types identified in 26% of video intervals and 39% of all hard bottom intervals (Figure 6a). Bedrock outcrops comprised 18% of the total 30-s intervals, but 27% of the primary hard bottom intervals. There was no significant difference between the depth-related distributions of the seven bottom-types identified, although soft substrates were slightly more common at deeper depths than hard substrates (Figure 6b).

Similar observations were made regarding dominant bottom-types from the still imagery, where soft substrates were present in 28% of images and hard substrates comprised 65% (Figure 6a). The remaining 7% of images were predominately composed of dominant shell hash (~6%) and mussel beds (~1%). Fine-grain soft substrates were the most common bottom-type observed in the still images, followed by pebbles (38% of all images and 59% of hard bottom substrates). Bedrock and cobbles comprised the dominant bottom-type in only 11% of still images (17% of hard bottom-type stills), less than observed in the video intervals. Akin to the video intervals, all bottom-types were observed across the depth range surveyed (Figure 6b). However, mussel beds were observed across a much larger depth range (~20-80 m) in the still images compared to video intervals (~25-30 m). This is due to mussel beds comprising the dominant bottom-type in only one transect in the video intervals (CD87 in 17 intervals), but across five transects (and 34 still images) in the still images. Such a difference could be due to varying annotator bias on what constitutes the primary bottom-type, as an annotator may have labelled a still image as a mussel bed primary bottom-type when only clumps of mussels were present.

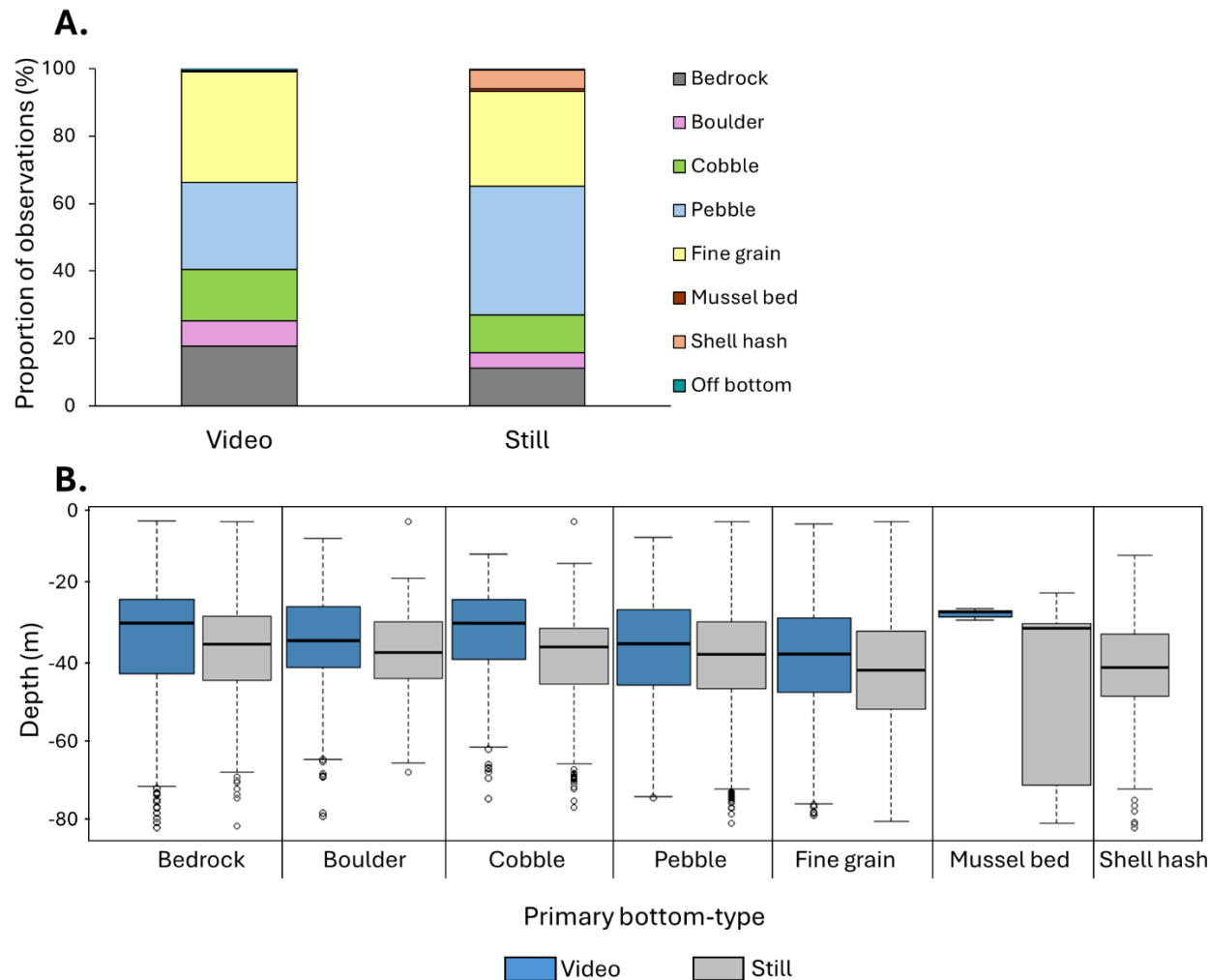


Figure 6 (A) Proportional (%) bar chart of the primary bottom-type observations in the analyzed 30-s video intervals (bedrock – 18%, boulder – 8%, cobble – 15%, pebble – 26%, fine-grained – 33%, mussel bed – 0.3%, and off-bottom – 0.6%) and digital still images (bedrock – 11%, boulder – 5%, cobble – 11%, pebble – 38%, fine-grained – 28%, mussel bed – 0.7%, shell hash – 6%, and off-bottom – 0.5%). (B) Boxplots of primary bottom-types are also shown according to depth distribution (m) and imaging technique: video intervals (blue) and digital still images (grey). Shell hash was only included in the still image analysis.

3.3 TAXA OCCURRENCES AND COUNTS

A total of 19216 and 16827 taxa occurrences were documented across the 5561 video intervals and 5047 still images, respectively. In the digital still images, of the 32 primary taxa reported and excluding the 'unknown' groupings, blood stars (*Henricia* spp.) were the most commonly occurring taxa, present in 26% of still images, across the entire depth range surveyed (Table 1). Video intervals documented high prevalence (>25%) of several taxa, including *Urticina/Cribsinopsis* spp., *Placopecten magellanicus*, common sea stars, and *Cancer* spp. (Table 1). Anthropogenic debris was rarely encountered, observed in only 0.6% of video intervals, and absent from still images (Table 1).

Counts of taxa, for the 41 types analyzed across the survey, were calculated for each of the drift transects in the video intervals (Figure 7) and digital still images (Figure 8). Given that transects had up to 14 and 16 taxa counts from individual video intervals and still images respectively, we provide generalized overview map representations where larger symbol sizes are used for successively higher taxa counts (Figure 7 and 8). Taxa counts were variable across transects; however, this representation provides a visual summary of where high taxa counts are distributed, both within and across EBSAs (see source data for more detailed *post-hoc* evaluation; Lawton 2022; Teed and Lawton 2026). The highest taxa counts occurred in the HH/WI/P EBSA transects, particularly in the Deer Island Passage area (average: 15 taxa in video intervals and 17 in still images) in the southern part between Campobello Island and Deer Island, namely in Head Harbour Passage and surrounding Indian Island. From the video analysis, site CD001 located off Doctor's Cove at the southern tip of Deer Island, observed 29 of 41 key taxa. Another area of high taxa count occurred in the northeastern part of the EBSA near several smaller islands: Adam, Simpsons, Barnes, and White (Figure 7a and 8a), with up to 26 taxa. According to the video intervals, CD012 had the lowest taxa count with only two reported taxa (algae) off Spruce Island, likely due to the low visibility because of high turbidity in this transect. In the still images, one transect (CD057 off The Wolves) revealed none of the 41 taxa, likely due to low visibility leading to the inability to analyze video intervals, as when there was too much turbidity. Overall, taxa counts were relatively high around The Wolves Islands (average: 12 taxa in video intervals and 13 in still images), with up to 21 taxa observed in CD048 (Figure 7b and 8b). Similar taxa counts were observed in transects off Southern Grand Manan (average taxa observed per transect: 10 in video intervals and 12 in still images), with CD151 east of White Head Island reaching 19 taxa (Figure 7c and 8c). It should be noted that if all the taxa observed were identified to the lowest possible taxonomic level, then the sum of counts and their distributions would likely shift.

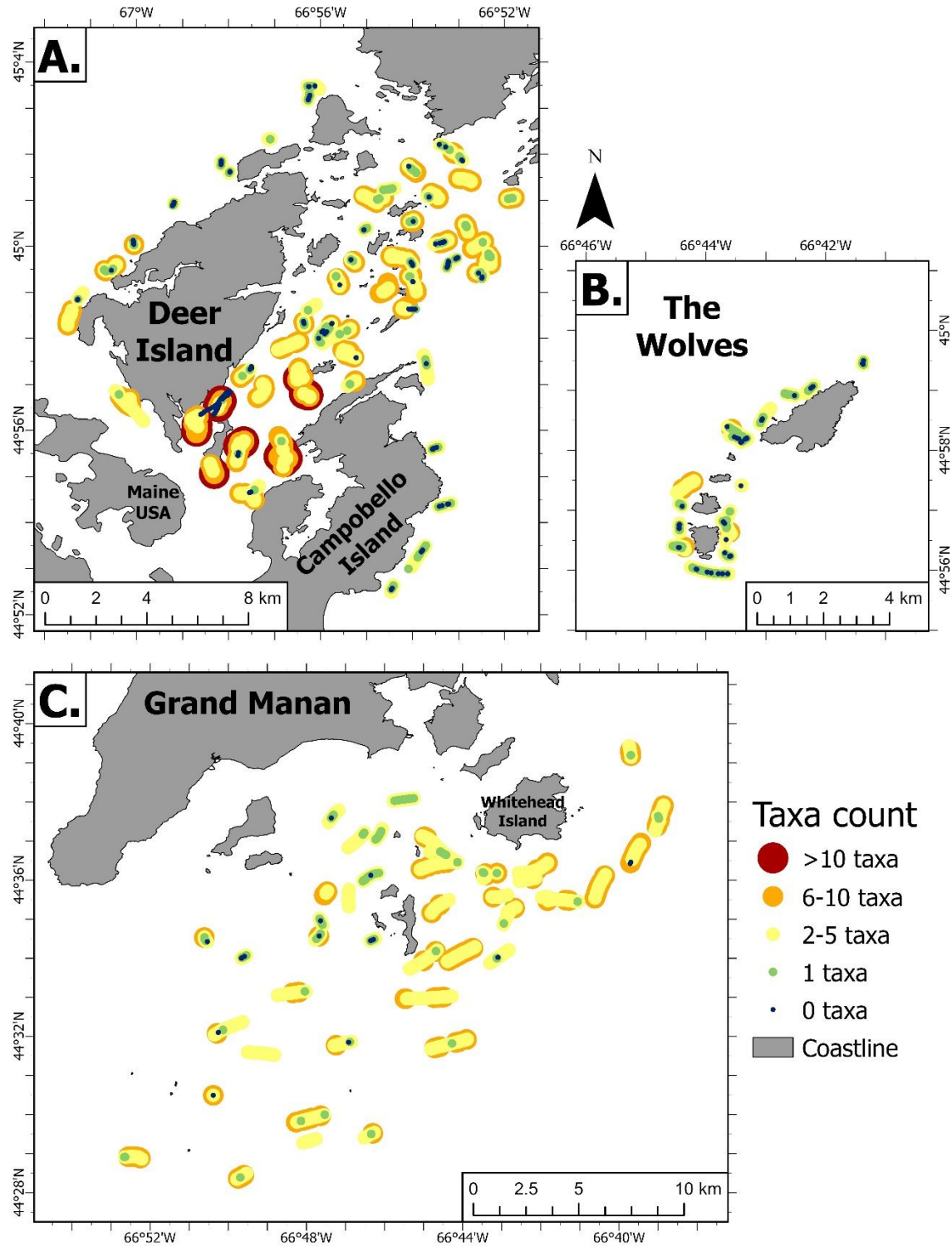


Figure 7 The number of taxa present (*i.e.*, count out of $n=41$ possible taxa) in each 30-s video interval ($n=5561$) across 136 transects. (A) contains taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

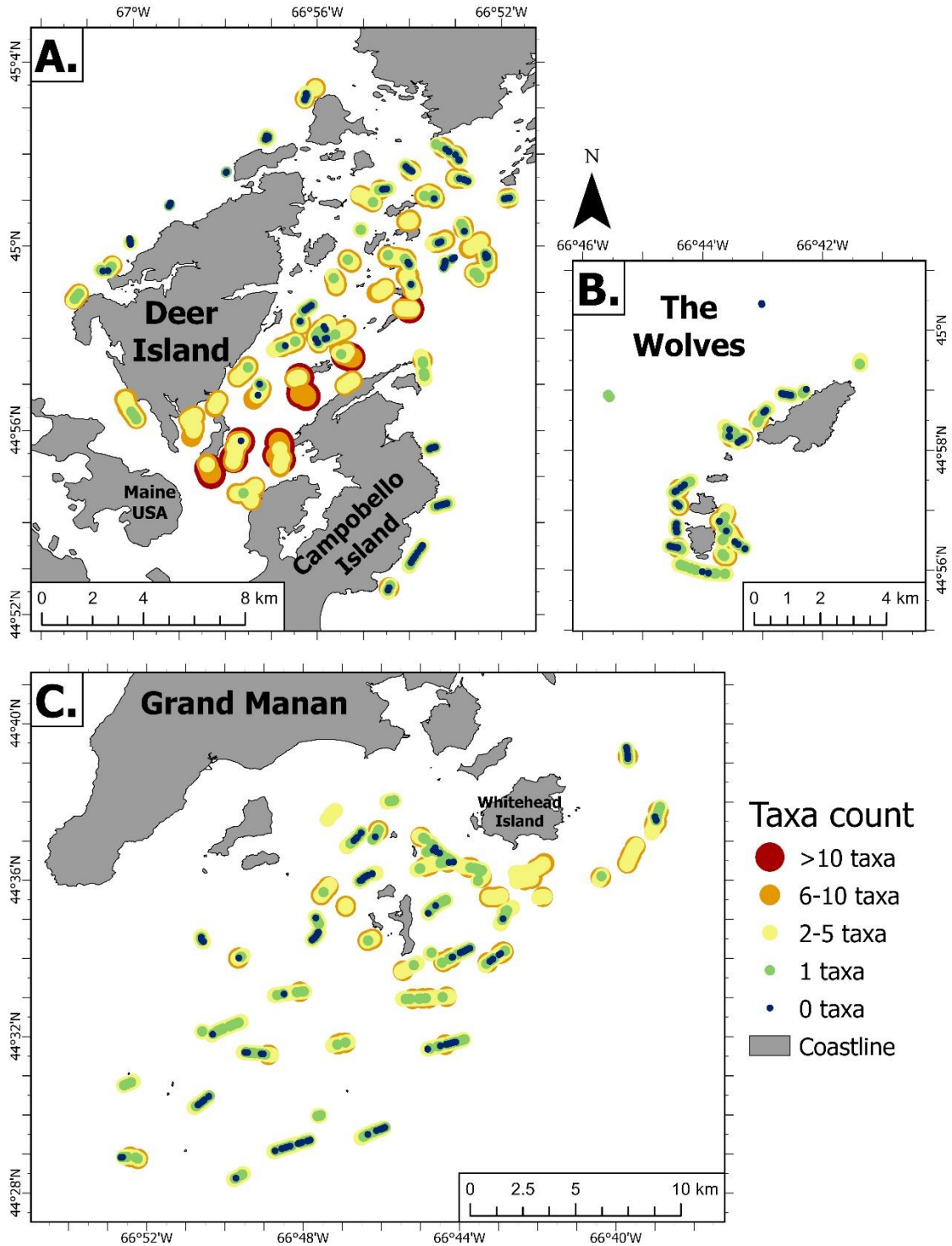


Figure 8 The number of taxa present (*i.e.*, count out of $n=41$ possible taxa) in each analyzed digital still image ($n=5047$) across 134 transects. (A) contains taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

3.3.1 ACTINOPTERYGII

Fishes of interest were present in 13% of the video intervals and <5% of the still images (Table 1). Considering fish are highly mobile taxa, fish were likely better captured from continuous seafloor video but were still likely underrepresented considering they may avoid camera systems (Rooper et al. 2019; Boulard et al. 2023; Figure 9 and 10). Most transects had at least one fish taxa present, with 73 transects having at least two (as documented from the video analysis; Figure 9). The suborder Cottoidei, containing fishes such as sculpins, was specifically identified as a key taxon. Others like redfish (*Sebastes fasciatus*), hake (*Urophycis chuss* or *U. tenuis*), ocean pout (*Zoarces americanus*), and winter flounder (*Pseudopleuronectes americanus*), among other species, were also observed, but not recorded as individual taxa due to the difficulty in confidently identifying every encounter. Fishes were found across all three study areas on all bottom-types but were most common on fine-grained and pebble substrates (Figure 11a and 12a).

3.3.2 ASCIDIACEA

Ascidians were much more prevalent in the still imagery (49%) compared to the video intervals (~15%). Lower detectability of ascidians in video intervals is likely due to the higher pixel resolution of the digital stills being able to better capture small specimens that can often blend in with the underlying substrate (such as *Dendrodoa carnea* and small *Boltenia ovifera*) (Figure 13 and 14). The most common ascidian species was the stalked tunicate *B. ovifera*, present in 14% of video intervals and 12% of still images (Table 1), primarily in the HH/WI/P EBSA (Table 3), with few occurrences off The Wolves Islands, and none in Southern Grand Manan. *B. ovifera* were found mainly on bedrock and boulder bottom-types (Figure 11b and 12b). This species is of particular interest as it is known to generate biogenic habitat for other species (Francis et al. 2014; Mireault et al. 2025).

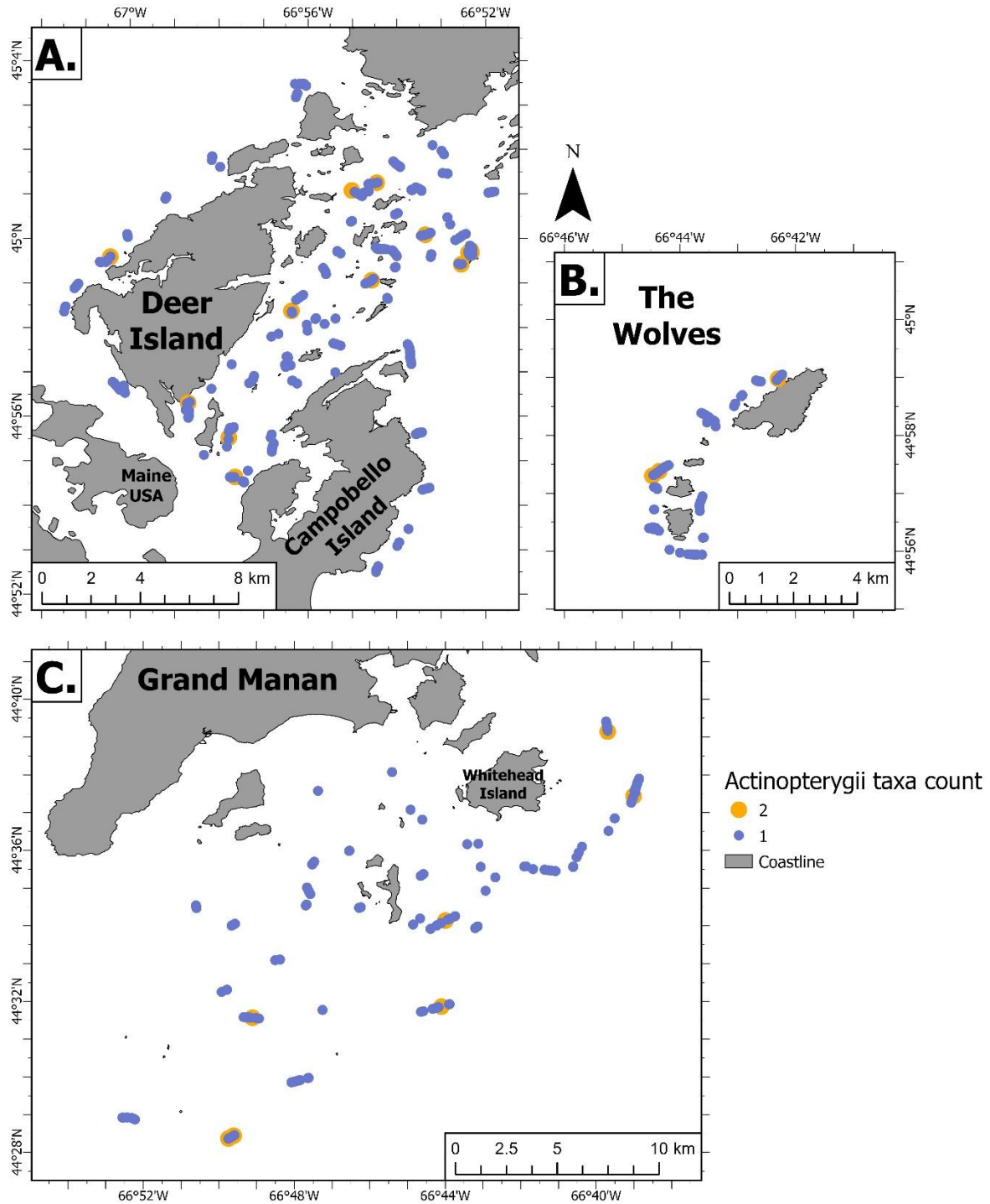


Figure 9 The number of taxa present in the Actinopterygii taxa group (including Cottoidei, and unknown fishes: $n=2$) across each 30-s video interval ($n=5561$). (A) contains fish taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

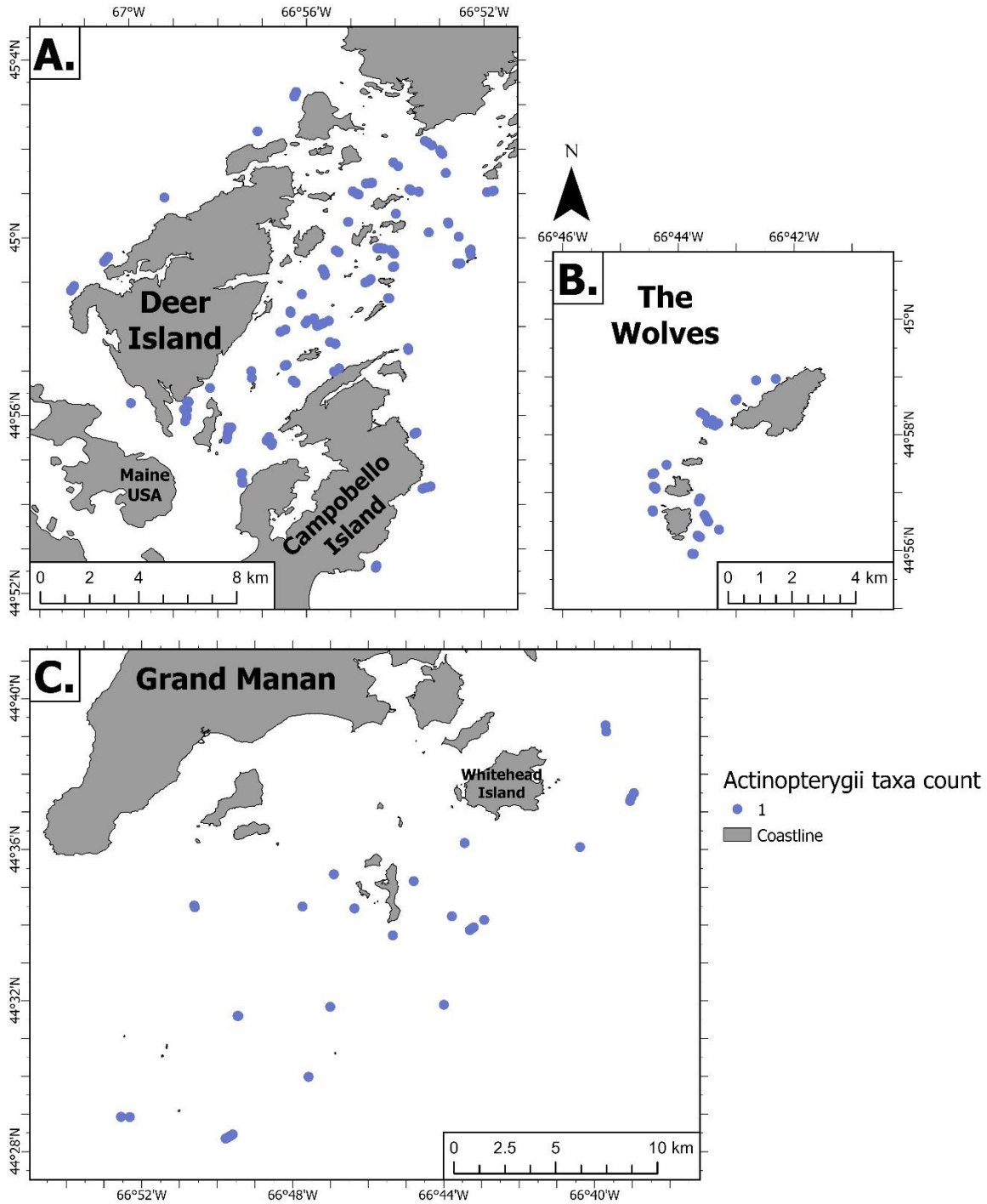


Figure 10 The number of taxa present in the Actinopterygii taxa group (including Cottoidei, and unknown fishes: $n=2$) across each analyzed digital still image ($n=5047$). (A) contains fish taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

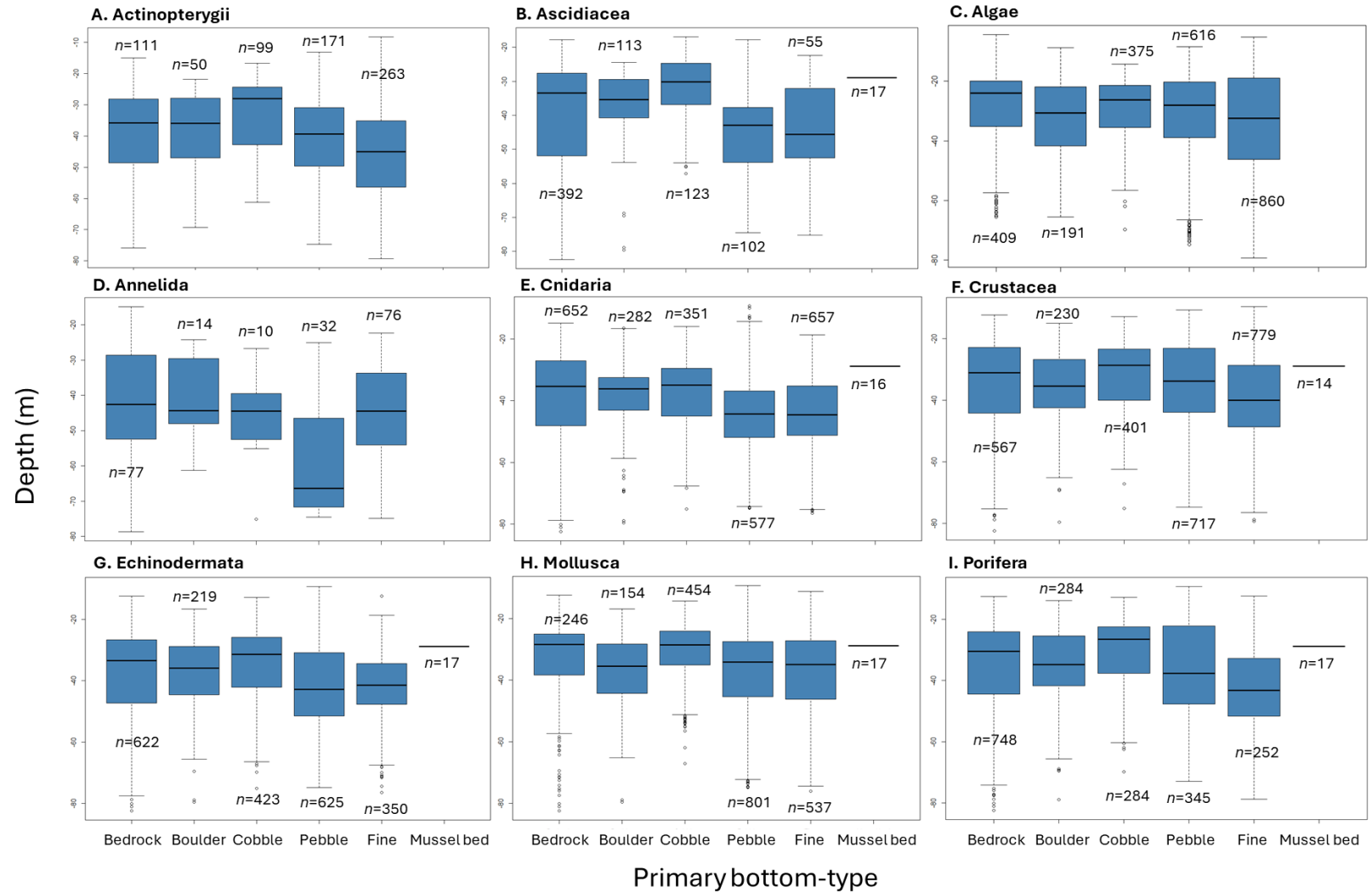


Figure 11 Boxplots of the video interval primary bottom-type (*i.e.*, bedrock, boulder, cobble, pebble, fine-grain, and mussel bed) depth distribution according to taxa group: (A) Actinopterygii, (B) Ascidiacea, (C) Algae, (D) Annelida, (E) Cnidaria, (F) Crustacea, (G) Echinodermata, (H) Mollusca, and (I) Porifera. The number of video intervals within each substrate category (n) are provided on the boxplots.

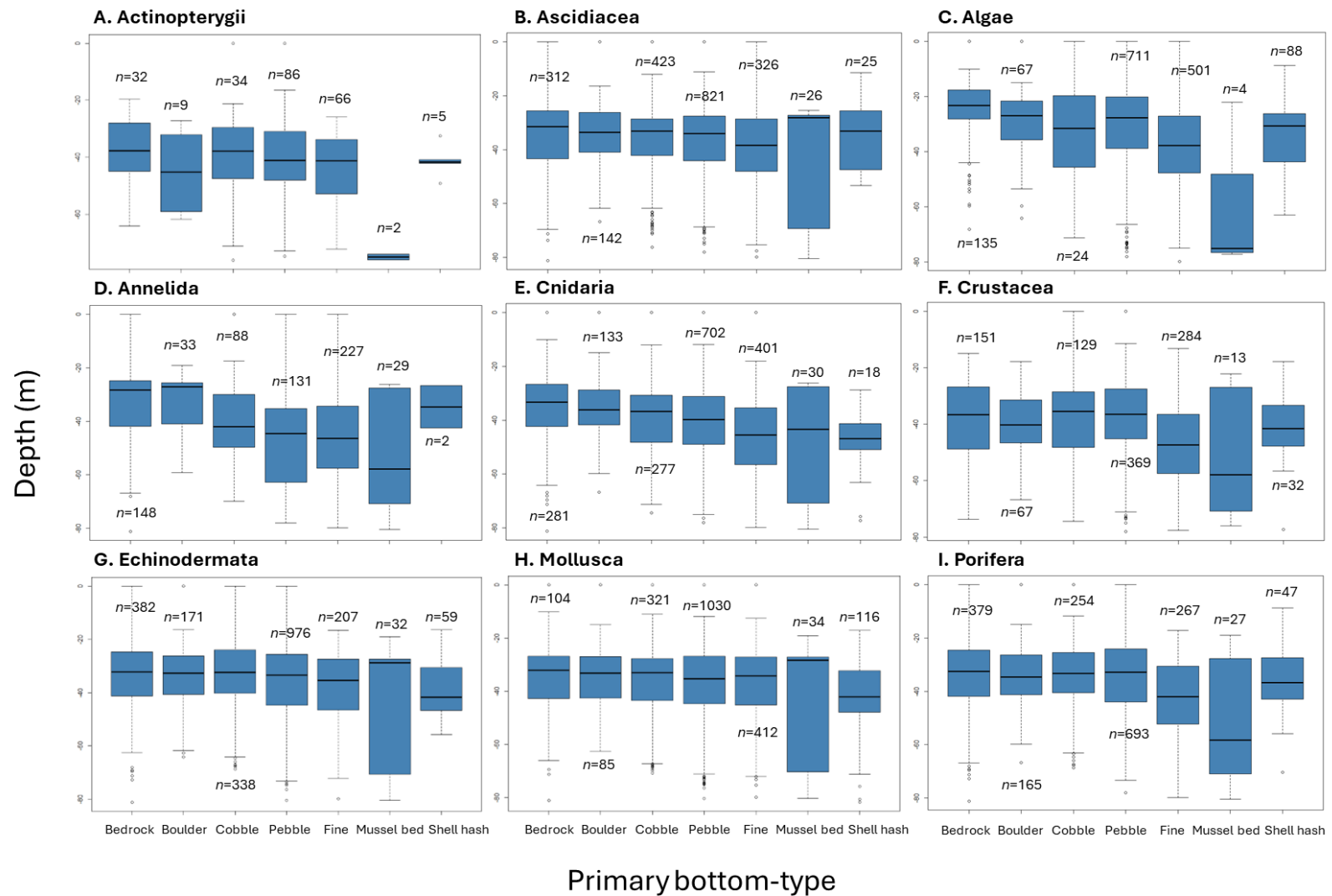


Figure 12 Boxplots of the digital still imagery primary bottom-type (*i.e.*, bedrock, boulder, cobble, pebble, fine-grain, and mussel bed) depth distribution according to taxa group: (A) Actinopterygii, (B) Ascidiacea, (C) Algae, (D) Annelida, (E) Cnidaria, (F) Crustacea, (G) Echinodermata, (H) Mollusca, and (I) Porifera. The number of still images within each substrate category (*n*) are provided on the boxplots.

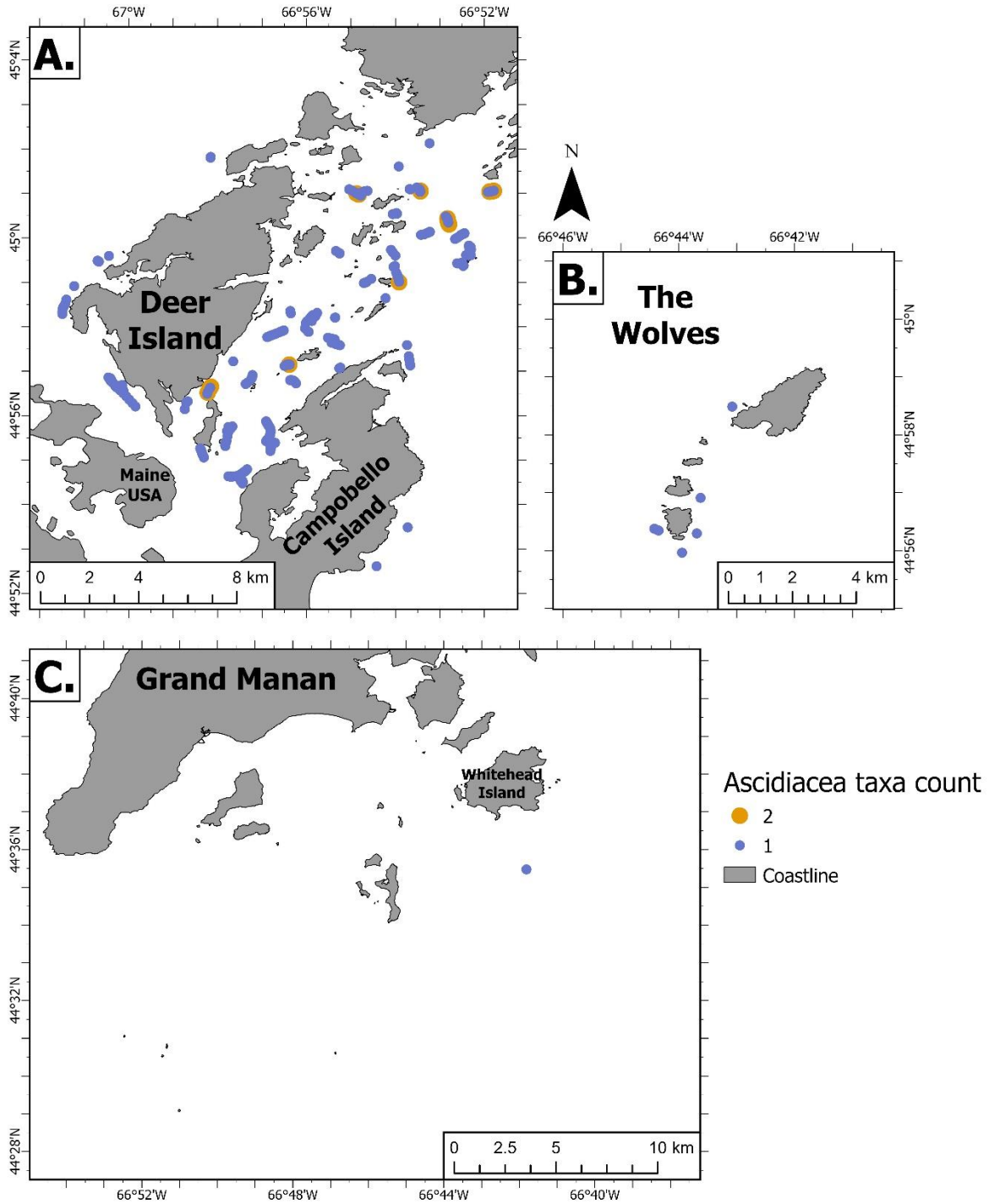


Figure 13 The number of taxa present in the Asciidiacea taxa group (including *Boltenia ovifera*, *Dendrodoa carnea*, and unknown ascidians: n=3) across each 30-s video interval (n=5561). (A) contains ascidian taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

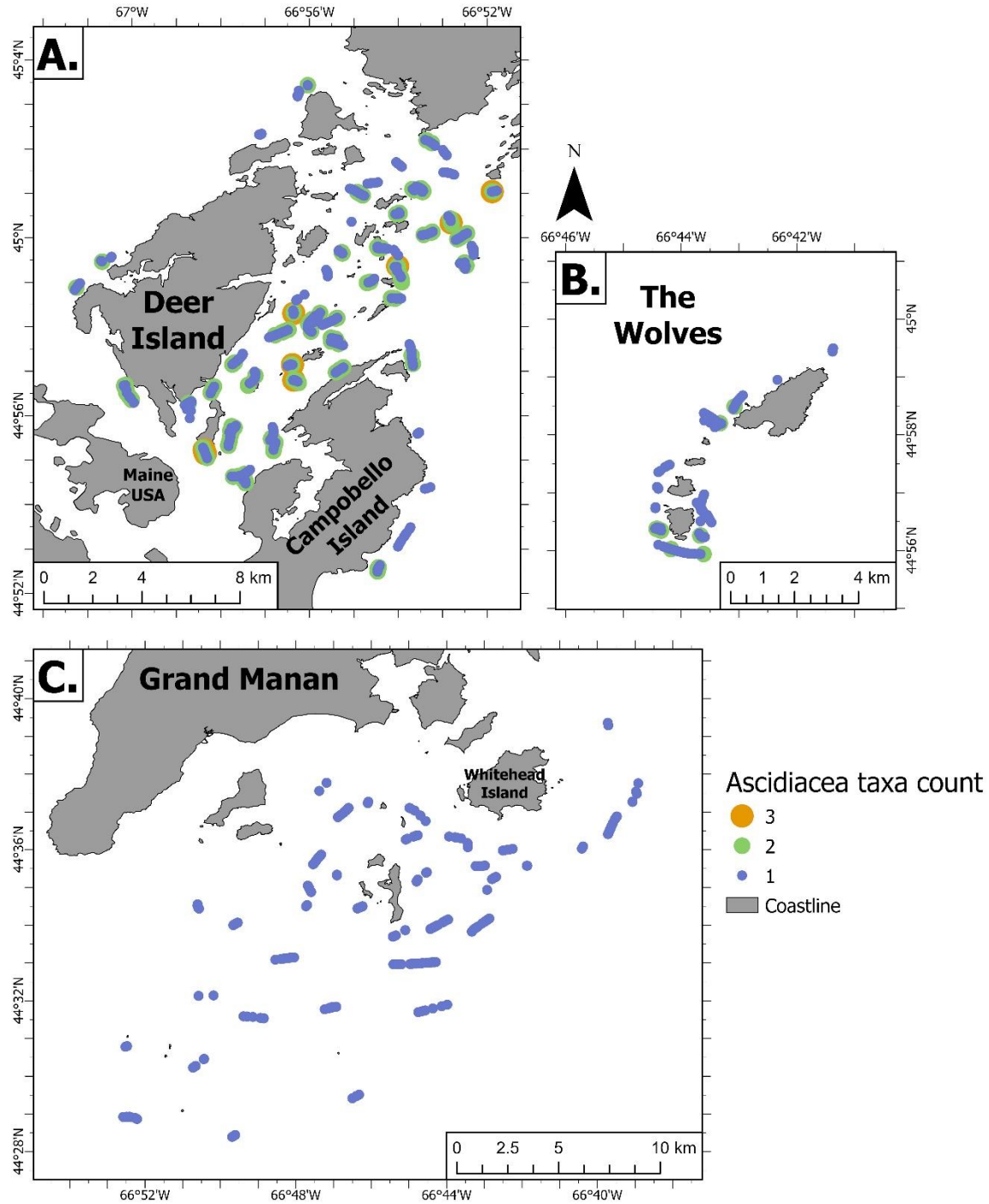


Figure 14 The number of taxa present in the Asciacea taxa group (including *Boltenia ovifera*, *Dendrodoa carnea*, and unknown ascidians: n=3) across each analyzed digital still image (n=5047). (A) contains ascidian taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

3.3.3 ALGAE

Marine algae taxa were present in 58% of the video intervals and 42% of the still images (Table 1). These occurrences include taxa commonly seen in Atlantic Canada such as *Laminaria* spp. and *Chorda filum*; however, *Fucus* spp. was not conclusively identified. Fragments of algae floating by, or algae that could not be conclusively identified were grouped into 'Algae unknown', which contained the bulk of algae observations (75 and 88% of video interval and still image algae observations respectively) (Table 1). Sites CD016, 082, 091, 094, 107, 121, 122 and 123 had at least four species of algae present (Figure 15 and 16). Most of the sites had at least one species present in at least one video interval or still image. Encrusting coralline algae had the widest distribution of the algae taxa in both video intervals (present in 10% of intervals – Table 1) and digital stills (7% presence), while *Laminaria* spp. was more common in just the video intervals (7.6%) and found predominantly in Southern Grand Manan (Table 3). Algae taxa were found mostly on hard substrates and were recorded as occurring across the whole depth range (Figure 11c and 12c). The scoring of algae taxa in water depths below those at which most live algal beds are located (typically <20 m) reflects the encounter of near-seafloor drifting algal detritus (part, or whole marine plant) advected from their original coastal site locations. Export of algal production from shallow coastal sites provides a significant resource subsidy to deeper and offshore locations (Filbee-Dexter and Scheibling 2016).

3.3.4 ANNELIDA

Occurrences of Annelida in this study was composed of mainly one key taxa, *Myxicola* spp., a polychaete worm reported here to genus level as it may now be part of a species complex (WoRMS 2025) (Figure 4). This taxon forms a distinctive mucus tube visible at the surface and were more prevalent in the still images (~14%) than the video intervals (4%) (Figure 4; Table 1). Similar to Ascidiacea, this is likely due to the higher pixel resolution of the digital stills being able to better capture cryptic species. Annelids were not commonly observed in Southern Grand Manan transects, with no observations made from the video intervals, but were noted more frequently in northern sites in the HH/WI/P EBSA and off The Wolves Islands (Table 3, Figure 17 and 18). Annelids observed on bedrock bottom-types were often burrowed into sediment filled cracks on the surface of the substrate (Figure 11d and 12d).

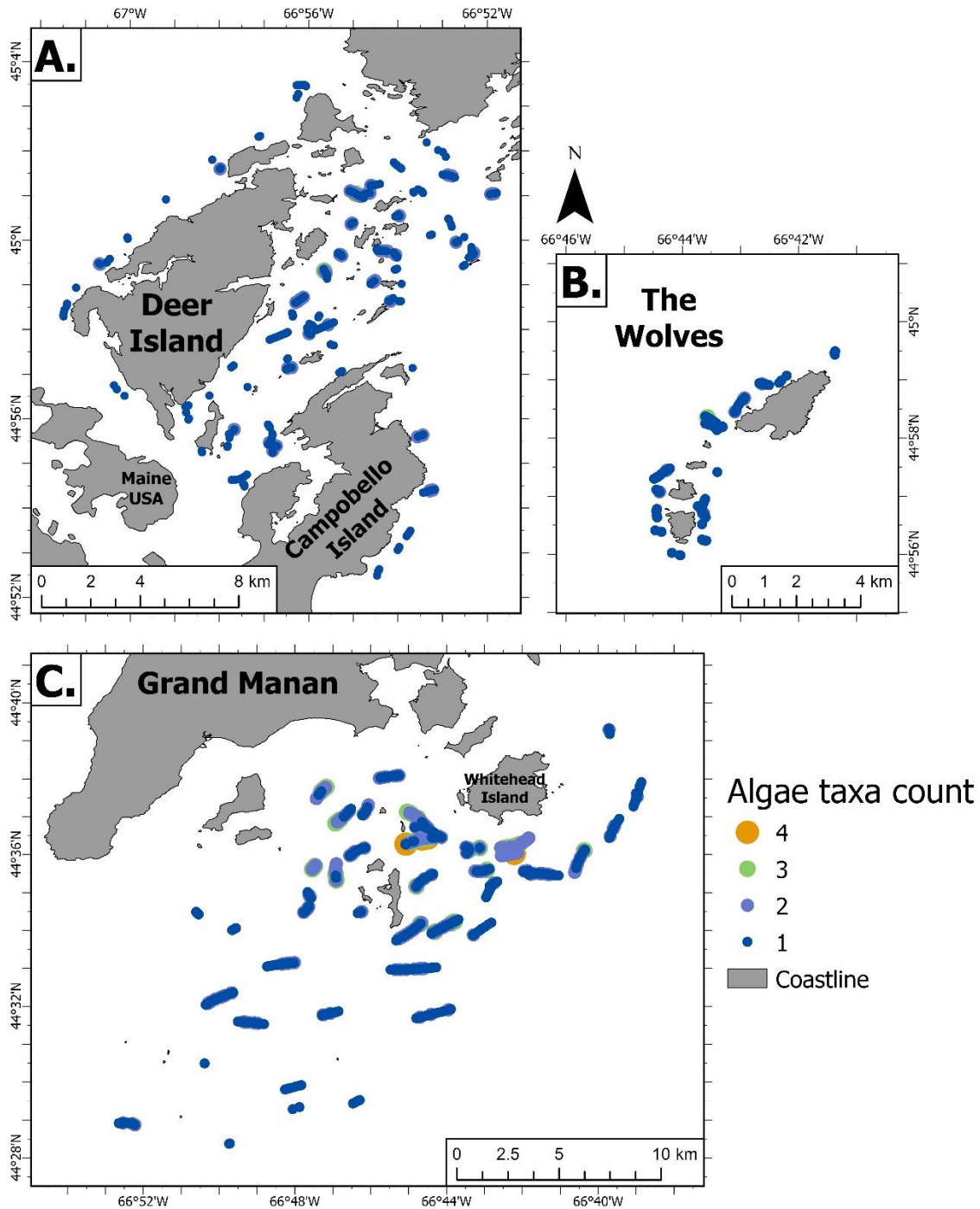


Figure 15 The number of taxa present in the Algae taxa group (including *Fucus* spp., *Ascophyllum nodosum*, *Laminaria* spp., *Chorda filum*, *Desmarestia* spp., encrusting coralline algae, and unknown algae: n=7) across each 30-s video interval (n=5561). (A) contains algae taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

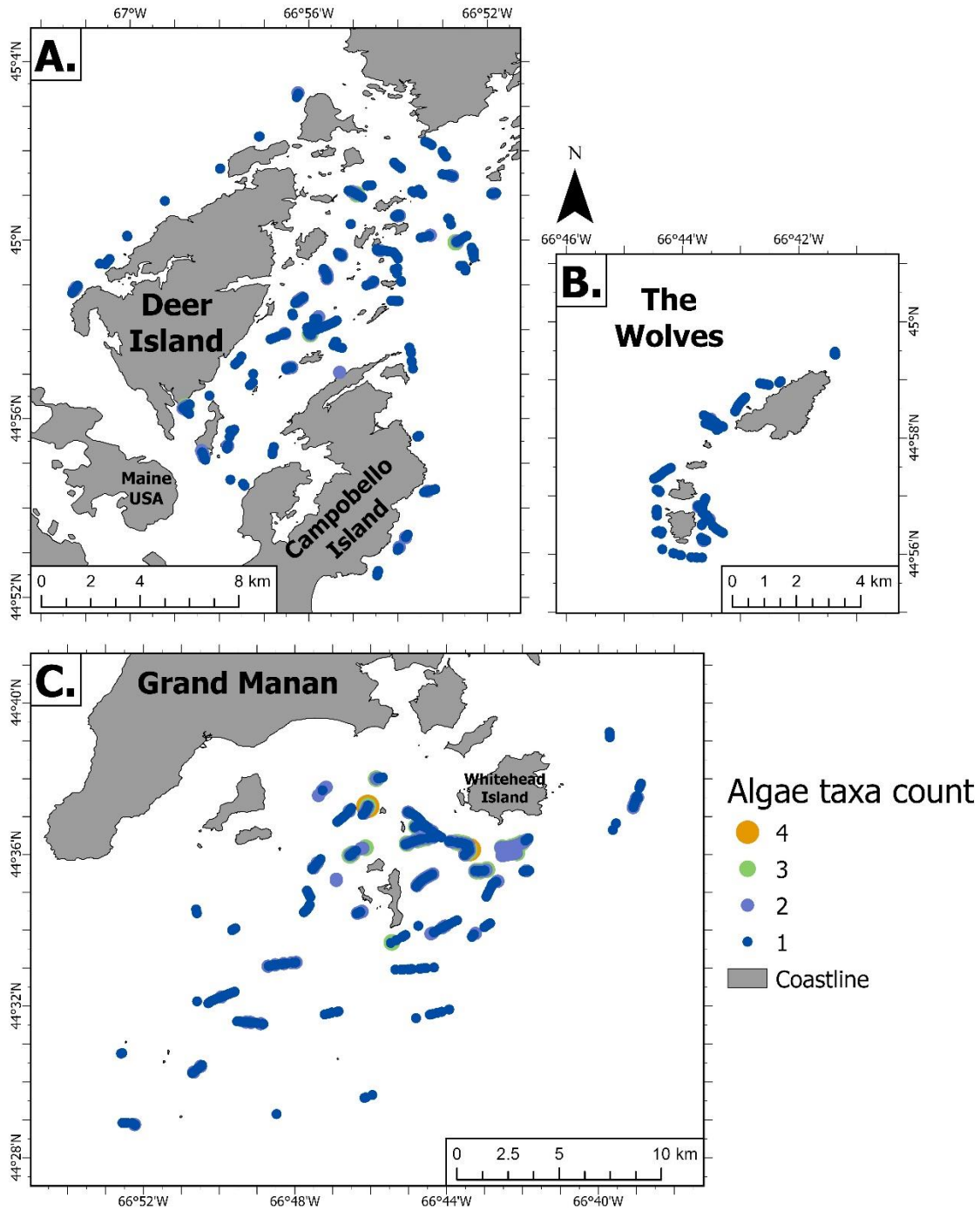


Figure 16 The number of taxa present in the Algae taxa group (including *Fucus* spp., *Ascophyllum nodosum*, *Laminaria* spp., *Chorda filum*, *Desmarestia* spp., encrusting coralline algae, and unknown algae: n=7) across each analyzed digital still image (n=5047). (A) contains algae taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

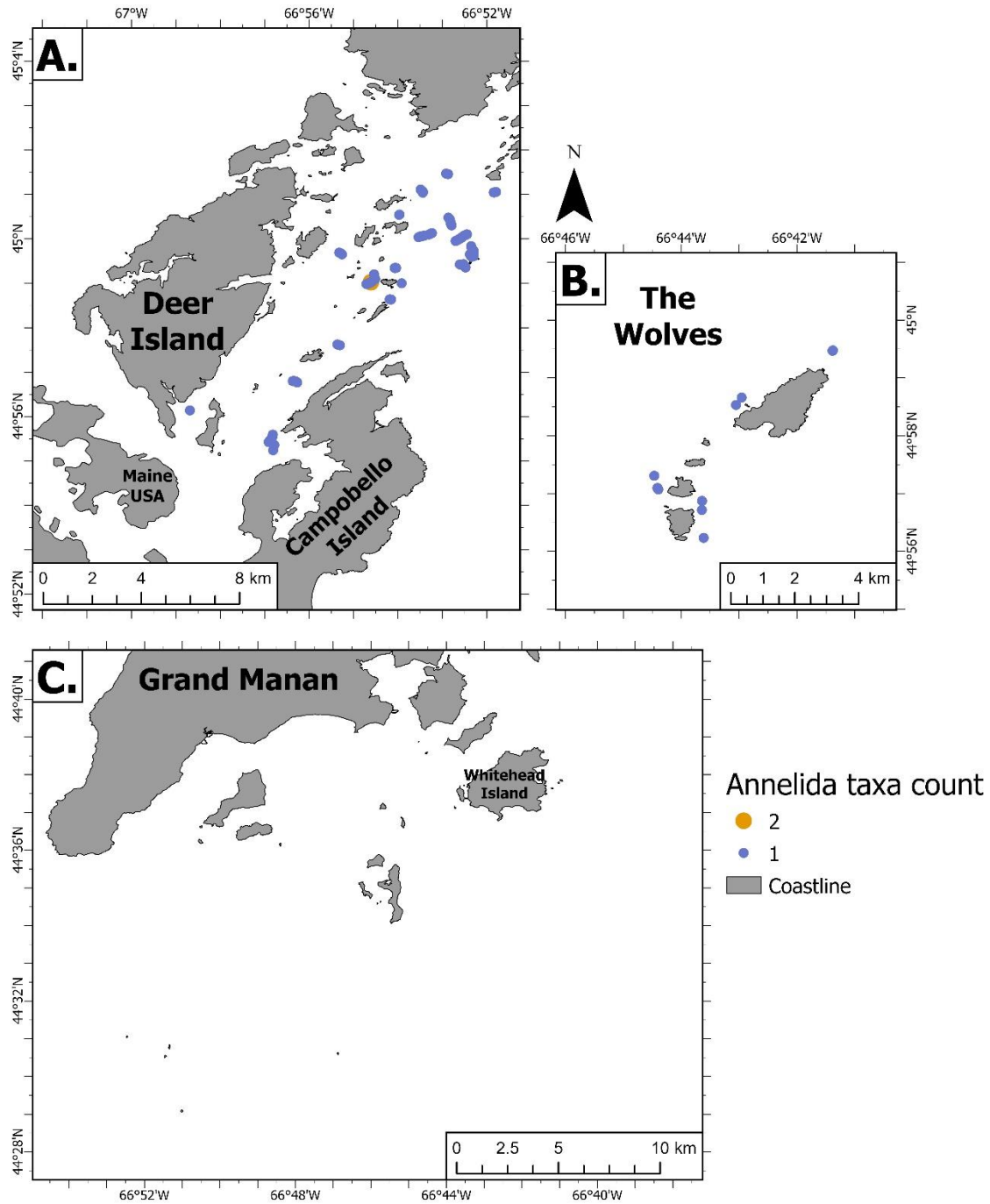


Figure 17 The number of taxa present in the Annelida taxa group (including *Myxicola* spp., and unknown annelids: n=2) across each 30-s video interval (n=5561). (A) contains annelid taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

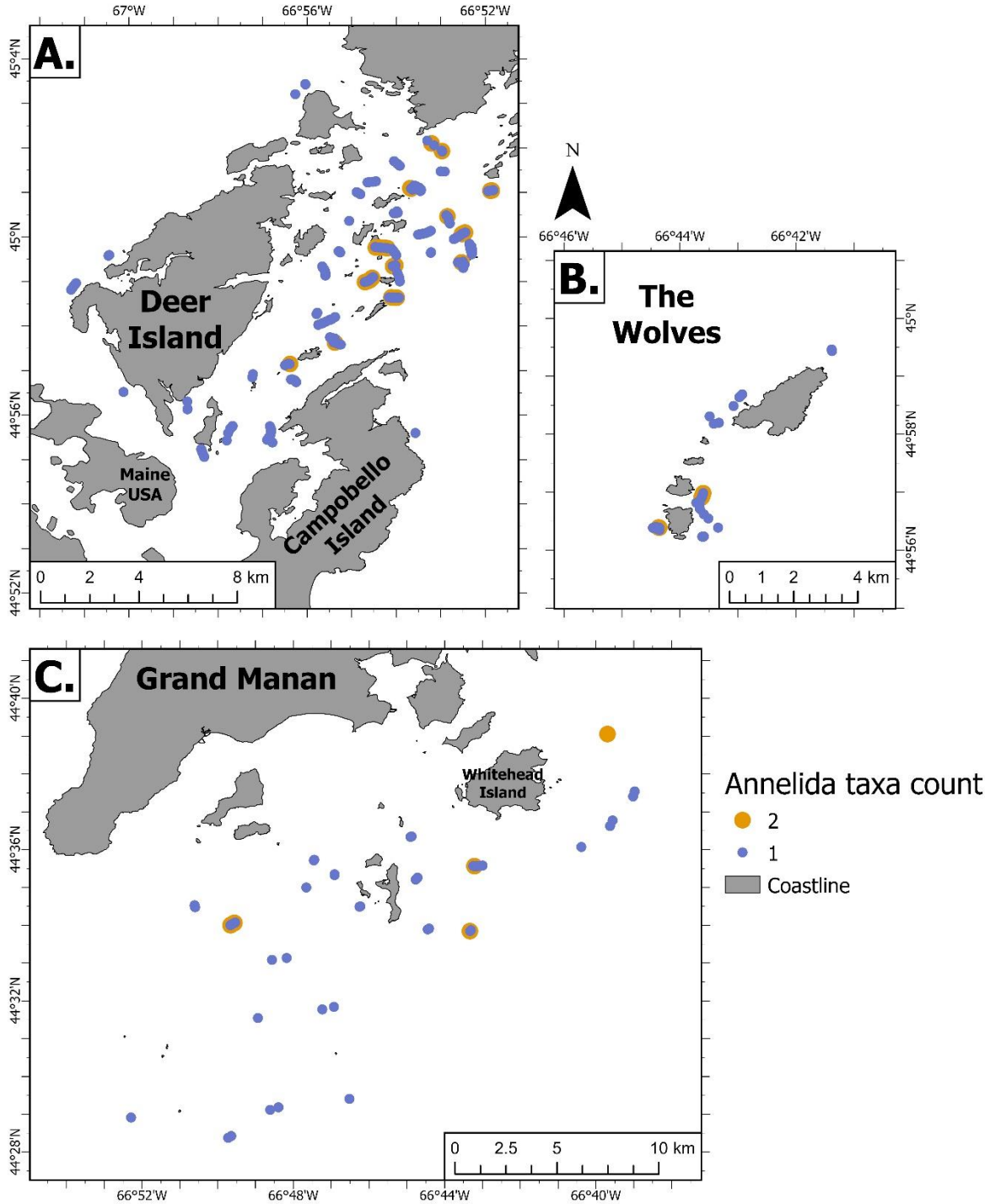


Figure 18 The number of taxa present in the Annelida taxa group (including *Myxicola* spp., and unknown annelids: $n=2$) across each analyzed digital still image ($n=5047$). (A) contains annelid taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

3.3.5 CNIDARIA

Cnidaria taxa were present in 51% of the video intervals and 48% of the still images (Table 1). Anemones of *Urticina/Cribrinopsis* spp. (Order Actiniaria) and *Pachycerianthus borealis* (Order Ceriantharia) were the most common taxa (Table 3). Several sites had more than two types of cnidarians present, namely in the HH/WI/P EBSA, particularly in CD001, 009 and 019 (Figure 19 and 20). In transects CD001 and 019, most of the cnidarians were found on pebble bottom-types while in CD036, most occurred on bedrock substrates interspersed with sand, owing to the different preferred bottom-types of the taxa that comprise this group (Figure 11e and 12e). *Metridium senile* were found primarily in the HH/WI/P area, while *Pachycerianthus borealis* was present mainly around The Wolves Islands and in the northern part of the HH/WI/P area (Table 3).

3.3.6 CRUSTACEA

Crustaceans, as a group were present in ~60% of the video intervals but only 22% of the still images (Table 1). Due to difficulties in reliably distinguishing fine detail in carapace and claw morphology across all imagery, rock and Jonah crabs were grouped together into *Cancer* spp. In the video intervals, *Cancer* spp. had the most extensive distribution of any taxa of crustaceans observed, occurring in 37% of video intervals (Table 1). In contrast, shrimp was the most commonly occurring crustacean taxa from the digital stills (in 8% of images), slightly higher than *Cancer* spp. (7% of still images). Due to the higher resolution of digital stills, shrimps are more easily detectable, while larger, less concentrated mobile crustaceans such as crabs are likely better captured from continuous seafloor video, especially considering larger mobile organisms may potentially avoid the camera system lights (similar to fishes; Rooper et al. 2019). Similarly, lobsters were also more commonly observed in 18% of video intervals, while only documented in 2% of still images (Table 1). Several sites including CD001, 008, 011, and 019 had occurrences of at least three crustacean taxa (Figure 21 and 22). Crustaceans were found across all three study areas (Table 3) on all bottom-types across all depths reported in this survey (Figure 11f and 12f).

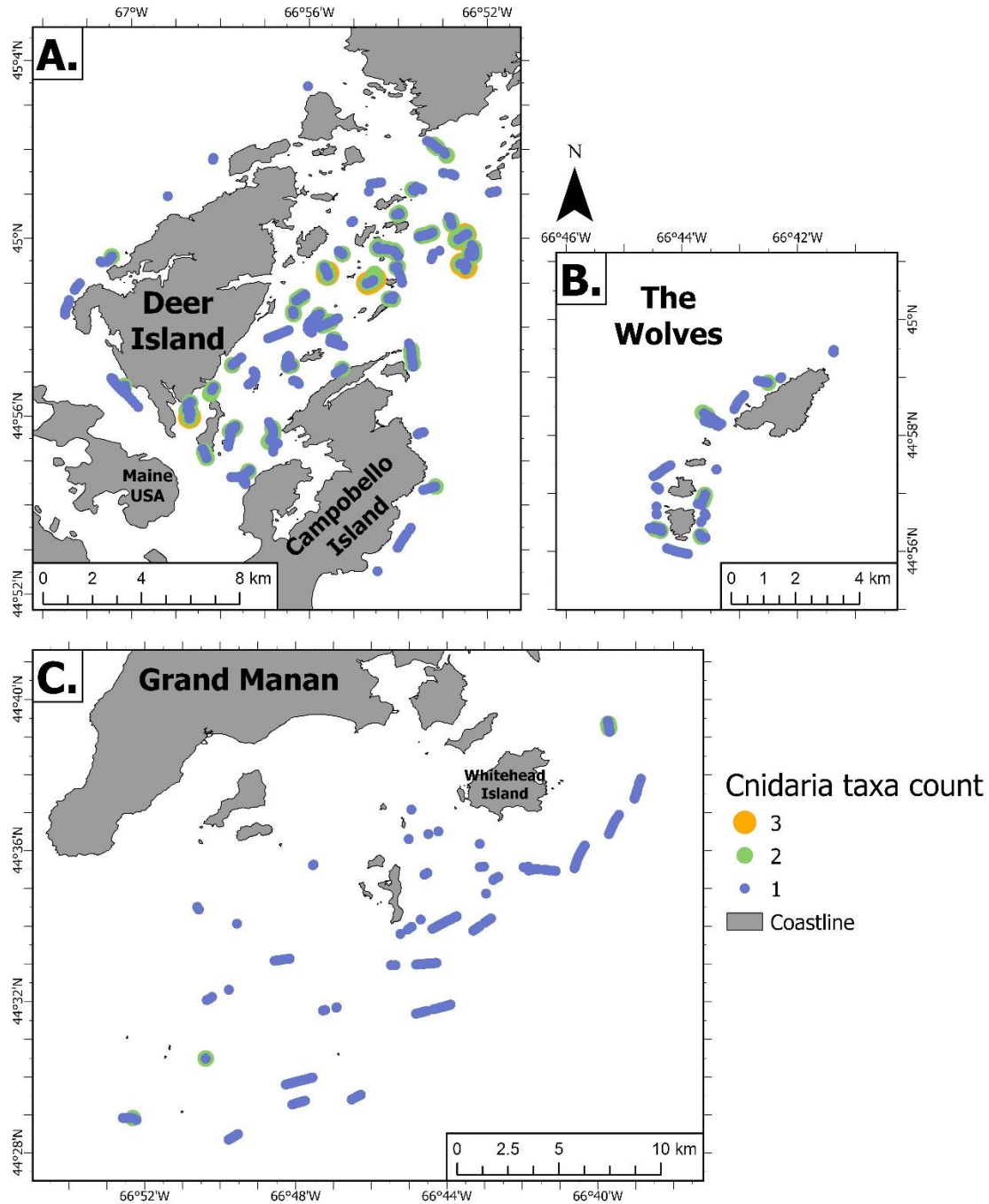


Figure 19 The number of taxa present in the Cnidaria taxa group (including *Metridium senile*, *Urticina/Cribrinopsis* spp., *Gersemia rubiformis*, *Pachygerianthus borealis*, and unknown cnidarians: n=5) across each 30-s video interval (n=5561). (A) contains cnidarian taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

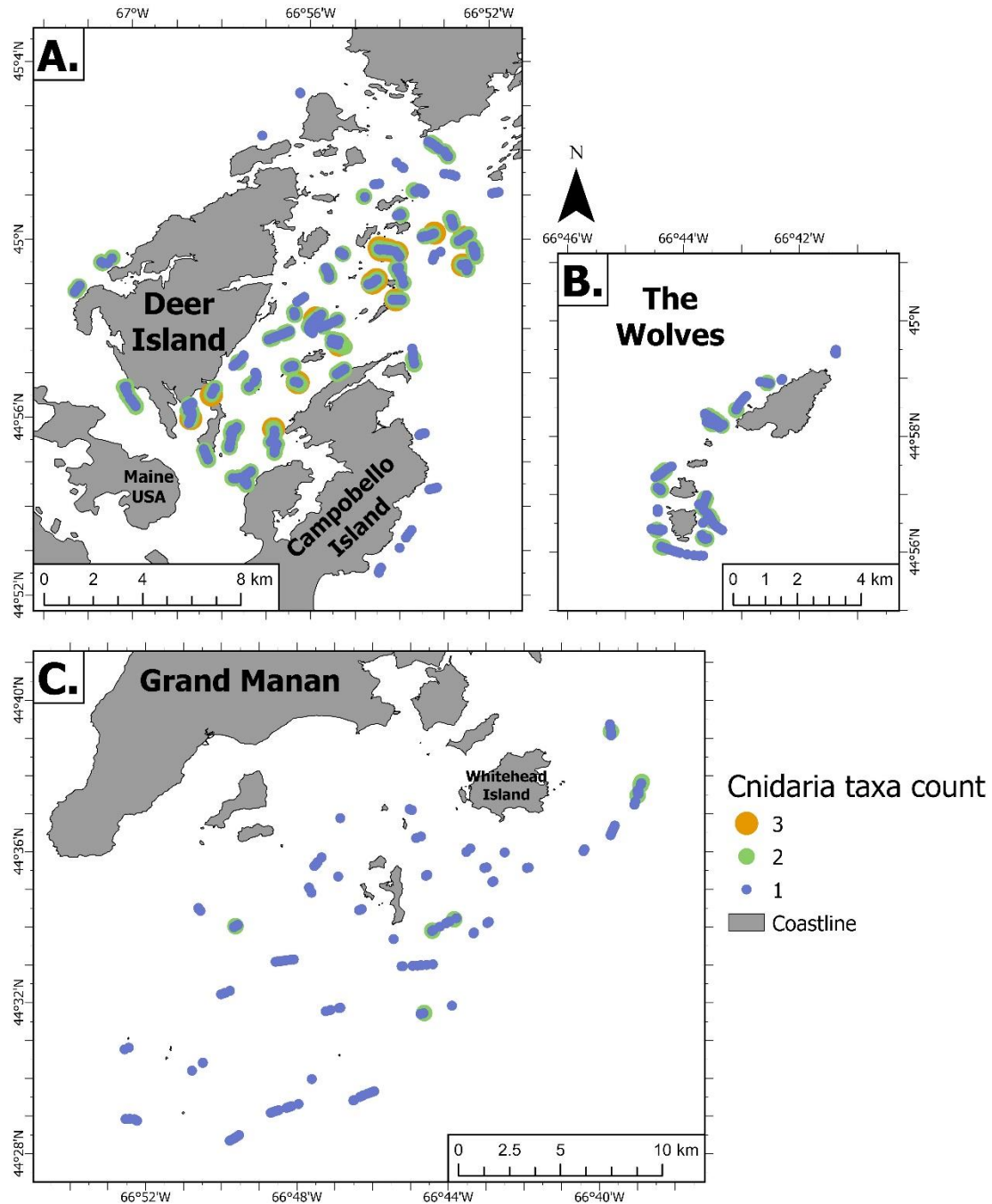


Figure 20 The number of taxa present in the Cnidaria taxa group (including *Metridium senile*, *Urticina/Cribrinopsis* spp., *Gersemia rubiformis*, *Pachycerianthus borealis*, and unknown cnidarians: n=5) across each analyzed digital still image (n=5047). (A) contains cnidarian taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

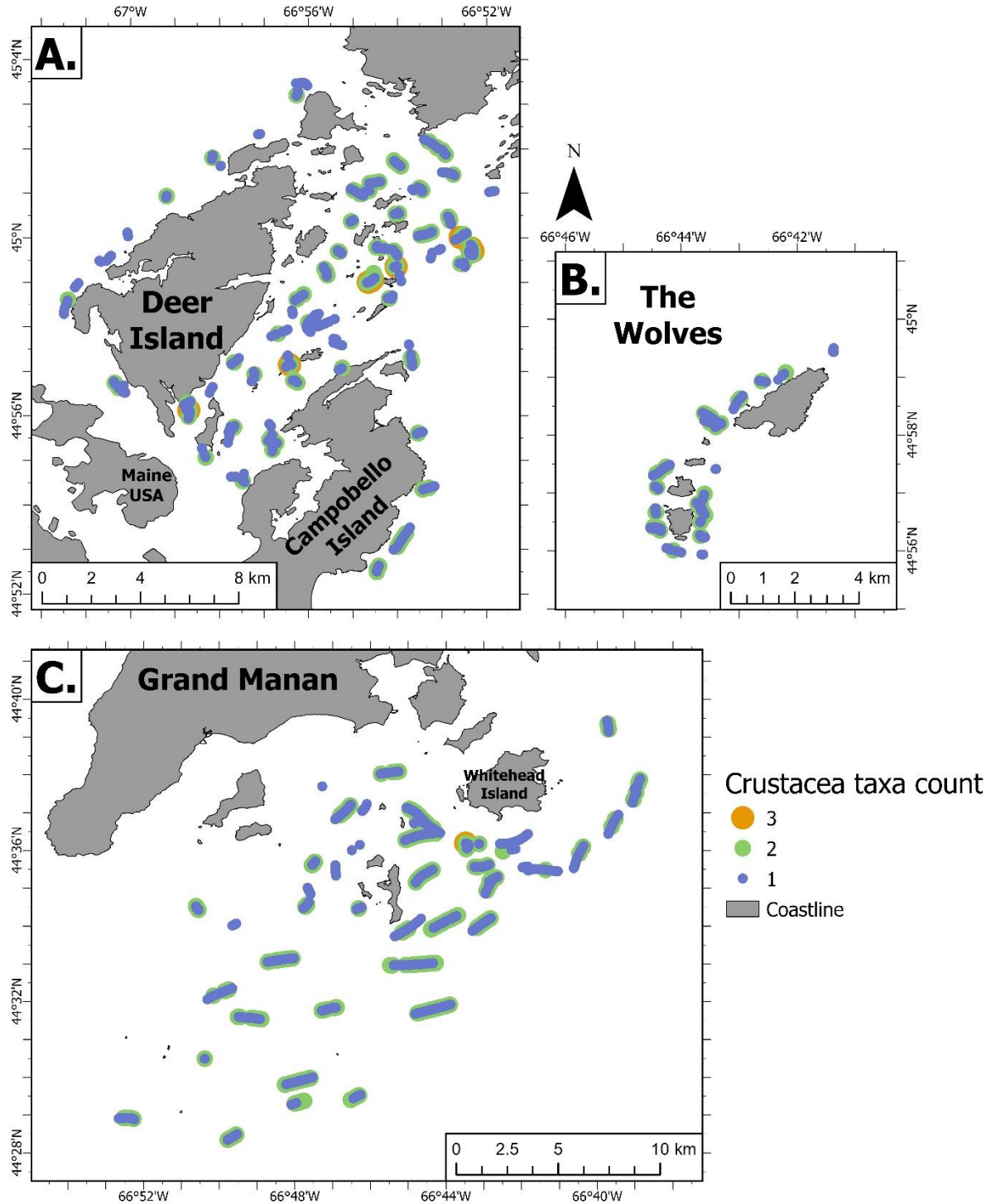


Figure 21 The number of taxa present in the Crustacea taxa group (including *Homarus americanus*, *Cancer* spp., *Hyas coarctatus*, *Pagurus* spp., shrimps, and unknown crustaceans: n=6) across each 30-s video interval (n=5561). (A) contains crustacean taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

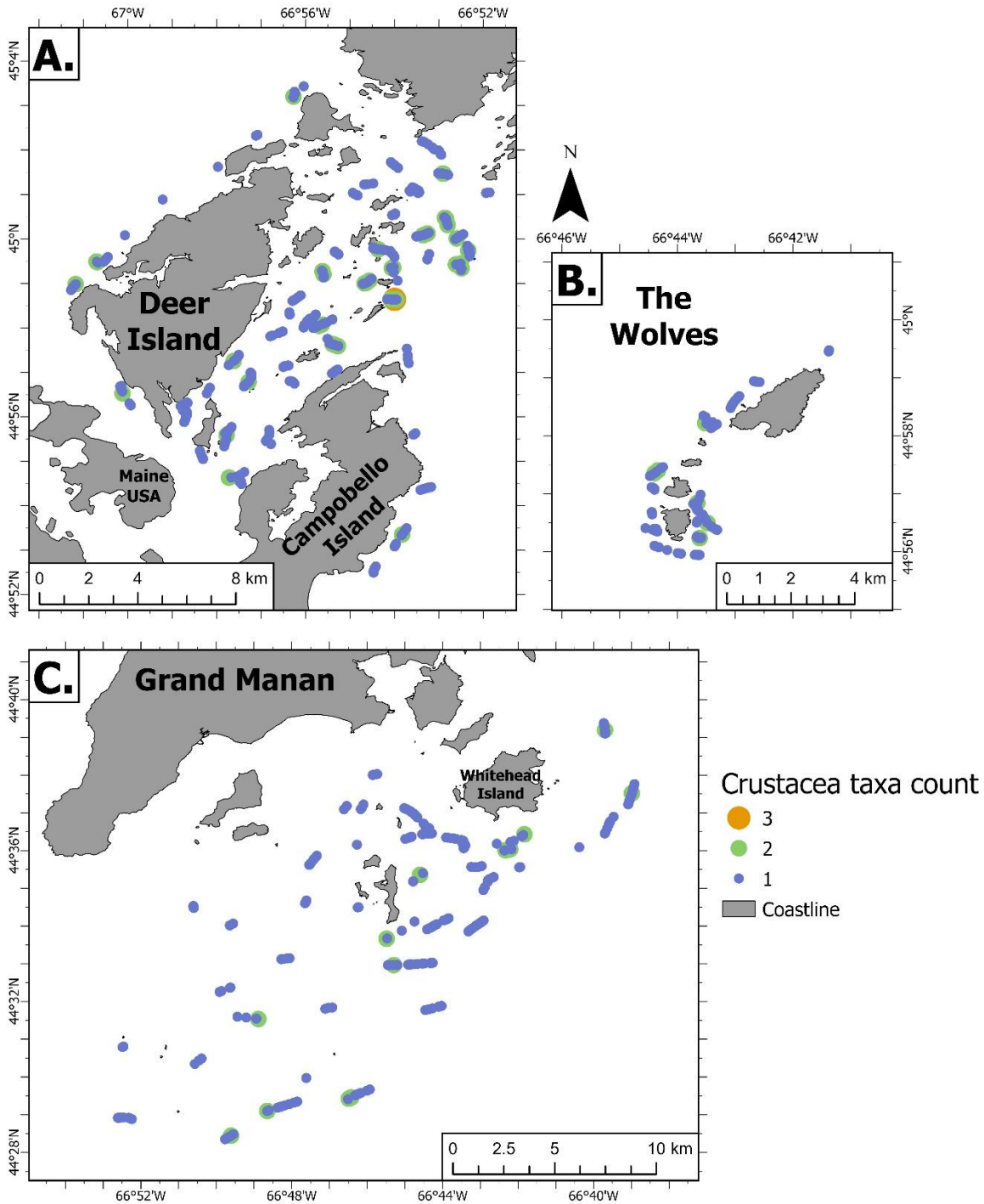


Figure 22 The number of taxa present in the Crustacea taxa group (including *Homarus americanus*, *Cancer* spp., *Hyas coarctatus*, *Pagurus* spp., shrimps, and unknown crustaceans: n=6) across each analyzed digital still image (n=5047). (A) contains crustacean taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

3.3.7 ECHINODERMATA

Echinoderms were present in 65% of video intervals and 63% of still images, occurring in at least one video interval at each site (Table 1). Most of the observed taxa were sea stars (*Henricia* spp. and *Asterias/Leptasterias* spp.), with few occurrences of sand dollars (Table 1), which were only noted in still imagery from the HH/WI/P and Southern Grand Manan EBSAs (Table 3). Sea urchins and sea cucumbers were also occasionally encountered (~10% of video intervals and 11% of still images), with urchins sometimes observed at high densities (see section 3.5). Several sites had more than one taxa present (Figure 23 and 24). Echinoderms were primarily found on bedrock, cobble, and pebble primary substrates (Figure 11g and 12g). The sites in the southern Deer Island Passage (adjacent to Indian Island) had some of the highest prevalence of multiple echinoderm taxa per still image and video interval, especially relative to The Wolves Islands and Southern Grand Manan transects (Figure 23 and 24).

3.3.8 MOLLUSCA

Mollusc taxa were present in 42% of video intervals and 52% of still images (Table 1). *Placopecten magellanicus* was the most common species of mollusc analyzed, found throughout the study area (36% of video intervals and 19% of still images) (Table 1). Several sites had more than one species of molluscs present, with the highest mollusc taxa count occurring in the HH/WI/P sub-area, and in CD114 off White Head Island in Southern Grand Manan (Figure 25 and 26). Occurrences were recorded primarily on pebble, fine-grained and cobble substrates (Figure 11h and 12h). More cryptic species, such as the two mussel species (*Mytilus edulis* and *Modiolus modiolus*), were particularly difficult to distinguish from cobble or pebble substrates in the video intervals regardless of quality, and their presence is likely under reported. The horse mussel, *M. modiolus*, is documented to form extensive biogenic reefs, particularly in the HH/WI/P EBSA (Mireault et al. 2025), and comprised the primary bottom-type in 16 video intervals (all in CD087 – Head Harbour Passage) and 34 still images (across CD020, 087, 091, 112, and 146). All gastropods observed were classified as 'Mollusca unknown'.

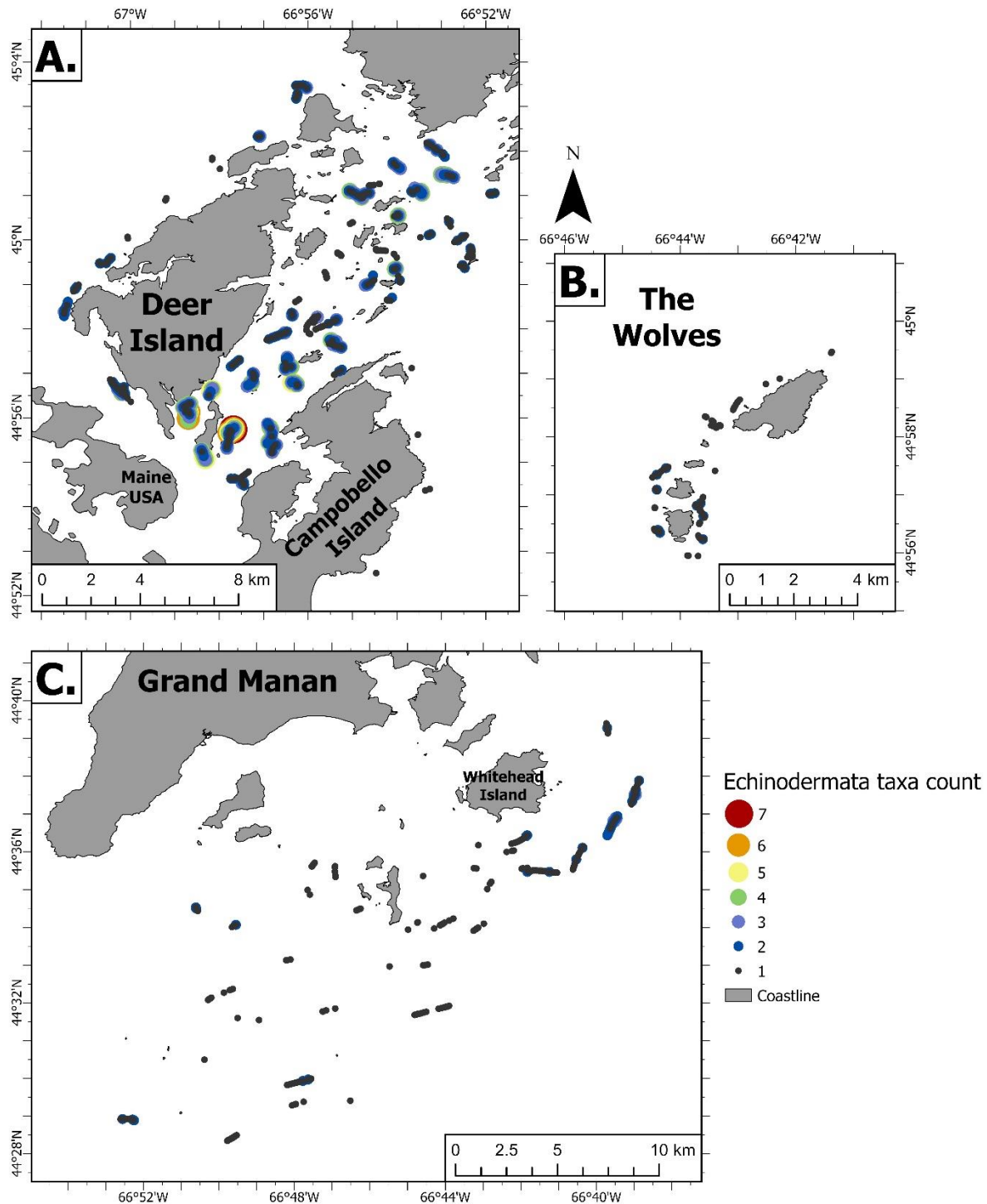


Figure 23 The number of taxa present in the Echinoderm taxa group (including *Strongylocentrotus droebachiensis*, *Cucumaria frondosa*, *Echinarachnius parma*, *Asterias/Leptasterias* spp., *Henricia* spp., *Solaster endica*, *Crossaster papposus*, and unknown echinoderms: $n=8$) across each 30-s video interval ($n=5561$). (A) contains echinoderm taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

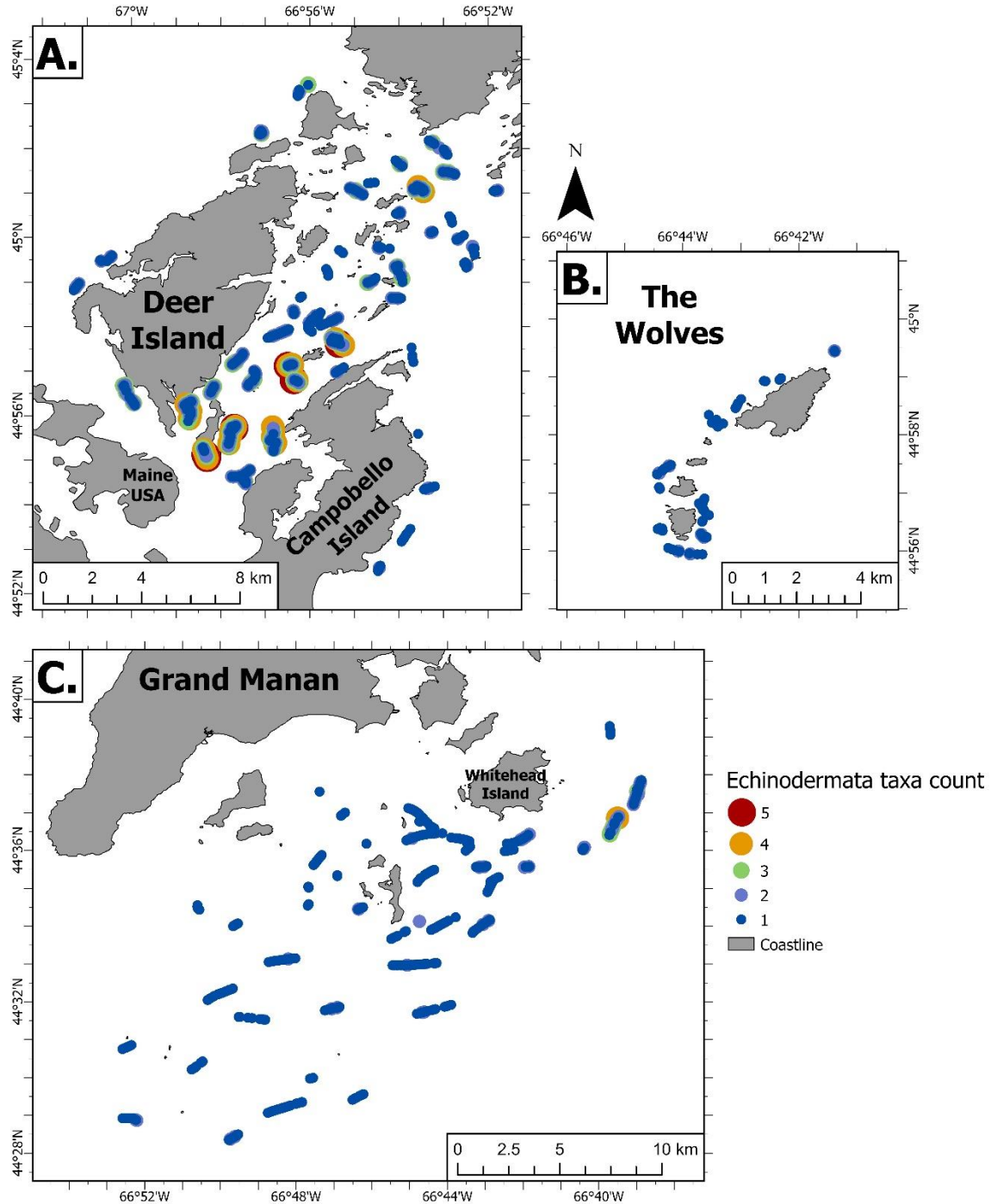


Figure 24 The number of taxa present in the Echinoderm taxa group (including *Strongylocentrotus droebachiensis*, *Cucumaria frondosa*, *Echinarachnius parma*, *Asterias/Leptasterias* spp., *Henricia* spp., *Solaster endeca*, *Crossaster papposus*, and unknown echinoderms: $n=8$) across each analyzed digital still image ($n=5047$). (A) contains echinoderm taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

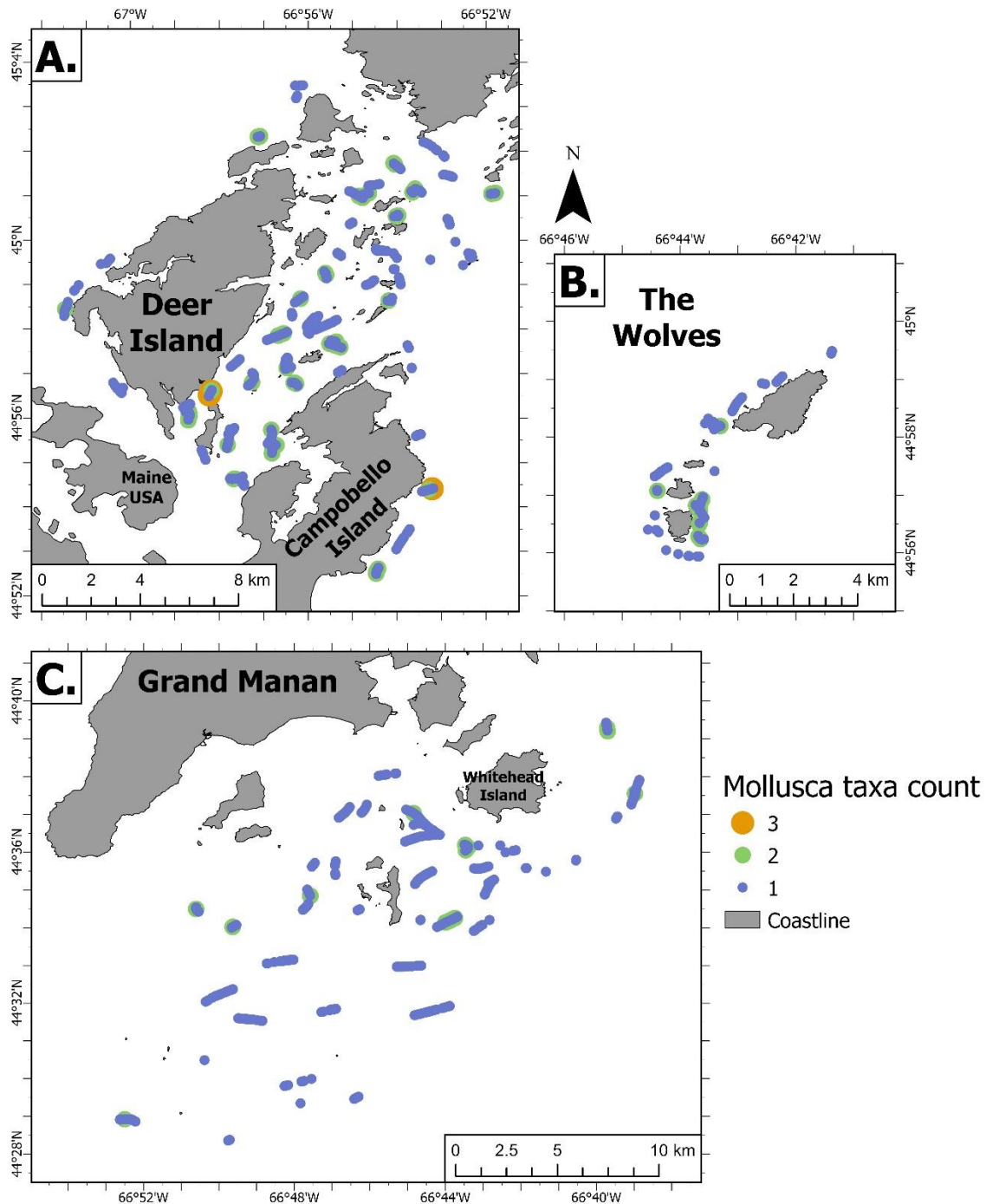


Figure 25 The number of taxa present in the Mollusca taxa group (including *Mytilus edulis*, *Modiolus modiolus*, *Placopecten magellanicus*, and unknown molluscs: $n=4$) across each 30-s video interval ($n=5561$). (A) contains mollusc taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

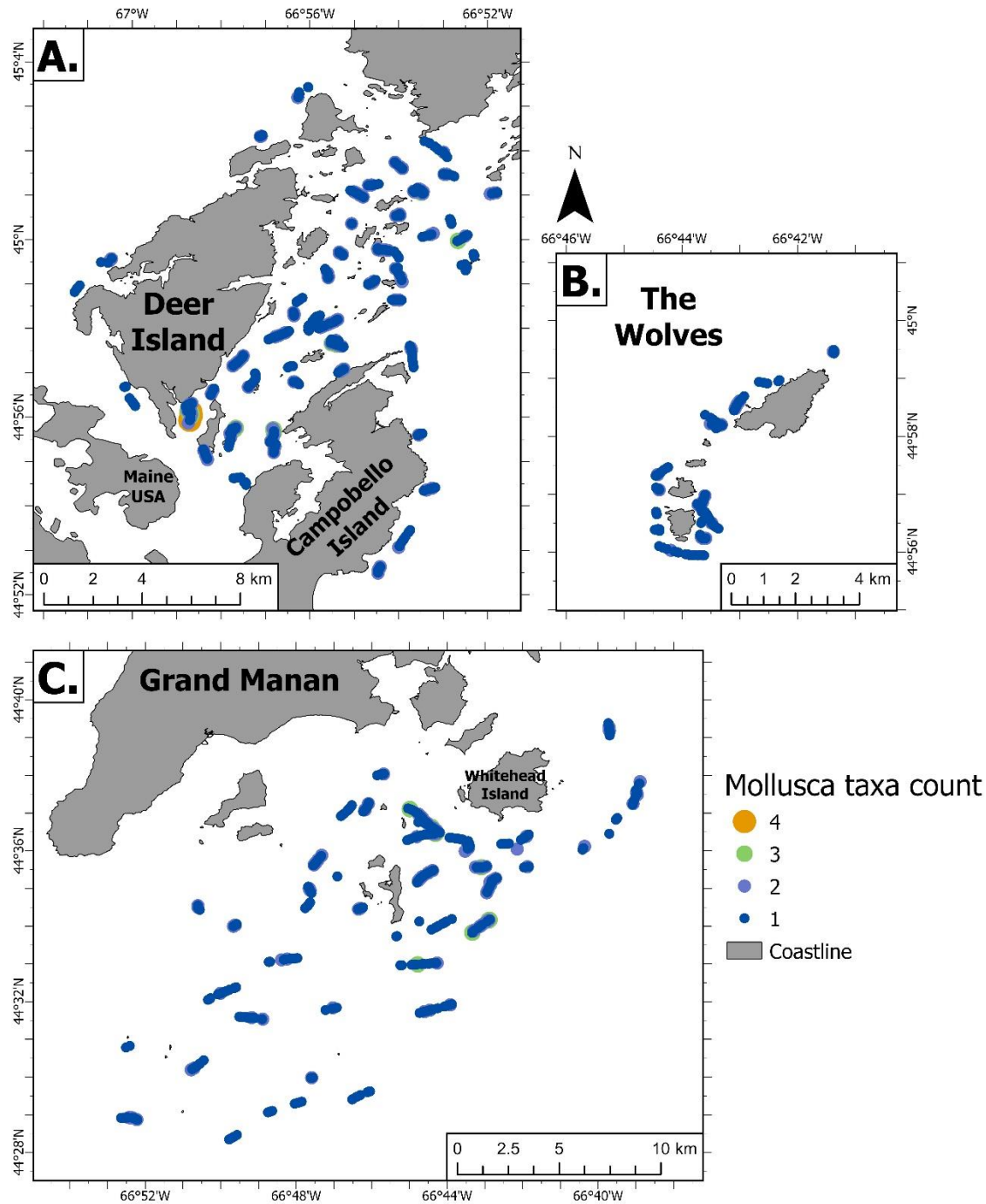


Figure 26 The number of taxa present in the Mollusca taxa group (including *Mytilus edulis*, *Modiolus modiolus*, *Placopecten magellanicus*, and unknown molluscs: $n=4$) across each analyzed digital still image ($n=5047$). (A) contains mollusc taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

3.3.9 PORIFERA

Porifera taxa were present in 26% of the video intervals and 37% of the still images (Table 1). Morphotypes observed were generally massive with large oscula and yellow in color. There were two key taxa identified to species level (*Halichondria panicea* and *Halichondria sitiens*); however, porifera are generally hard to identify visually from morphotype and color alone (Goodwin 2017; Dinn 2020). Thus, the total number of Porifera taxa is under-reported. Especially considering *Haliclona osculata* and *Isodictya* spp. could not be distinguished and were combined. Notably, several sites in the HH/WI/P sub-area (CD004, 005, 008, 009, 011, 019, 020, 035, 085, 087) and a few Grand Manan sites (CD135, 136, 139, 151) had more than two taxa of porifera present (Figure 27 and 28). Site CD004 was particularly diverse, and traversed an area of mostly bedrock outcrops with a biogenic turf veneer. Most of the sites had at least one sponge taxa present in at least one of the video intervals and one still image. Pebbles and bedrock appeared to be their preferred bottom-types (Figure 11i and 12i). *Haliclona/Isodictya* spp. were found mainly in the southern region of the Deer Island Passage and off Southern Grand Manan (Table 3).

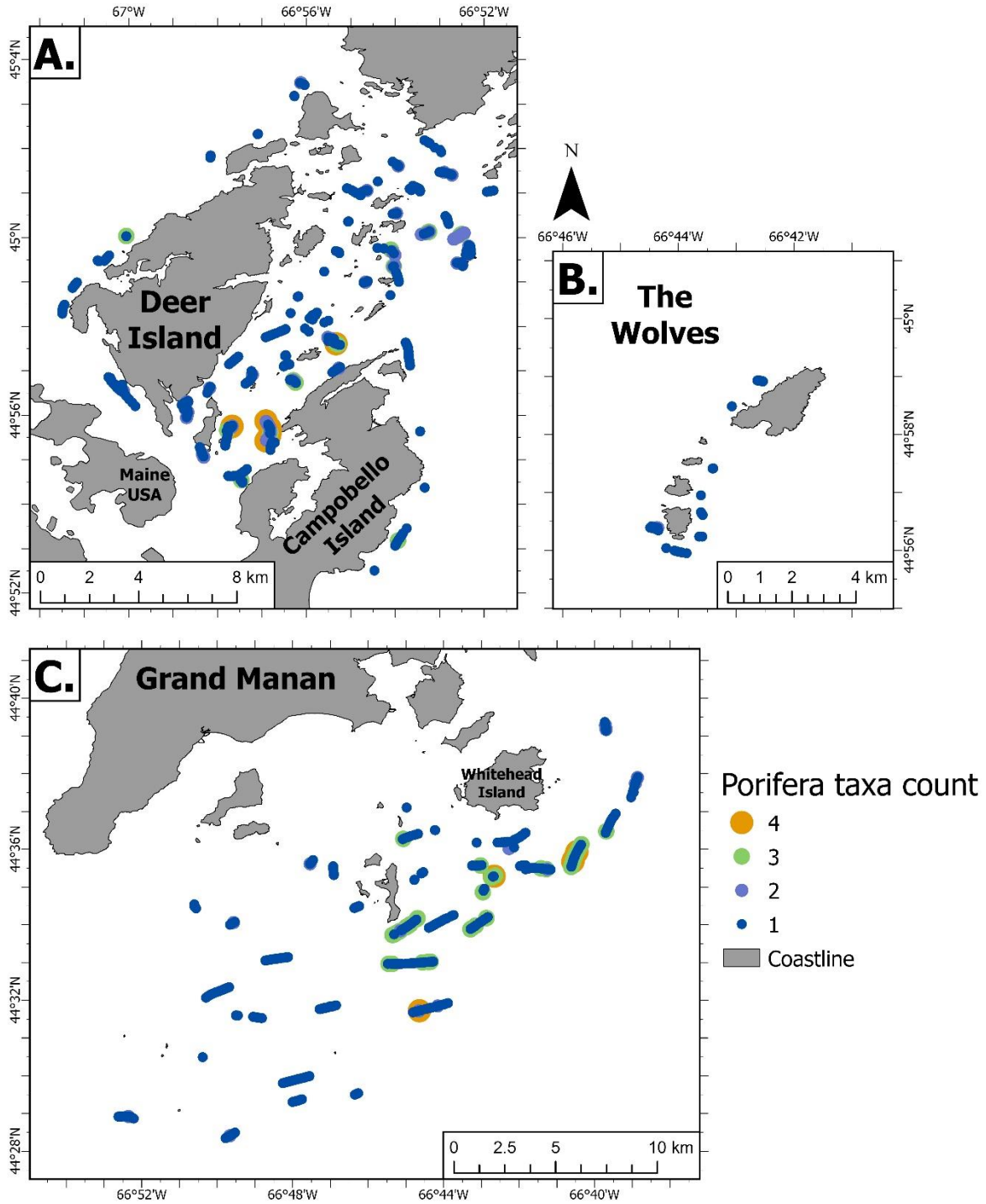


Figure 27 The number of taxa present in the Porifera taxa group (including *Haliclona/Isodictya* spp., *Halichondria panicea*, *Halichondria siliens*, and unknown sponges: $n=4$) across each 30-s video interval ($n=5561$). (A) contains sponge taxa count video interval observations within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

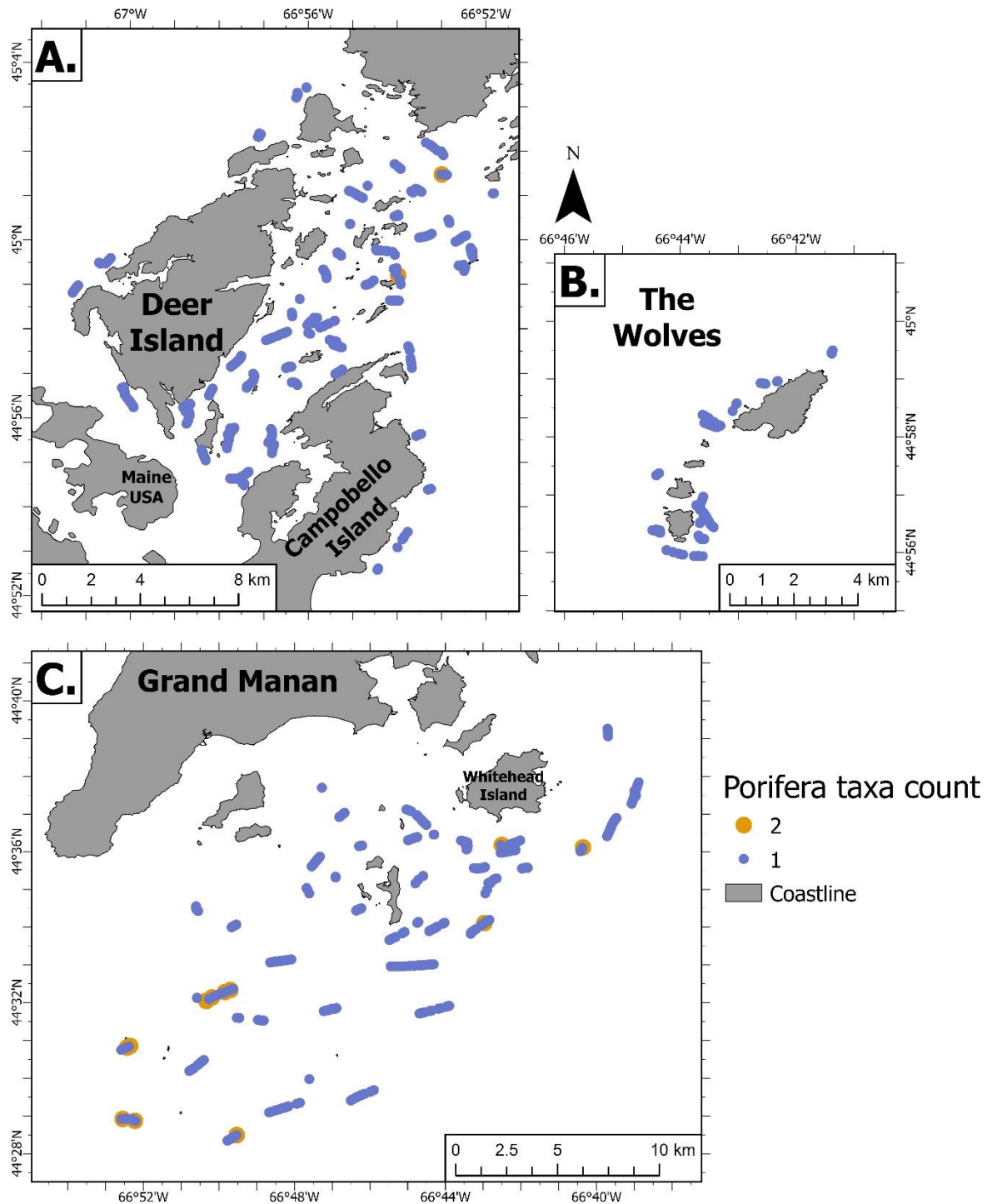


Figure 28 The number of taxa present in the Porifera taxa group (including *Haliclona/Isodictya* spp., *Halichondria panicea*, *Halichondria siliens*, and unknown sponges: $n=4$) across each analyzed digital still image ($n=5047$). (A) contains sponge taxa count still image occurrences within and surrounding the HH/WI/P EBSA, while (B) highlights observations surrounding The Wolves Islands, and (C) off Southern Grand Manan.

3.4 GEOGRAPHIC AREA SUMMARIES

Transect substrate and taxa occurrences are presented based on three geographic sub-areas; the HH/WI/P sub-area (including the EBSA and areas adjacent to Deer and Campobello Islands), The Wolves Islands EBSA, and Southern Grand Manan sub-area (including the EBSA and areas directly adjacent to it).

3.4.1 HEAD HARBOUR/WEST ISLES/PASSAGES

The HH/WI/P sub-area included all sites within the EBSA along with additional sites surrounding the west coast of Deer Island and the east coast of Campobello Island (Figure 2a). A total of 74 transects were conducted in this area with reliable continuous seafloor video coverage, with 68 of those also producing high-resolution still images (Table 2). These transects covered distances ranging from 62 m to 1 km, totaling a distance of 30 km. Just under 26 hours of video was collected here. A total of 3022 30-s video intervals and 2767 still images were reviewed. Depths ranged from 8 to 89 m (average: 37 m), while video intervals per transect ranged from 12 to 59 and analyzed still images ranged from 4 to 74 per transect. HH/WI/P transects encountered the highest-quality near-seafloor visibility, with >75% of video intervals containing visibility <10 cm. Fine grain and pebble substrates comprised the highest percentage of primary bottom-types in the area from the video intervals (29 and 28% respectively) and still images (29 and 39% respectively) (Figure 29). Boulders and mussel beds comprised the lowest percentage of primary bottom-types (<8 and ~1% respectively), along with shell hash, which was only documented in the still imagery (0.1%). Combining the video interval and still image data, taxon counts ranged from 1 to 29 taxa per transect, with a total count of 41 taxa across all HH/WI/P transects. Commonly observed benthic biota here included *Urticina/Cribrinopsis* anemones, the sea scallop *Placopecten magellanicus*, common sea stars (*Asterias/Leptasterias* spp. and *Henricia* spp.), unknown sponges and algae, and the stalked tunicate *B. ovifera* (Table 3).

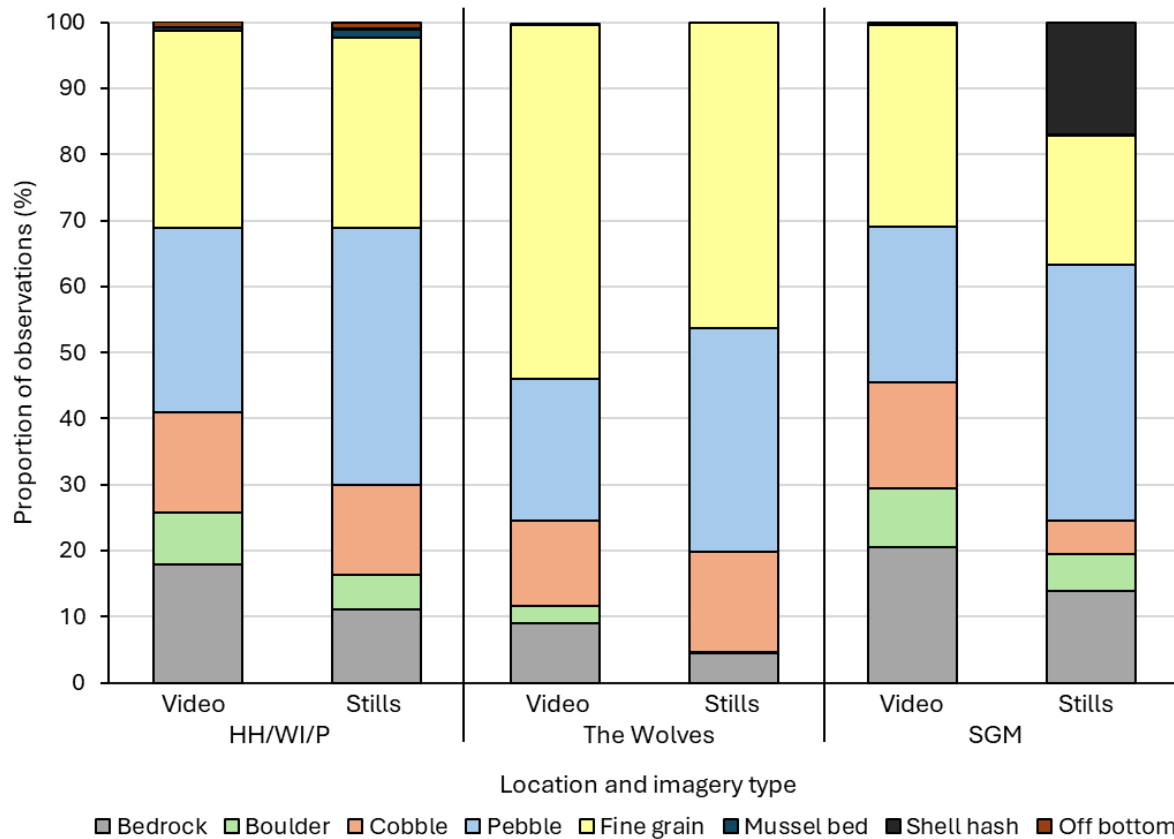


Figure 29 Proportion (%) bar chart of each primary bottom type according to sub-area including HH/WI/P (left), The Wolves Islands (center), and Southern Grand Manan (right) in the analyzed 30-s video intervals (n=5561) and digital still images (n=5047).

Table 3 Proportion (%) of priority taxa (n=41) and debris according to study sub-area (HH/WI/P, The Wolves, and Southern Grand Manan – GM) in both the video intervals and digital still images. Predominant taxa (occurring in $\geq 20\%$ of imagery) in each sub-area and in each imagery technique are highlighted in bold.

Biotic group	Taxa/Label	Proportion of video occurrences in HH/WI/P	Proportion of still image occurrences in HH/WI/P	Proportion of video occurrences in The Wolves	Proportion of still image occurrences in The Wolves	Proportion of video occurrences in GM	Proportion of still image occurrences in GM
Actinopterygii	Cottoidei	5%	2%	3%	1%	3%	0.6%
	Fish – unknown	10%	4%	14%	4%	5%	2%
Ascidacea	<i>Boltenia ovifera</i>	26%	21%	1%	2%	0.1%	0%
	<i>Dendrodoa carnea</i>	0%	1%	0%	0%	0%	0.1%
	Ascidians - unknown	2%	47%	0%	41%	0%	18%
Algae	<i>Fucus</i> spp.	1%	0.3%	0%	0.5%	0.4%	0.4%
	<i>Ascophyllum nodosum</i>	0.1%	0.5%	0.2%	0%	0.1%	0%
	<i>Laminaria</i> spp.	3%	0.4%	1%	0.2%	17%	4%
	<i>Chorda filum</i>	4%	0.8%	11%	0%	3%	7%
	<i>Desmarestia</i> spp.	3%	0%	0.6%	0%	1%	0.4%
	Encrusting coralline algae	3%	6%	0.6%	0.6%	25%	12%
	Algae - unknown	15%	20%	20%	36%	67%	45%
Annelida	<i>Myxicola</i> spp.	7%	17%	1%	2%	0%	3%
	Annelids - unknown	0.2%	5%	0.6%	7%	0%	3%
Cnidaria	<i>Metridium senile</i>	2%	0.1%	0%	0%	0%	0%
	<i>Urticina/Cribrinopsis</i> spp.	46%	23%	4%	0.6%	22%	6%
	<i>Gersemia rubiformis</i>	0.6%	1%	0.2%	0%	0%	0%
	<i>Pachycerianthus borealis</i>	15%	8%	45%	28%	1%	1%
	Cnidarians - unknown	7%	39%	4%	15%	0.1%	4%
Crustacea	<i>Homarus americanus</i>	13%	2%	16%	2%	28%	2%
	<i>Cancer</i> spp.	27%	5%	36%	6%	54%	10%
	<i>Hyas coarctatus</i>	0.6%	0.2%	0%	0%	0.1%	0.1%
	<i>Pagurus</i> spp.	4%	6%	1%	4%	0.3%	3%
	Shrimp	3%	13%	0.3%	7%	0%	0.4%
	Crustaceans – unknown	0.1%	0.3%	0.2%	0.2%	0%	0.1%
Echinodermata	<i>Strongylocentrotus droebachiensis</i>	18%	17%	0.2%	0.2%	2%	2%
	<i>Cucumaria frondosa</i>	20%	8%	0.2%	0%	0.1%	0.1%
	<i>Echniarachnius parma</i>	0%	0.3%	0%	0%	0%	0.2%
	<i>Asterias/Leptasterias</i> spp.	39%	23%	4%	1%	13%	6%

Biotic group	Taxa/Label	Proportion of video occurrences in HH/WI/P	Proportion of still image occurrences in HH/WI/P	Proportion of video occurrences in The Wolves	Proportion of still image occurrences in The Wolves	Proportion of video occurrences in GM	Proportion of still image occurrences in GM
	<i>Henricia</i> spp.	17%	23%	7%	8%	10%	38%
	<i>Solaster endica</i>	2%	1%	0.2%	0%	0%	0.1%
	<i>Crossaster papposus</i>	1%	1%	10%	4%	0.5%	0.6%
	Echinoderms – unknown	1%	10%	0%	3%	0%	0.2%
Mollusca	<i>Mytilus edulis</i>	0.6%	2%	0.2%	0%	0%	2%
	<i>Modiolus modiolus</i>	4%	4%	2%	0%	2%	1%
	<i>Placopecten magellanicus</i>	36%	21%	24%	14%	43%	19%
	Molluscs – unknown	3%	28%	3%	27%	1%	30%
Porifera	<i>Haliclona/Isodictya</i> spp.	1%	0%	0%	0%	4%	0.1%
	<i>Halichondria panicea</i>	2%	0%	6%	0%	0.5%	0.3%
	<i>Halichondria sitiens</i>	4%	0%	0%	0%	0.4%	0.4%
	Sponges - unknown	33%	40%	7%	23%	42%	36%
None	Debris	0.1%	0%	0.6%	0.2%	0%	0%

Table 3 cont.

3.4.2 THE WOLVES ISLANDS

Reliable continuous seafloor video was recorded for 18 transects around the Wolves Islands within the Quoddy Region EBSA. High-resolution digital still images were collected from 20 transects. Transects covered distances ranging from 68 m to 1.2 km (totaling 9.3 km). Over five hours of video was collected, totaling 641 30-s video intervals, with video intervals ranging from 4 to 50 per transect (Table 2). A total of 658 digital stills were collected here, with the number of images analyzed per transect ranging from 2 to 52 images (Table 2). Depths in these transects ranged from 15 to 71 m (average: 34 m) and contained variable visibility >5 cm (Figure 5). These sites contained mainly soft substrates (54 and 46% in the video and stills, respectively) followed by the pebble bottom-type (22 and 34% in the video and stills, respectively) (Figure 29). No mussel beds were observed in The Wolves transects. Strong tidal and near-seafloor current influences restricted deployment times around these islands, with many transects of less than 25 minutes (Table 2). When combining video and image analysis, taxon counts ranged from 0 to 21 taxa per transect, with an overall count of 37 taxa. The most commonly seen benthic fauna observed in this area were burrowing anemones *Pachycerianthus borealis*, sea scallops *P. magellanicus*, unknown ascidians, *Cancer* crabs, and American lobsters *Homarus americanus* (Table 3).

3.4.3 SOUTHERN GRAND MANAN

Grand Manan transects include all transects occurring in and surrounding the Southern Grand Manan EBSA. Overall, 44 transects were conducted and reliably collected continuous seafloor video, while 46 transects collected high-resolution still images (Table 2). Here, total distance covered was 39.5 km equating to just under 17 hours of video footage and 1622 digital stills (2 to 55 stills per transect) (Table 2). Transects ranged from 221 m to 1.6 km in length, containing 14 to 50 30-s video intervals, totaling 1898 intervals. Depths ranged from 5 to 82 m (average: 29 m), and visibility resembled that of The Wolves transects, with all intervals containing visibility >5 cm (Figure 5). Grand Manan transects were predominately comprised of fine grain (31 and 20% in the video and stills respectively) and pebble substrates (24 and 39% in the video and stills respectively), followed by bedrock (21% in the video intervals and 14% in the stills) and cobbles (16% in video intervals) (Figure 29). Mussel beds were reported as the primary bottom-type in only two images in two different transects (CD122 and 146) off Southern Grand Manan, between South Green Island and White Head Island. Taxon counts ranged from 3 to 19 taxa per transect, with an overall count of 39 taxa in the Southern Grand Manan area. Unidentified

algae, sponges, and molluscs, along with *Henricia* sea stars, *Cancer* crabs and the sea scallop *P. magellanicus* were the most commonly occurring benthic taxa in transects occurring off Southern Grand Manan (Table 3).

3.5 SELECT TAXA ABUNDANCES

All abundance/count data for the 41 taxa analyzed here are available on Canada's Open Data Portal (Lawton 2022) and on OBIS (Teed and Lawton 2026). Six taxa chosen for visualization purposes in this report include conservation priority species, *B. ovifera* (stalked tunicate) and *M. modiolus* (horse mussels), along with commercially important species, *P. magellanicus* (Atlantic sea scallop), *Cucumaria frondosa* (sea cucumber), *Strongylocentrotus droebachiensis* (green sea urchin), and *H. americanus* (American lobster).

Boltenia ovifera had the highest reported abundance of all 41 taxa, at 273 ind. image⁻¹, with 3% of still images containing *B. ovifera* having abundances >100 ind. image⁻¹ (Figure 30), all of which occurred on bedrock substrates. All instances of high *B. ovifera* abundance were located within the HH/WI/P EBSA, while *B. ovifera* was not encountered in Southern Grand Manan (Figure 30). Using the 0.375 m² average FOV from a subset of 200 survey images yielded a corresponding density of ~728 ind. m⁻². This was 37% above the highest local densities for this species within the HH/WI/P EBSA reported by Mireault et al. (2025; 456 ind. m⁻²). Given this discrepancy for *B. ovifera* and to corroborate high density estimates for the other five taxa, we evaluated all images from the highest abundance class observations for each species to determine image-specific FOVs. For *B. ovifera*, a total of 17 images had abundances over >100 ind. image⁻¹. We derived image-specific FOVs for 12 images (that had the trigger weight [10-cm] in view), yielding a revised maximum density estimate of 564 ind. m⁻².

Green sea urchins (*S. droebachiensis*) had the second highest reported abundance of the species described here, reaching 128 ind. image⁻¹; however, only 0.4% of observations reported abundances >100 ind. image⁻¹ (Figure 31). Instances of high sea urchin abundance predominately occurred in the HH/WI/P sub-area on mixed hard substrates (*i.e.*, bedrock, boulders, cobbles and pebbles), with a few observations in Southern Grand Manan off Whitehead Island (Figure 31). Only one occurrence of sea urchins was documented off The Wolves (Figure 31b). For *S. droebachiensis*, only two images had abundances over >100 ind. image⁻¹. We derived image-specific FOVs for these two images, yielding a revised maximum density estimate of 315 ind. m⁻², similar to the ~341 ind. m⁻² estimate using the average FOV.

Horse mussels (*M. modiolus*) reached abundances of 94 ind. image⁻¹ (density of ~250 ind. m⁻² using the average FOV – similar to maximum density estimate of 240 ind. m⁻² from Mireault et al. 2025), with 2% of images (where horse mussels were present) containing abundances >50 ind. image⁻¹ and forming mussel beds (Figure 32). Highest horse mussel abundances occurred in the HH/WI/P EBSA, particularly in the Head Harbour Passage on mixed hard substrates (mainly pebbles, cobbles and boulders) and areas surrounding Indian Island (Figure 32a), along with Whitehead Island off Southern Grand Manan (Figure 32c). No horse mussels were observed off The Wolves (Figure 32b). For *M. modiolus*, a total of three images had abundances over >50 ind. image⁻¹. However, only one of these images had the trigger weight in view to derive image-specific FOVs, yielding a revised highest density estimate of 276 ind. m⁻².

The highest reported abundance of sea cucumbers (*C. frondosa*) was 18 ind. image⁻¹ (density of ~50 ind. m⁻² using average FOV), with 3% of observations containing abundances of 11-20 ind. image⁻¹ (Figure 33). *C. frondosa* predominately occurred in the HH/WI/P EBSA (with highest abundances in Head Harbour Passage and near Adam Island - Figure 33a) on mixed hard substrates (pebbles, cobbles, boulders and bedrock), with no occurrences off The Wolves (Figure 33b), and only two occurrences in Southern Grand Manan (Figure 33c). For *C. frondosa*, a total of five images had abundances within >10 ind. image⁻¹. We derived image-specific FOVs for three images, yielding a revised highest density estimate of 48 ind. m⁻².

Atlantic sea scallops (*P. magellanicus*) reached abundances of 9 ind. image⁻¹ (densities of ~24 ind. m⁻² using average FOV), with only 0.7% of image observations in abundance class 3 (6-10 ind. image⁻¹) (Figure 34). Scallops occurred in all three sub-areas, across depth gradients, and predominately on pebble and cobble bottom types (Figure 34). For *P. magellanicus*, a total of six images had abundances >5 ind. image⁻¹. We derived image-specific FOVs for four images, yielding a revised maximum density estimate of 13 ind. m⁻².

American lobsters (*H. americanus*), mostly larger juveniles and adults, were only reported as 1 ind. image⁻¹ (Figure 35; ~2 ind. m⁻² using average FOV; no adjustment to image-specific FOV for this species). In the HH/WI/P sub-area, lobsters predominately occurred in the northern region of the EBSA (Figure 35a). Lobsters also occurred off The Wolves (Figure 35b) and off Southern Grand Manan (Figure 35c) across depth gradients on predominately fine grain bottom types.

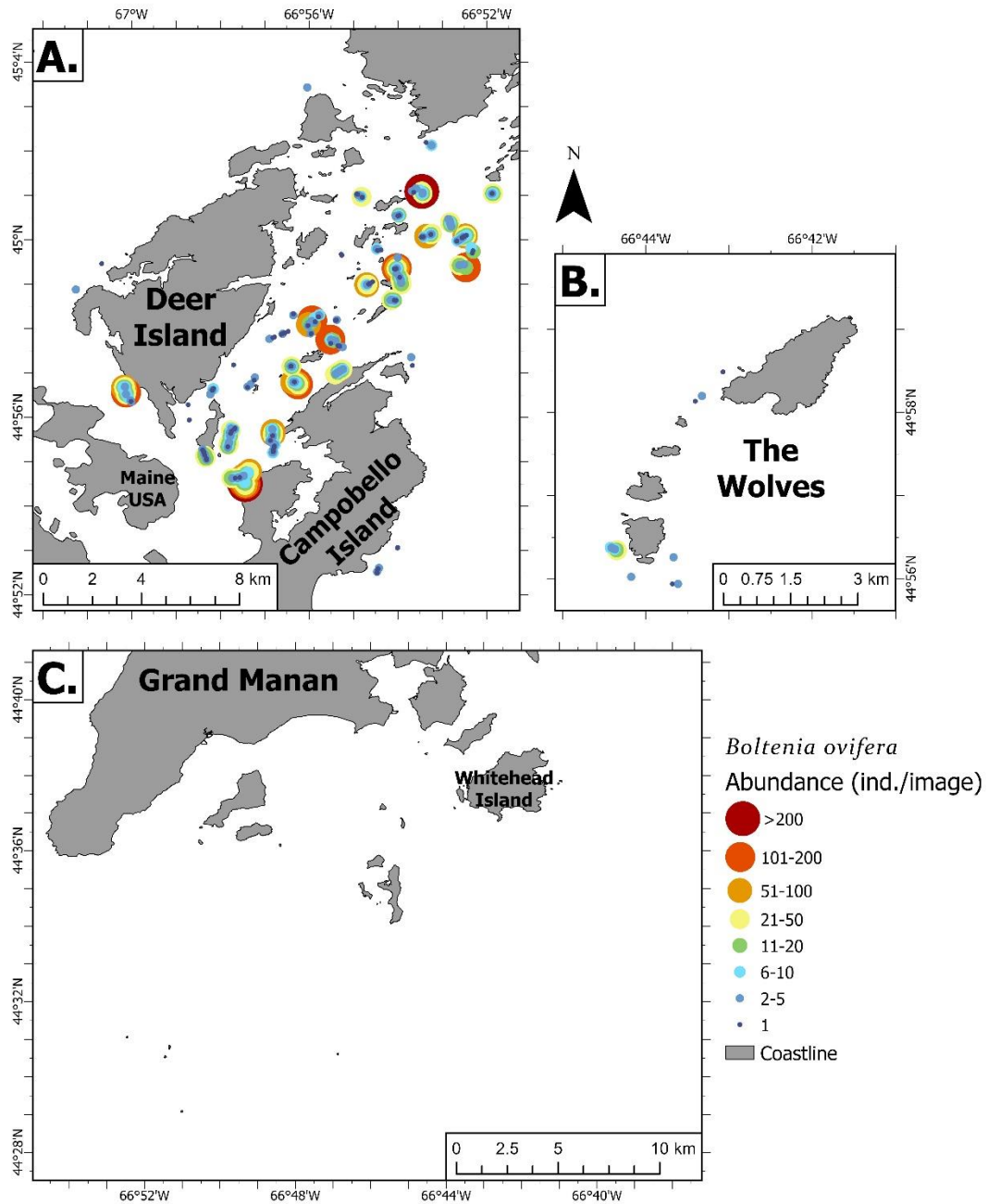


Figure 30 Abundance (count of individuals per image) of the stalked tunicate *Boltenia ovifera* in the (A) HH/WI/P, (B) The Wolves, and (C) Southern Grand Manan sub-areas.

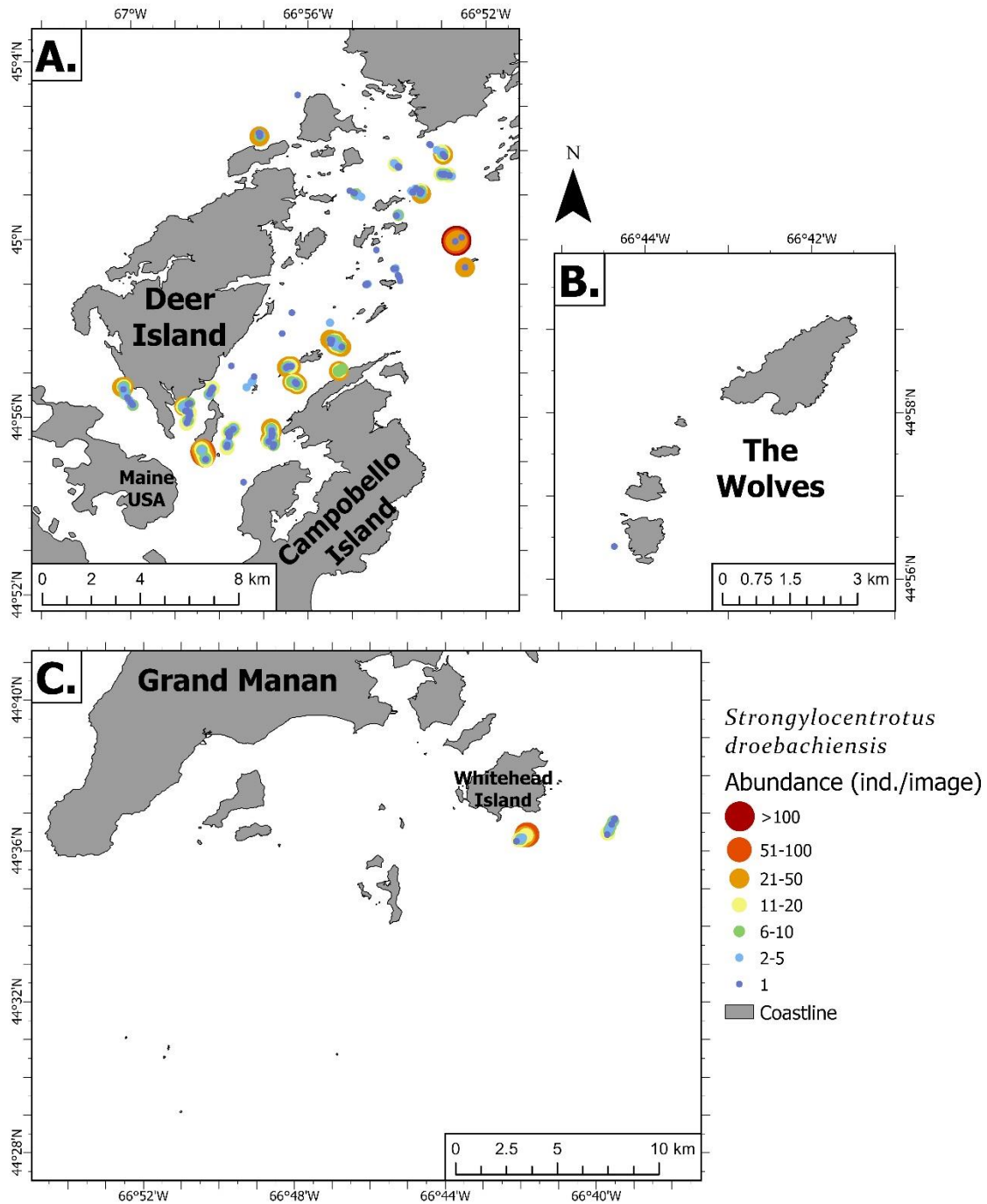


Figure 31 Abundance (count of individuals per image) of the green sea urchin *Strongylocentrotus droebachiensis* in the (A) HH/WI/P, (B) The Wolves, and (C) Southern Grand Manan sub-areas.

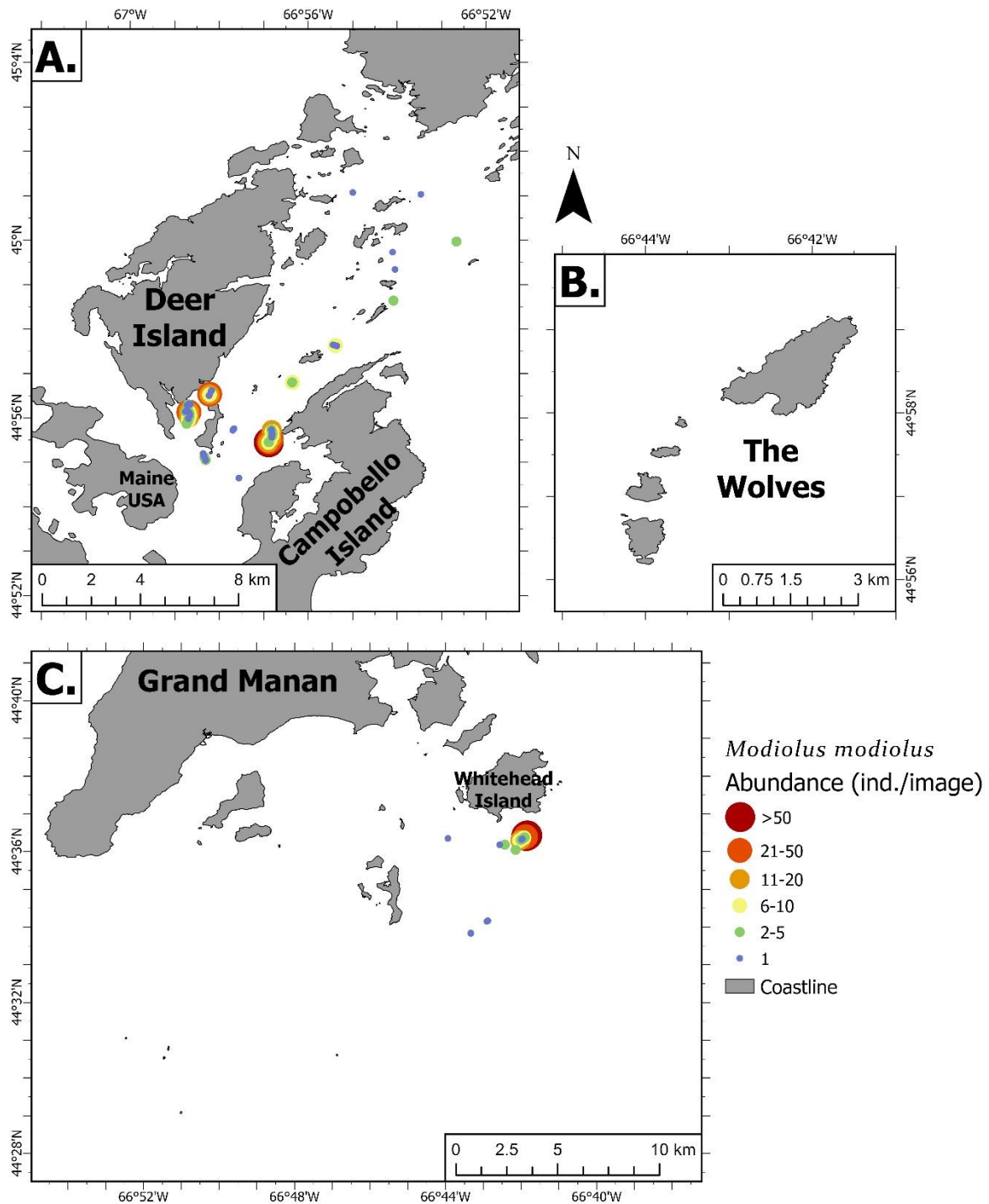


Figure 32 Abundance (count of individuals per image) of the horse mussel *Modiolus modiolus* in the (A) HH/WI/P, (B) The Wolves, and (C) Southern Grand Manan sub-areas.

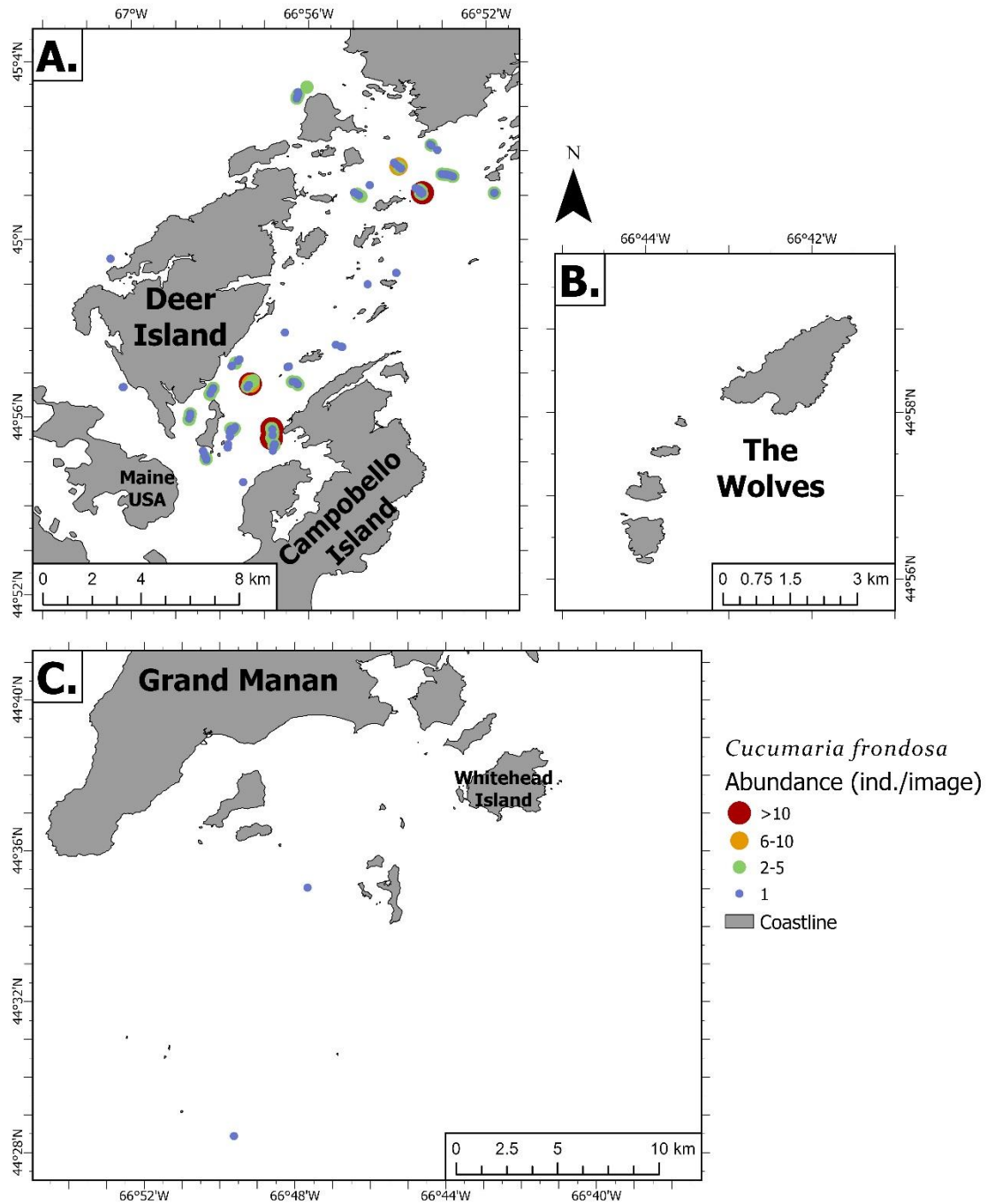


Figure 33 Abundance (count of individuals per image) of the orange-footed sea cucumber *Cucumaria frondosa* in the (A) HH/WI/P, (B) The Wolves, and (C) Southern Grand Manan sub-areas.

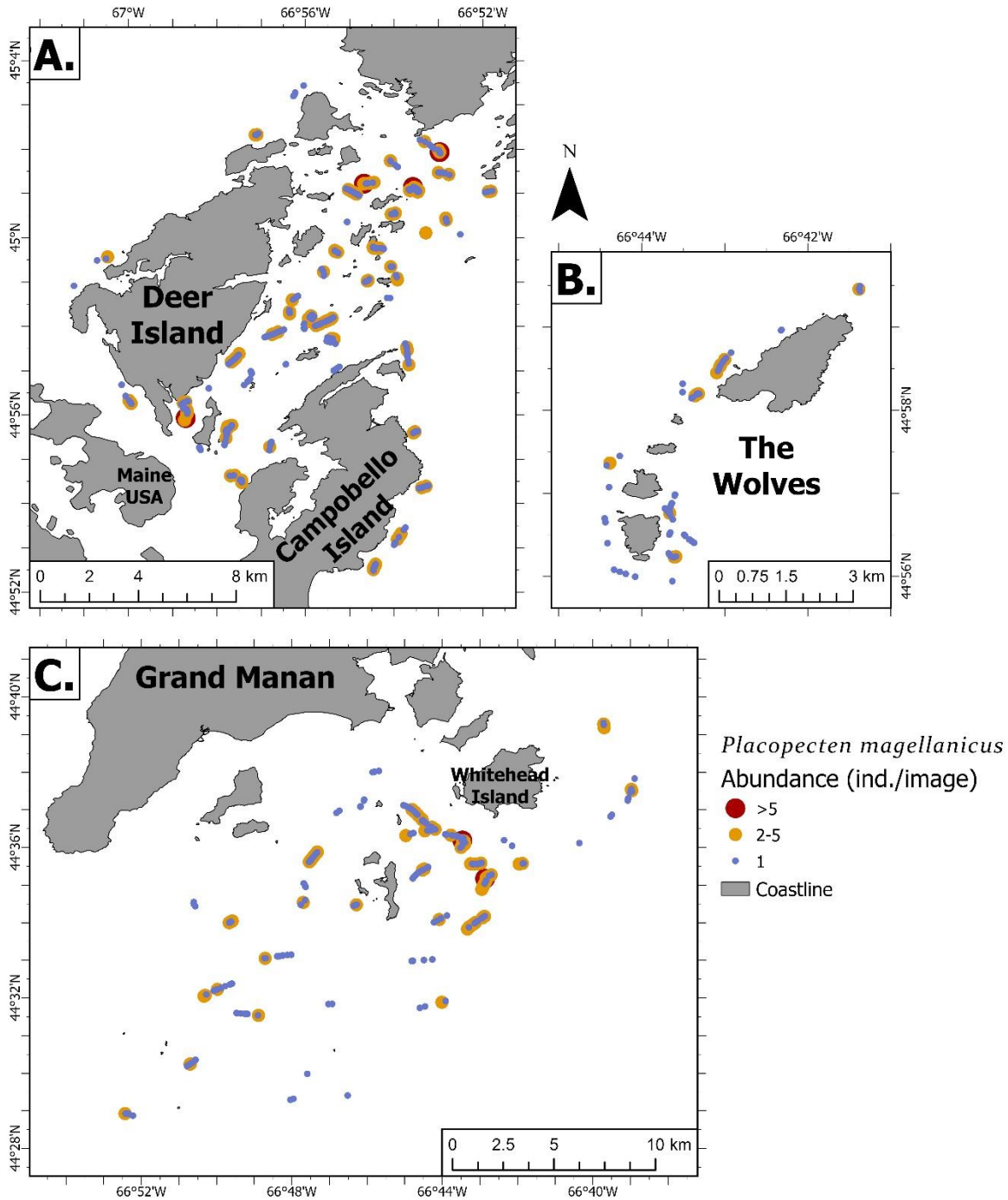


Figure 34 Abundance (count of individuals per image) of the Atlantic sea scallop *Placopecten magellanicus* in the (A) HH/WI/P, (B) The Wolves, and (C) Southern Grand Manan sub-areas.

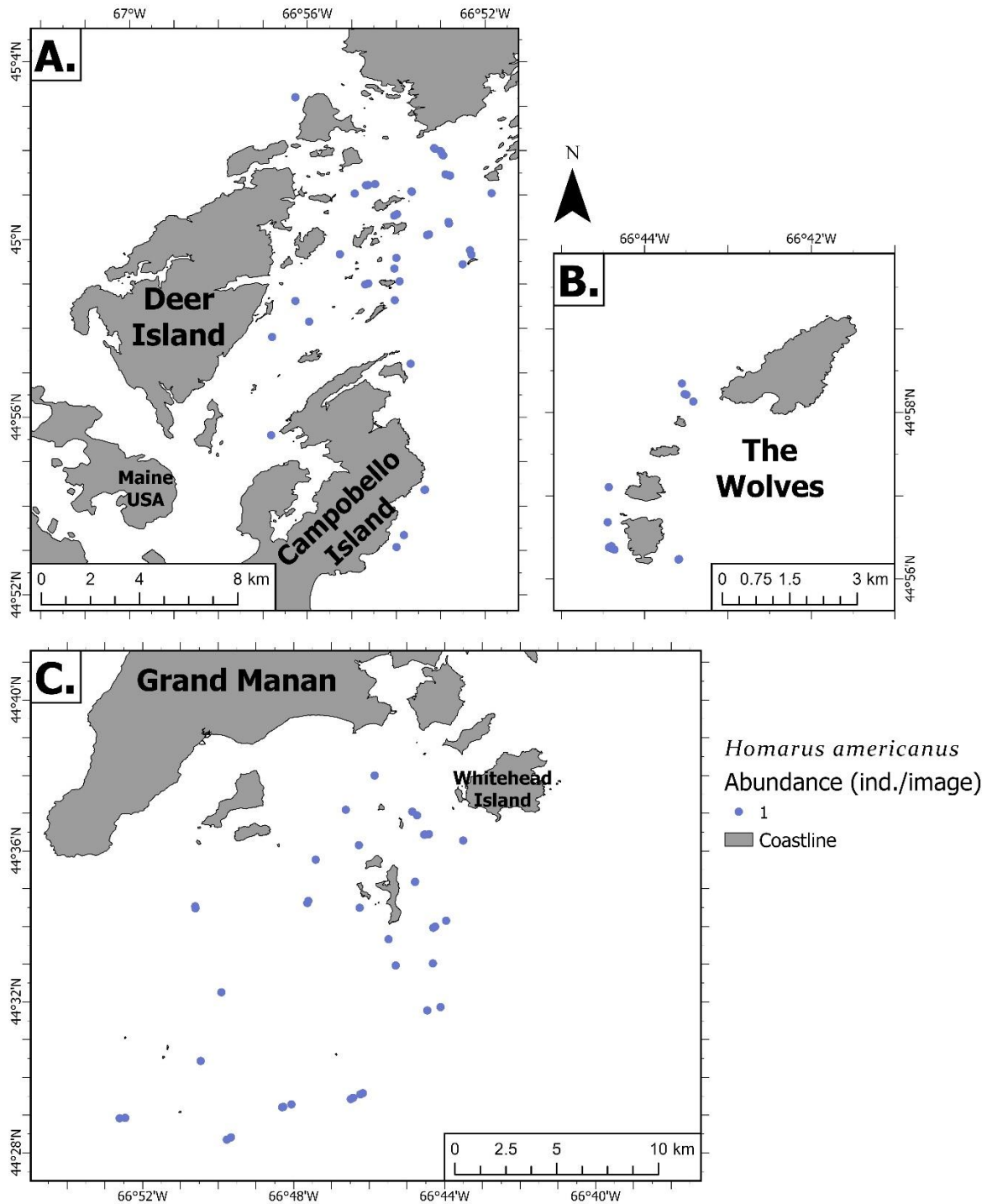


Figure 35 Abundance (count of individuals per image) of the American lobster *Homarus americanus* in the (A) HH/WI/P, (B) The Wolves, and (C) Southern Grand Manan sub-areas.

3.6 VIDEO AND STILL IMAGERY COMPARISON

Of the transects analyzed, 128 contained both high quality digital still images and high-definition video. Within these transects, 4059 video intervals had still images that fell within the 30-s interval (total of 4559 images). Once occurrences were collated across images to generate one image occurrence value per taxa per video interval, 166 419 image occurrences were available for comparison (4059 matching video interval values x 41 taxa). When comparing taxa presence from video intervals to digital still images, there was an 89% match. The 11% that did not match included at least one observation of each taxon (Table 4). Overall, sponges were detected more in the video intervals when compared to the digital stills. Cnidarians showed a similar trend, except for unknown Cnidarians which were more prevalent in the digital still images (likely hydrozoans). Cryptic annelids and small ascidians were much more prevalent in the higher-resolution digital stills. Similarly, smaller, enigmatic crustaceans such as shrimp were also more prevalent in the high-resolution stills, while larger, highly mobile taxa (such as lobsters and crabs) were much more prevalent in the video intervals. Highly mobile fish occurred at a much higher frequency in the video intervals. Molluscs and echinoderms were highly variable in terms of detectability between digital stills and video intervals but in general, larger taxa like scallops, urchins, sea cucumbers, and sun stars were more prevalent in video intervals. Algae occurrences were also variable according to imagery technique, with *Fucus* spp., *Laminaria* spp., and *Desmarestia* spp. having higher prevalence in video intervals, while the remaining algae taxa had relatively equal occurrence (Table 4).

Concerning the primary bottom type, 54% of still image primary bottom type observations matched with the category assigned in video intervals. However, they did differ in the remaining 46%, with many differing observations of closely aligned grain sizes such as cobble in an image observation, compared to the boulder bottom type seen across a 30-s video interval.

Table 4 Proportion (%) of priority taxa (n=41) and debris with matching and unmatching occurrences according to the 30-s video intervals and digital still images.

Biotic group	Taxa/Label	Proportion of matching occurrences	Proportion of unmatching occurrences
Actinopterygii	Cottoidei	94%	6%
	Fish – unknown	89%	11%
Ascidacea	<i>Boltenia ovifera</i>	92%	8%
	<i>Dendrodoa carnea</i>	99%	1%
	Ascidians - unknown	61%	39%
Algae	<i>Fucus</i> spp.	99%	1%
	<i>Ascophyllum nodosum</i>	99%	1%
	<i>Laminaria</i> spp.	93%	7%
	<i>Chorda filum</i>	93%	7%
	<i>Desmarestia</i> spp.	98%	2%
	Encrusting coralline algae	91%	9%
	Algae - unknown	69%	31%
Annelida	<i>Myxicola</i> spp.	91%	9%
	Annelids - unknown	95%	5%
Cnidaria	<i>Metridium senile</i>	99%	1%
	<i>Urticina/Cribrinopsis</i> spp.	76%	24%
	<i>Gersemia rubiformis</i>	99%	1%
	<i>Pachyercianthus borealis</i>	87%	13%
	Cnidarians - unknown	75%	25%
Crustacea	<i>Homarus americanus</i>	81%	19%
	<i>Cancer</i> spp.	64%	36%
	<i>Hyas coarctatus</i>	99%	1%
	<i>Pagurus</i> spp.	93%	7%
	Shrimp	92%	8%
	Crustaceans – unknown	99%	1%
Echinodermata	<i>Strongylocentrotus droebachiensis</i>	93%	7%
	<i>Cucumaria frondosa</i>	92%	8%
	<i>Echniarachnius parma</i>	99%	1%
	<i>Asterias/Leptasterias</i> spp.	83%	17%
	<i>Henricia</i> spp.	70%	30%
	<i>Solaster endeca</i>	99%	1%
	<i>Crossaster papposus</i>	97%	3%
	Echinoderms – unknown	94%	6%
Mollusca	<i>Mytilus edulis</i>	98%	2%
	<i>Modiolus modiolus</i>	96%	4%
	<i>Placopecten magellanicus</i>	65%	35%
	Molluscs – unknown	69%	31%
Porifera	<i>Haliclona/Isodictya</i> spp.	99%	1%
	<i>Halichondria panicea</i>	98%	2%
	<i>Halichondria sitiens</i>	98%	2%
	Sponges - unknown	70%	30%
None	Debris	100%	0%

4 DISCUSSION

A total of 5561 30-s continuous seafloor video intervals and 5047 digital still images were analyzed to document primary bottom-types and select taxa occurrence and abundance, towards benthic habitat characterization across three coastal EBSAs in SWNB. This included the completion of 150 near-seafloor imagery transects from summer 2016 to fall 2017, many of which provide an initial baseline characterization of benthic features to ~85-m depths. Primary novel characterization occurred off the coast of Southern Grand Manan near the complex, current-exposed Murr Ledges. We also provide additional characterization of heavily-used (*i.e.*, fishing and recreation) areas such as the HH/WI/P EBSA, with particular focus on depths beyond dive survey limits (~35-m depths) that have dominated characterization of the EBSA thus far. Overall, this survey provides new and detailed high-resolution descriptions of benthic habitats present in three SWNB EBSAs from shallow coastal waters of Southern Grand Manan (5-m depth), to the deeper channels off Head Harbour Passage (89-m depths). At completion (2017) the SPERA benthic imagery survey coverage represented the most comprehensive seafloor imagery data bank acquired in SWNB. Subsequent benthic imagery surveys (2022-2024) have augmented this data bank, with additional area and depth coverages using a newer camera system deployable to 200 m depth (Teed and Lawton 2025).

4.1 EBSA CHARACTERIZATION

In the HH/WI/P EBSA, we collected approximately 26 hours of continuous seafloor video over a compiled distance of 30 km. Overall, when combining video and still image observations, the HH/WI/P sub-area housed all 41 taxa analyzed and demonstrated the highest taxa counts across transects. This EBSA is a known diversity hotspot, where diversity is driven by persistent hydrodynamic conditions (*i.e.*, tidal currents) that increase water circulation and decrease turbidity, allowing numerous species to flourish (Buzeta 2008). Additionally, the complex geomorphology of numerous islands that are clustered among shallow areas are also conducive to increase benthic diversity (Buzeta 2008). Our survey highlights this diversity, though we acknowledge this underrepresents overall species richness, due to the subset of taxa selected for analysis. Common taxa observed in this EBSA included *Boltenia ovifera* (and other unknown ascidians), various anemones, crabs (particularly from video observations), common sea stars and blood stars, scallops, horse mussels, and various unknown sponges. These taxa have been documented in historical dive surveys (MacKay et al. 1978c; Lawton pers. obs.), and are known to occupy various coarse substrates that are reflected in the current survey. Additionally, sponges in particular

are thought to be more diverse on complex topography (Goodwin et al. 2025), akin to our findings.

Boltenia ovifera and *Modiolus modiolus* in particular were observed forming tunicate fields and mussel beds as well as having high site fidelity to the HH/WI/P EBSA, with very few observations in The Wolves or Southern Grand Manan. Both of these species are known to be widely distributed elsewhere in the SS-BoF marine bioregion, forming tunicate fields and expansive mussel bioherms (Francis et al. 2014; Beazley et al. 2017; Wilson et al. 2021; Teed et al. 2025b). Such biogenic habitats warrant increased conservation priority due to their ability to increase habitat complexity and thus, house high species diversity (Kenchington et al. 2019; NAFO 2024), with areas of known concentration being high priority objectives in the bioregional conservation network plan (DFO 2018).

Similarly, green sea urchins and sea cucumbers were only observed in abundance in the HH/WI/P sub-area. These near-seafloor imagery-based observations have some relevance to stock assessments and commercial fisheries distributions of these species, with up to 90% of sea cucumber catch in SWNB being concentrated to the Letete Passages (Northern Deer Island), though there have been significant declines observed in the fishery in recent decades (Martin et al. 2023). Dense aggregations of green sea urchins are also historically known from this sub-area, both from SCUBA-based urchin population surveys, and the spatial effort applied by commercial diving licenses (Robichaud 2010a). Primarily, the sea urchin fishery in this sub-area is a dive fishery, with ~50% of the dive fishery catch occurring in waters <10 m (Robichaud 2010a). Green sea urchins are also fished off Grand Manan, predominately by dragging (Robichaud 2010b). Our survey reported fewer observations of green sea urchins there compared to HH/WI/P.

Scallops also support important commercial fisheries in SWNB (DFO 2019). While scallops were certainly prevalent in the near-seafloor imagery data from both EBSAs, abundances remained relatively low (<5 ind. m⁻²), though this does not account for scallop spat that are too small to detect from imagery. Additionally, our survey was limited to depths of 85 m, likely underestimating the presence of taxa such as *Placopecten magellanicus*, which likely occur in the deeper, mixed substrate channels (Lawton and Teed 2025).

Regarding transects conducted off The Wolves, we collected over 5 hours of continuous seafloor video over a linear distance of ~9 km, documenting 37 taxa (of the 41 analyzed). Common taxa observed here included cerianthids, scallops, unknown algae and ascidians (specific to still images) across predominately fine grain and pebble substrates.

Cluster analysis previously completed by Buzeta (2008) suggested that species assemblages occurring off The Wolves are most similar to the HH/WI/P EBSA compared to surrounding areas (such as Grand Manan, Passamaquoddy Bay, Brier Island, etc.). However, this may have been limited by the shallow dive survey depths in which the previous study was based. For example, while scallops were characteristic of both The Wolves and HH/WI/P EBSA transects, they were more prevalent in the HH/WI/P and Southern Grand Manan transects. Conversely, cerianthids specifically were characteristic of The Wolves (compared to the other two EBSAs), dominating fine-grain habitats. Cerianthids are known to occur in the area and can form dense aggregations, providing structure for taxa, such as fishes, on an otherwise homogenous sandy/muddy seafloor (Fuller et al. 2008; Kenchington 2014). While recognized locally as a significant component of fine-grained sediments, most observations on their distribution come from SCUBA diver surveys in shallow water habitats. Our documentation of cerianthid distribution across a greater depth range (survey depths to 89 m; deepest cerianthid observation 79 m) provides significant new information on their distribution in SWNB.

Prior species assemblage data from dive surveys also suggested that The Wolves may be distinguished from surrounding areas due to increased presence of blue mussels (*Mytilus edulis*) (MacKay and Boisen 1979; Buzeta 2008). However, the current survey documented just one blue mussel occurrence (only in the video), with most mussel occurrences reported in the other two EBSAs. Absence of blue mussels in The Wolves transects is likely due to these transects predominately occurring in deeper waters (*i.e.*, >35 m) and encountering fine grain sediments, as opposed to hard, coarser substrates in shallower waters that blue mussels prefer. Overall, while the current survey documents a high taxa count (of 37 taxa) off The Wolves Islands, prevalence of most taxa remained low, which could be due to the small sample size (18 transects). Future studies should expand spatial coverage here, especially considering the area is suggested to be highly natural with high benthic diversity generating important feeding grounds for cetaceans (Buzeta 2014). Extending spatial coverage in the waters surrounding The Wolves would further support management and conservation decisions.

Off Southern Grand Manan, we collected just under 17 hours of continuous seafloor video coverage over a compiled distance of almost 40 km and documented 39 taxa (of the 41 analyzed). This is the first benthic imaging survey to be conducted in this area beyond dive survey depths, due in part to the strong rip currents present in this EBSA. Absent taxa include the frilled anemone, *Metridium senile*, and sea strawberry, *Gersemia rubiformis*. The absence of *M. senile* here is perplexing, considering the wide range of preferred coarser

substrates and higher currents in this area, while the sea strawberry is likely absent from analyzed imagery in Southern Grand Manan due to persistently high currents making soft corals susceptible to dislodgement (Gordan et al. 2005; Cogswell et al. 2009). Overall, this EBSA was diverse, likely due to the heterogeneous substrates sampled, coupled with the complexity of high- and low-relief areas (*i.e.*, steep and gentle slopes) known to be associated with increased diversity (Goodwin et al. 2025). Common taxa recorded in this EBSA include scallops, *Cancer* spp., blood stars, unknown algae, coralline algae, various sponges, and lobster. As mentioned above, scallops are known to occupy this area, supporting a significant commercial fishery (DFO 2019). Crabs, blood stars, and various sponges are associated with coarser substrates, and considering this EBSA contained extensive bedrock patches, these taxa are expected to be common and have been documented as such from prior dive surveys (MacKay et al. 1979). Most kelp (*Laminaria* spp.) and coralline algae observations were primarily reported in this EBSA, akin to previous findings (MacKay et al. 1979; Buzeta 2008), on coarser substrates at shallow depths.

Lobsters comprise an economically important commercial fishery in Lobster Fishing Area 36 (which includes the Quoddy Region) and Lobster Fishing Area 38 (Grand Manan), operating for over 150 years (DFO 2023b). Lobsters, primarily larger juveniles and adults, were observed predominately in video intervals, although typically as sporadic individual occurrences over a transect length, rather than repeated observations in proximity, that would have indicated presence of aggregations. Aggregation of lobsters in specific coastal locations is a known feature of their summer use of the lower Bay of Fundy, including several well-documented areas on Grand Manan (Tremblay et al. 2006; Lawton et al. 2024; Dinning et al. 2025), though our imagery surveys did not encounter any new locations. As with *Cancer* crabs and demersal fishes, the more sporadic occurrences of these mobile species were only documented from continuous seafloor video coverage. In summary, the Southern Grand Manan EBSA contains diverse taxa across highly heterogeneous substrates, hosting numerous commercially important species. However, similar to the HH/WI/P sub-area, future studies should aim to extend depth coverage in the deeper channels off Southern Grand Manan.

4.3 IMAGERY TECHNIQUES AND ANALYSIS APPROACHES

All 5047 still images and 5561 30-s video intervals were annotated to document occurrences of 41 select taxa to inform management and conservation priorities of three coastal EBSAs in SWNB. As the objective of the current study was to characterize benthic habitats, complete assemblage analysis was not attempted. Thus, the taxa count observed

in each still image and video interval was from the selected set of 41 taxa, and not a formal richness value that would aim to identify all taxa visible in an image. Choosing select taxa was a distinct aspect of the survey approach, largely due to resource constraints (*e.g.*, trained personnel, limited time, etc.), and interest in particular taxa. Analyzing both sets of imagery for select taxa allowed for the entire suite of imagery to be annotated, and for abundances to be measured across still images. Many studies to date have taken an alternate route, annotating complete assemblages of a subset of imagery (*e.g.*, Lacharité and Brown 2019; Command et al. 2024; Cutcliffe et al. 2025; Paulin et al. 2025; Teed et al. 2025a); however, there are examples that resemble the analysis documented here, or studies that have analyzed for one species of interest across all images (*e.g.*, Nozères et al. 2025; Teed et al. 2024; Teed and Lawton *in review*). Surveys that have attempted to document all species present have reported significant annotator time investment and expertise development, and in many cases, due to limitations of image resolution, these studies cannot confidently identify all taxa to species level (Command et al. 2024; Paulin et al. 2025; Teed et al. 2025a). This often leads to taxa exclusions from community assemblage analyses. Moreover, full taxa assemblages are typically not possible from imagery surveys due to the limitations of only documenting organism occurrences visible on or above the seafloor (*i.e.*, often no endobenthic/burrowing species documented). In contrast, we focused on confident identifications of 41 select taxa (19 of which were identified to the species level and an additional nine to genus level) across nine biotic groups, not only documenting organism occurrence (from two imaging techniques), but also abundance (from still images).

Regardless of the method chosen to interpret benthic imagery survey data, geospatially resolved imagery, such as the image inventory documented here, acts as a data bank that can be revisited and reanalyzed to meet diverse emerging scientific analyses and management needs over time (Mallet and Pelletier 2014). For initial or immediate application, investigators can select how to analyze subsets of data. Such selections include distance-based selection of images, presence only, presence-absence, percent cover, and/or abundance for select or all organisms occurring in an imagery file. We chose to document occurrence (presence-absence) and abundance of 41 select taxa, and we reported on abundance of six key species of commercial importance and high conservation priority. We considered it important to document both occurrence and abundance to inform fisheries and conservation management. For example, while scallops were much more prevalent than horse mussels throughout the study area, abundances of scallops were low (<5 ind. image⁻¹), whereas when present, horse mussels were found forming dense mussel beds (reaching

densities of over 200 ind. m⁻²). Moreover, high concentrations of species of conservation concern are prioritized over basic prevalence data to insure the protection of dense populations (DFO 2018, 2020).

Following initial analysis based on original research questions, and with the requisite metadata, new types of analyses can be conducted by revisiting these imagery datasets (*i.e.*, report on all abundances, estimate percent cover, etc.). For instance, a more recent imagery survey conducted in Head Harbour and Western Passages in 2022 (Teed et al. 2024) documented extensive colonies of the invasive tunicate, *Didemnum vexillum*. Thought to be a recent invader, data from deeper-water near-seafloor imagery surveys, SCUBA diving surveys, and eDNA analyses included in Teed et al. (2024) provided impetus to expand invasive species monitoring through new joint academic-industry efforts. As imagery surveys continue to be conducted in SWNB, updates to confident taxa identified and emerging cryptic or invasive species could employ the imagery dataset collected here to further investigate community baselines and provide insight into species establishment or distribution shifts over time.

Another aspect of our approach includes the descriptions of diversity within and across the nine biotic groups documented (Figures 9-28). With only 32 taxa selected, the nine remaining taxa were not classified beyond their biotic group. As such, various taxa could comprise the 'unknown' categories, likely greatly underestimating how diverse these assemblages are. For example, molluscan taxa counts in this study could only reach a maximum of four taxa (*Mytilus edulis*, *Modiolus modiolus*, *Placopecten magellanicus*, and unknown), and thus, all remaining bivalves, gastropods, polyplacophorans, etc. are grouped into one 'unknown' taxa label. Previous dive surveys across Deer Island and Campobello have reported on >30 molluscan taxa (MacKay et al. 1978c), indicating that benthic habitats are certainly more diverse overall than documented through imagery surveys because physical sampling can sample smaller taxa, especially burrowing types like most bivalve species. Future imagery studies could attempt to expand the taxa list by identifying unknown taxa beyond their biotic grouping, or alternatively, focus could be given to just the 32 specific taxa, providing more confident occurrence and abundance estimates, and provide for monitoring temporal change in those specific taxa groups.

4.3.1 VIDEO VERSUS STILL IMAGERY

The 2016-2017 survey employed two imaging techniques, still imagery and continuous video (from two different cameras), allowing for simultaneous collection and comparison. There are benefits and drawbacks of collecting either type of media; however,

some drawbacks are accounted for with the use of both imaging techniques. The primary video imagery acquired on the project was in the common (at the time) HD format. While HD video has lower resolution (1920 x 1080 pixels), incorporating a still camera allows for high-resolution periodic images (*i.e.*, increased number of pixels). Such high-resolution permits closer inspection of taxa for more confident annotations and precise measurements of seafloor substrates. For instance, smaller, more cryptic taxa such as shrimps, annelids, ascidians, and unknown cnidarians (predominately hydrozoans) were more prevalent in the higher-resolution digital stills. In contrast, continuous video can capture subtle substrate variability and overall benthic habitat patch sizes at much finer spatial scales, as opposed to still images which represent a fraction of the seafloor coverage of the video footage. Moreover, continuous video can encounter more sparse, solitary mobile taxa, as demonstrated in the current study with higher prevalence of crabs, lobsters, fishes, scallops, urchins and sea cucumbers in the video intervals.

In our study, continuous video analysis observed higher taxa occurrences, reporting almost 2400 more occurrences compared to digital stills, and revealed higher heterogeneity of substrates (Figure 6a). Overall, while there were observed differences in taxa occurrences when comparing continuous video and still imagery techniques, these differences were minimal (~11% of observations did not match). Our findings further confirm the usefulness of employing either imagery technique but highlights the benefits of the simultaneous collection of both continuous video and high-resolution digital stills. Since the 2016-2017 imagery surveys, UHD (4K) cameras have become broadly available, with many manufacturers offering on-board camera image recording and/or transmission of UHD (4K) over fibre-optic cables to surface recording systems. Progressive upgrades to the image resolution of both video and digital still camera systems will change some of the specifics of which approach can resolve benthic habitat structural features and biota, but the generalities of the specific applications for which each imagery type is better suited will likely prevail.

Regional benthic habitat surveys conducted concurrently and subsequently to the 2016 and 2017 surveys reported here, have undertaken further comparative assessments of the benefits of benthic video versus benthic still imagery approaches (Kenchington et al. 2014; Gale et al. 2017; Cutcliffe et al. 2025; Teed et al. 2024; Teed et al. 2025a; Teed and Lawton *in review*). The more recent surveys using similar camera systems with both video and still image capture capability have reinforced the utility of collecting both types of data. Cutcliffe et al. (2025) used UHD (4K) video systems, while the other reports noted here used HD video. For example, in the HH/WI/P EBSA, Teed et al. (2024) demonstrated that

continuous video coverage successfully cataloged the broad spatial extent of invasive tunicate colonies and number of patches, while high-resolution digital stills allowed for confirmation of identification compared to a similar looking native species. Using the same imaging system in the St. Anns Bank Marine Protected Area off Nova Scotia, crinoids were found forming distinct dense aggregations at fine spatial scales, only captured from the analysis of continuous seafloor video (Teed and Lawton *in review*). Thus, depending on project and management objectives, collecting simultaneous video and still imagery is immensely valuable. Still imagery can confirm species identifications while continuous video can measure spatial extent of habitat patches and species aggregations that warrant protection.

4.3.2 CAMERA SYSTEM DEPTH CAPABILITIES

One limitation of the camera system employed here was the restricted depth capability in 2016 to 2017, allowing for surveying to depths of ~85 m. As noted above, this decision was in part due to technical considerations on reliability of transmission of HD video over copper-based video cabling available at that time. While the islands in SWNB are surrounded by shallow shoals and several smaller islands, channels >85 m depths do occur in the HH/WI/P EBSA, and immediately to the south-east of the Grand Manan EBSA; depths of over 200 m may occur rapidly when descending into the Grand Manan Basin. Depth capabilities of camera technologies used for near-seafloor imagery surveys is linked to overall ocean technology considerations. Coastal work conducted off small coastal science vessels, perhaps up to 10 m in length, typically cannot mount complicated winches and surface monitoring systems. Through the broader availability of small Remotely Operated Vehicle (ROV) systems, new survey capacities have come forward for small coastal vessel applications. Larger coastal survey vessels, such as the CCGS *Viola M. Davidson*, with cranes and areas for dedicated winch installations, along with science laboratory space, offer the potential to deploy more sophisticated camera survey packages. Subsequent developments, including the transition to optical fibre-based cabling, providing more comprehensive capabilities for interfacing between surface controls and underwater systems (*e.g.*, CTD, both video and digital still camera control, still image and HD/4K video transfer to surface recording systems) have allowed both for greater control of near-seafloor operations, as well as deeper deployment capabilities – currently to 200 m (see for example Teed et al. 2025b). To survey greater than 200-m depths, larger surface winch control systems, larger vessels, and other deployment considerations would need to be considered. Additionally, with the requirement to access larger survey vessel platforms, survey time availability may become restricted (as compared to smaller coastal platforms) and larger

vessels may also have more difficulty in working very close into shore. Overall, while the current system sampled benthic habitats extensively across three coastal EBSAs, future surveys should prioritize expanding depth coverage to characterize habitats beyond 85-m depths using advanced camera systems.

4.4 DATA APPLICATION AND RECOMMENDATIONS

The SWNB near-seafloor imagery survey in 2016 to 2017 provided a major expansion in the availability of geospatially referenced benthic imagery in SWNB coastal waters, prior to the addition of a supplementary large imagery data bank collected in more recent surveys, which commenced in 2022. The SPERA-funded benthic imagery survey provided new descriptions of three EBSAs within SWNB that have not been previously well-sampled beyond dive survey depths, including significant benthic survey coverage in deeper passages and channels. As the first near-seafloor imaging survey to sample extensively in this region beyond 35-m depths, this survey forms an independent study classified as a baseline characterization survey, documenting select taxa occurrences and abundances. This baseline survey can be used in the development of long-term monitoring protocols to revisit sampled areas. Efficient repeatability for long-term monitoring is difficult to achieve, but of significant relevance to document temporal changes in benthic habitats.

The survey approach we employed here is limited to drift transects, which restricts the ability to return fully to specific prior transect lines, though overlapping certain portions of prior transects may be feasible. Given that all transect lines and still images are geolocated, proximity analysis between prior and repeat survey observations could be undertaken within temporal monitoring programs. Advances in marine survey technologies, such as Autonomous Underwater Vehicles (AUVs), could be utilized in the future to resample transects at a high spatial resolution. Considering that no spatial conservation measures are yet in place for these three EBSAs (nor at the time of the survey), before a monitoring framework can be developed, further sampling is required to provide benthic habitat characterization across the entire depth distribution of these EBSAs (to ~200-m depths). To support more recent iterations of the bioregional marine conservation network plan (DFO 2025), imagery surveys should first focus on expanding depth coverage and sampling areas outside of the EBSAs to establish habitat comparisons within and between proposed conservation sites.

Even though further work is needed to fully characterize the three EBSAs studied here, the imagery analysis in its current state has several applications. Using occurrence and abundance data, Species Distribution Models (SDMs) could be conducted on select taxa

to predict where commercially important and/or conservation priority species occur throughout the entirety of each EBSA. SDMs have been conducted using a subset of data from the 2016-2017 surveys on *Boltenia ovifera* and *Modiolus modiolus* in the HH/WI/P EBSA, which predicted high habitat suitability for both species throughout the EBSA, with particular high suitability in the Head Harbour and Western Passages (Mireault et al. 2025). These SDMs have been used in recent conservation planning exercises, helping to identify key areas of tunicate fields and mussel beds, and as such, performing SDMs on commercially important species at similar high-resolution spatial scales (≤ 5 m) could have significant management implications. Considering that the HH/WI/P EBSA is an area of contention, more recently, consultations (since 2023) have been conducted with proposals for smaller-scale conservation sites within each of the three EBSAs described here (DFO 2025). Producing SDMs and providing density estimates across these areas would then identify hotspots for conservation focus. Additionally, our image analysis not only has application in species modelling but can also improve substrate classifications. Specifically, as mentioned above, our comprehensive analysis of primary substrate can be used to help ground-truth prior regional substrate predictions (*e.g.*, Greenlaw and Harvey 2022) and validate regional geological interpretations (*e.g.*, Philibert et al. 2024).

Considering the 2016-2017 benthic survey comprises an expansive imagery bank, image highlights and samples of areas of high biodiversity can be displayed in conservation planning consultations. In particular, imagery surveys provide visual context for stakeholders to observe the seafloor *in situ*, showcase diverse areas, and highlight regions of conservation concern. For example, as a result of this survey, we have further validated the HH/WI/P EBSA as a key area of high biodiversity that should be protected in some capacity, and more specifically in the Head Harbour and Western Passages along with areas near Adams and Barnes Island. Providing visual proof of vulnerable benthic habitats, such as *B. ovifera* fields and *M. modiolus* reefs, can aid in increasing stakeholder support for implementing conservation measures. Establishing protection in areas across SWNB will not only support and aim to maintain high species diversity but also help to support fisheries stocks. Bearing this in mind, continuation of benthic imagery surveys to characterize vulnerable and commercially important ecosystems can play a key role in the development of management and conservation plans.

4.2 SEAFLOOR SUBSTRATE

Based on identifying the primary bottom-type by specific grain size (using an adapted Wentworth scale; Wentworth 1922; see also Sameoto et al. 2008) across all

analyzed 30-s video intervals and digital still images, we highlighted the heterogeneity of seafloor substrates across SWNB, in particular within the HH/WI/P sub-area (Figure 29). Prior marine geological interpretations of the Bay of Fundy (Shaw et al. 2012; Philibert et al. 2024) have generalized geological processes to infer seascapes (also known as underwater landscapes) based on patterns of geomorphology, texture (*i.e.*, grain size), and biota. Similarly, a regional expert group of marine geologists and ecologists, convened by DFO, prioritized geological interpretations in developing a regional substrate classification layer (at an ~100-m horizontal resolution in SWNB). Gaps were filled utilizing digital elevation models (derived from depth and slope) to infer likely substrate textures, and discrete substrate samples (from Natural Resources Canada, the CHS, and DFO Science) (Greenlaw and Harvey 2022).

Even given the expert knowledge and previous survey data that generated these interpretations, the high heterogeneity of the seafloor at fine scales (*i.e.*, within a given EBSA) could not be captured. For instance, previous interpretations suggest the HH/WI/P and Southern Grand Manan EBSAs are dominated by bedrock interspersed with tidal scour areas containing mud, while The Wolves are surrounded by muddy gravels (Shaw et al. 2012; Greenlaw and Harvey 2022; Philibert et al. 2024). While the current survey generally agrees with interpretations surrounding The Wolves (Figure 29), the HH/WI/P and Southern Grand Manan sub-areas were much more variable and predominately contained pebble and gravel (fine grain mix) substrates. This certainly highlights a gap for characterizing finer-scale benthic habitats in SWNB within and across these described EBSAs. Our survey helps to fill this gap, providing high-resolution ground-truthing information not only on the primary bottom-type, but also on the transitions from one substrate to another within the context of linear transects over the seafloor that can characterize habitat patchiness at scales of 1 – 10 m spatial extents. Future iterations of substrate classifications could leverage data from this survey to strengthen spatial outputs and interpretations.

To demonstrate variability in seafloor substrates within and across transects, we compared primary bottom-types in digital stills to the associated analyzed video intervals. We found only a 54% match, which is likely because only one primary bottom-type was reported for each 30-s video interval, while several still images could have occurred within a given video interval. More specifically, still images were evaluated more closely to document cover of bottom types in each image (based on an overlying grid), while video intervals were more generalized across a much greater linear extent of the seafloor, over the course of 30-s. As such, still images capture seafloor heterogeneity at a higher resolution compared to the video interval analysis, though the video analysis still exemplified substrate variability

at a much finer spatial scale than prior geological interpretations and substrate classifications. Future studies could revisit the video analysis and comprehensively report primary bottom-type using a video frame-based approach, providing more continuous, detailed substrate coverage to further improve broad-scale classification accuracy.

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6 COMPETING INTERESTS STATEMENT

The authors declare there are no competing interests.

7 AUTHOR CONTRIBUTION STATEMENT

Conceptualization: PL, CM, LM; Data curation: LLT, LM, PL; Formal analysis: LM, LLT, CM, TB; Funding acquisition: PL; Investigation: PL, LM, CM, TB; Methodology: PL, CM, LM, LLT; Project administration: LLT, PL; Software: PL, CM, LLT; Resources: PL; Supervision: PL; Validation: LLT, LM; Visualization: LLT; Writing – original draft: LLT, PL, CM, LM; Writing – review and editing: PL, LLT.

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9 DATA AVAILABILITY STATEMENT

Transect and imagery metadata generated and analyzed during this study are available in the Lawton 2022 repository, <https://open.canada.ca/data/dataset/e736c0f0-b19e-4842-903d-28bfc756d48a>, and made available on OBIS at <https://obis.org/dataset/6e214947-9972-4b5b-9b1e-23d8eded90ba>. Still imagery and video files for this study are available from the Coastal Ecosystems Science Division (CESD) data manager upon reasonable request (email: DFO.CESDDataRequest-DSECDemandededonnes.MPO@dfo-mpo.gc.ca). However, imagery files will be uploaded in batches to the open data link provided (Lawton 2022) at a later date (as current Open Data Portal limits only permit files <20GB).

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