2015 Nearshore Ecological Survey August 22-26, 2015 Cambridge Bay, Nunavut

Conducted for: Canadian High Arctic Research Station POLAR (Polar Knowledge Canada)















By: Vancouver Aquarium Marine Science Centre

Danny Kent, Donna Gibbs, Mackenzie Neale, Jeremy Heywood





Introduction

As the Arctic continues on its path of rapid change, many of the biological and ecological effects of climate change and other factors are poorly understood. Key driving factors include freshwater input, changes in upwelling and current regimes, fluctuations in water temperature and water chemistry, and increased human activity. All of these factors influence the health and biodiversity of nearshore ecosystems.

In order to begin to understand these complex underwater communities and to interpret effects of change, wide-scope baseline surveys of these critical ecosystems must be undertaken to:

- a) identify sites of special interest or ecological sensitively that may be used for research on specific topics, for future monitoring, or which may require future protection,
- b) create a dynamic catalogue of sites which can be referenced by future researchers and by CHARS managers in assigning research areas to future research teams, and
- c) provide a set of data to which future surveys can be compared.

These types of surveys are best undertaken by scientific divers making first-hand observations in the water. To that end, the Vancouver Aquarium Marine Science Centre (VAMSC), working with POLAR (Polar Knowledge Canada) and supported by community experts, visited a range of dive sites in the vicinity of Cambridge Bay, Nunavut in August 2015 to begin the work of surveying, recording and cataloging nearshore ecology.

This study marks the start of the process to document the local marine environment. Ideally these survey records will be maintained at the Canadian High Arctic Research Station (CHARS) in Cambridge Bay, and become a resource that will assist researchers and policy-makers identify sites of special interest, protect sensitive ecosystems, plan future research, and track ecological changes over time.

Nearshore Ecological Survey Approach

This effort, dubbed the Nearshore Ecological Survey (NES), was undertaken by the VAMSC Arctic Dive Team whose members - Danny Kent, Donna Gibbs, Mackenzie Neale and Jeremy Heywood - are all experienced scientific divers. The team completed multiple no-decompression air dives (dive details available upon request) at each selected site; one buddy pair collected video and live specimens, and the other collected still images, temperature data (using a diver-carried depth-temperature data logger raw temperature data available upon request), and made species observations.

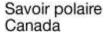
A preprinted log sheet was used to record observations in the field (Appendix D), and team members convened at the end of each day to collate all collected information and review video and still images.

Live specimens were held in at the Nunavut Arctic College in a portable holding system built by the team. (See picture in Appendix E.)

Collated data and images were then organized into NES Dive Site catalog pages and appendices (below) with additional video and mapping content online. (See Online Resources.)



Polar Knowledge





POLAR (Polar Knowledge Canada)

POLAR (Polar Knowledge Canada) is responsible for advancing Canada's knowledge of the Arctic and strengthening Canadian leadership in polar science and technology. A key mission of POLAR (Polar Knowledge Canada) is to manage Canada's new high arctic research station in Cambridge Bay, Nunavut. There, POLAR expects Canadian and international scientists to conduct world-class cutting edge Arctic research on both terrestrial and marine ecosystems. POLAR serves as Canada's primary point of contact with the circumpolar knowledge community, and liaises with research organizations and institutes throughout the circumpolar world, providing guidance for multilateral scientific projects relevant to Canadian interests.

POLAR's programs consist of a pan-northern science and technology program, a knowledge acquisition management and mobilization function and the Canadian High Arctic Research Station (CHARS) being built in Cambridge Bay, Nunavut. (www.canada.ca/en/polar-knowledge)

Vancouver Aquarium Marine Science Centre

The Vancouver Aquarium Marine Science Centre (VAMSC) is a non-profit society dedicated to the conservation of aquatic life. (www.vanaqua.org). VAMSC has been involved in the Canadian arctic since 1974 maintaining a collection of living arctic marine animals for display, interpretation and research. That expertise has been combined with knowledge of marine ecological survey techniques, gained over decades on Canada's West coast, for this study.





NES Dive Site:

Dock

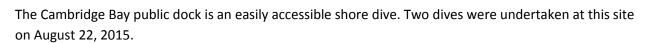


Chart: Cambridge Bay, CHS # 7750

Travel method and details: Truck to beach adjacent to dock.

Weather: Overcast, light wind, $6^{\circ}C$

Sea state: Rippled

Salinity: 24 parts per thousand (ppt) at surface

Planning considerations and hazards: The dock provides an ideal location for equipment and **Coordinates:** 69.11420°N, 105.05875°W



personnel shakedown dives. The site, especially closer to dock itself, is strewn with refuse discarded from the dock and (presumably) vessels moored at the dock. Care must be taken when diving around these hazards. Vessels tied up at, and adjacent to, the dock could present a hazard if vessel operators are unaware of diving activities.

Cultural notes, landmarks or features of interest: The Cambridge Bay public dock is an easily spotted landmark.

Terrestrial flora and/or fauna observed: Nothing noteworthy.

Other notes: A diver-towed dive flag on a float might be useful for this dive to indicate diver location for vessel operators.



*

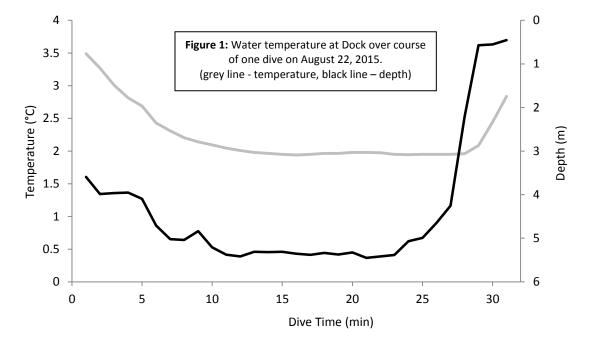
Savoir polaire Canada



Dive details:

Maximum depth reached: 7m

Minimum water temperature: +1.94°C (See Figure 1.)



Estimated horizontal visibility: 20m

General topography and substrate type: A flat, gently sloping silt and gravel/boulder bottom, with occasional drop stones.

List of observed species (See Appendix A for photos of species where available.):



Plants rockweed sugar kelp NES - 2015

Fucus sp. Saccharina latissima *

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thread algae red algae Sponges vase sponge yellow-orange blob sponge Cnidaria tube-dwelling anemone Arctic burrowing anenome Arctic lion's mane jellyfish thimble comb jelly double bubble jelly jelly plankton lobed sea gooseberry Worms cone worm **Moss animals** bryozoan Molluscs Arctic saxicave sea angel Arthropods amphipod Hyperid amphipod mysid **Echinoderms** frilled sea star red spiky sea star green urchin **Tunicates** pelagic sea tunicate **Fishes** Arctic shanny fourline snakeblenny snake blenny banded gunnel shorthorn sculpin

Sycon sp. undetermined sponge Pachycerianthus borealis? Halcampa arctica Cyanea sp. Sarsia sp. Mertensia ovum Halitholus cirratus undetermined jellies Bolinopsis infundibulum Pectinaria sp. encrusting bryozoan Hiatella arctica Clione limacina undetermined amphipod jelly riding amphipod undetermined mysid

undetermined algae

undetermined red algae

Urasterias lincki Icasterias panopla Strongylocentrotus droebachiensis

Oikopleura sp.

Stichaeus punctatus Eumesogrammus praecisus Lumpenus lumpretaeformis Pholis fasciata Myoxocephalus scorpius



NES Dive Site:

West Arm Tank Farm



The West Arm Tank Farm is an easily accessible shore dive. Four dives were undertaken at this site; two on August 22, and two deeper dives on August 23, 2015.

Chart: Cambridge Bay, CHS # 7750 **Coordinates:** 69.10267°N, 105.09068°W

Travel method and details: Truck to beach adjacent to tank farm. Note signs indicating restricted access to tank farm. Gravel road to dive site skirts edge of tank farm property.

Weather: Overcast, moderate wind, 6°C

Sea state: Choppy with whitecaps

Salinity: 23-24 ppt at surface, 27-28 ppt at 25m

Planning considerations and hazards: Take care not to trespass on tank farm property. Be aware of potential vessel traffic at barge landing. On the deeper set of dives at this location, two divers had second stage regulator 'freeze-up' free-flow incidents. Close buddy cooperation is vital to mitigate the potential negative effects of these situations.

Cultural notes, landmarks or features of interest:





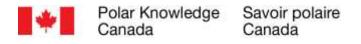
The tank farm and barge landing area are useful landmarks.

Terrestrial flora and/or fauna observed: Nothing noteworthy.

Other notes: An intact, sunken snowmobile was observed at this site at a depth of ~ 25m.

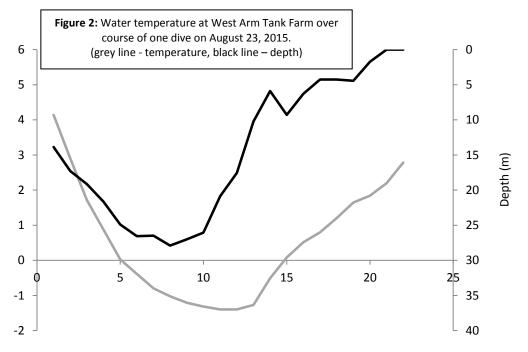
Dive details:

Maximum depth reached: 30m NES - 2015









Estimated horizontal visibility: 25m

General topography and substrate type: A moderate (~20°) slope of rocks and boulders interspersed with sections of silt and occasional drop stones.

List of observed species (See Appendix for photos of species where available.):

> Plants brown algae thread algae coralline algae NES - 2015



encrusting brown undetermined algae *Corallina* sp. A





red algae

Cnidaria

tube-dwelling anemone snail-dwelling anemone pale soft coral folded stomach jelly jellyfish thimble comb jelly jelly plankton lobed sea gooseberry purple Beroe double bubble jelly Worms ribbon worm arrow worm lugworm scale worm **Moss animals** bryozoan Molluscs Arctic saxicave chalky macoma chiton limpet wavy snail margarite snail sea angel dendronotid nudibranch Arthropods black and white amphipod mysid circumpolar eualid polar lebbeid shrimp lyre crab barnacle Echinoderms rose star wrinkled cushion star small yellow star with orange tips NES - 2015

branching rockweed-like

Pachycerianthus borealis? Allantactis (parasitica?) Alcyonium sp. Ptychogastria polaris Sarsia sp. Mertensia ovum undetermined jellies Bolinopsis infundibulum Beroe abyssicola Halitholus cirratus Cerebratulus sp. Sagitta elegans Arenicola? sp. Hormothoe sp. encrusting bryozoan Hiatella arctica Macoma calcarea Tonicella spp. Tectura sp. Buccinum sp. Margarites sp. Clione limacina Dendronotus sp. Stegocephalus inflatus undetermined mysid Eualus gaimardii Lebbeus polaris undetermined shrimp Hyas coarctatus Balanus sp. *Crossaster papposus* Pteraster militaris

Poraniomorpha tumida





frilled sea star red spiky sea star small brittle star green urchin scarlet sea cucumber sea cucumber **Tunicates** pelagic sea tunicate **Fishes** Arctic cod Greenland cod Arctic shanny sculpin Urasterias lincki Icasterias panopla undetermined brittle star Strongylocentrotus droebachiensis Psolus fabrici Sclerodactyla? briareus?

Oikopleura sp.

Boreogadus saida Gadus ogac Stichaeus punctatus Myoxocephalus sp.





NES Dive Site:

West Arm Airport Wall



The West Arm Airport Wall is shore dive only accessible by boat. Two dives were undertaken at this site on August 25, 2015.

Chart: Cambridge Bay, CHS # 7750 **Coordinates:** 69.10015°N, 105.11785°W

Travel method and details: Boat (5m skiff on loan from the Arctic Research Foundation) to narrow, rocky beach at the base of a ~8m high bluff situated near the east end of the Cambridge Bay airport runway. Land access is not possible for this site.

Weather: Sunny, light wind, 6°C

Sea state: Rippled

Salinity: 20 ppt at surface

Planning considerations and hazards: Be aware of submerged rocks when beaching the boat. The water depth drops dramatically very near shore – care is needed if wading in the shallows.

Cultural notes, landmarks or features of interest: The airport is right overhead.

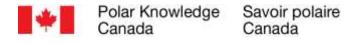
Terrestrial flora and/or fauna observed:





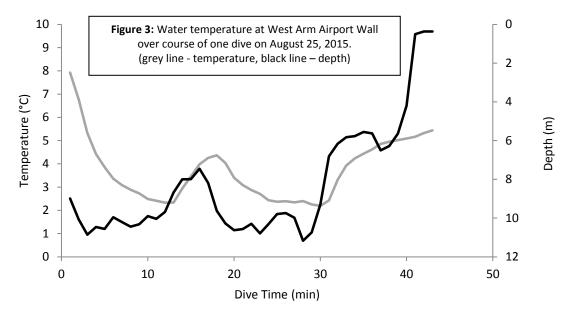
Peregrine falcons (two adults and a juvenile) nesting at the top of the bluff above dive site. A bearded seal was observed in the vicinity of the tank farm on the return boat trip.

Other notes: An alternative transportation method to this site (if the boat is small and/or slow) would be for half the team drive a truck with all the dive gear to the road accessible beach just west of the airport and have the boat meet there, where the equipment would be loaded for the short trip back to





the Airport Wall beach. This way the majority of the boat trip would be in an unencumbered (and therefore faster) vessel.



Dive details:

Maximum depth reached: 14m.

Minimum water temperature: +2.19°C (See Figure 3.)

Estimated horizontal visibility: 20m

General topography and substrate type: A wall of irregular slabs and blocks drops vertically to ~15m within 2m of shore. The base of the wall transitions into a slope of rocks and boulders with evident ice scouring channels.

List of observed species (See Appendix A for photos of species where available.): Next page...







Plants

brown algae rockweed thread algae coralline algae red algae red algae Sponges vase sponge bread crumb sponge gray encrusting sponge Cnidaria Arctic crimson anemone anemone tube-dwelling anemone snail-dwelling anemone Arctic burrowing anenome rugose anemone hydroid Arctic lion's mane comb jelly double bubble jelly Worms cone worm tubeworm **Moss animals** bryozoan Molluscs Arctic saxicave chiton limpet wavy snail snail with longitudinal ridges margarite snail velutina sea angel aeolid nudibranch dendronotid nudibranch Arthropods amphipod mysid NES - 2015

encrusting brown Fucus sp. undetermined algae Corallina sp. bladed red algae filamentous red algae

Sycon sp. Halichondria sp. undetermined sponge

Cribrinopsis similis Urticina spp. Pachycerianthus borealis? Allantactis (parasitica?) Halcampa arctica Hormathia nodosa Obelia sp. Cyanea sp. Mertensia ovum Halitholus cirratus

Pectinaria sp. *Euchone* sp.

encrusting bryozoan

Hiatella arctica Tonicella spp. Tectura sp. Buccinum sp. undetermined snail Margarites sp. Velutina sp. Clione limacina undetermined nudibranch Dendronotus sp.

undetermined amphipod undetermined mysid *

Savoir polaire Canada



polar lebbeid shrimp lyre crab barnacle **Echinoderms** rose star wrinkled cushion star Arctic blood star small yellow star with orange tips frilled sea star red spiky sea star small brittle star green urchin scarlet sea cucumber sea cucumber **Tunicates** pelagic sea tunicate **Fishes** Greenland cod Arctic shanny fourline snakeblenny snake blenny banded gunnel shorthorn sculpin

Lebbeus polaris undetermined shrimp *Hyas coarctatus Balanus* sp.

Crossaster papposus Pteraster militaris Aleutihenricia beringiana Poraniomorpha tumida Urasterias lincki Icasterias panopla undetermined brittle star Strongylocentrotus droebachiensis Psolus fabrici Sclerodactyla? briareus?

Oikopleura sp.

Gadus ogac Stichaeus punctatus Eumesogrammus praecisus Lumpenus lumpretaeformis Pholis fasciata Myoxocephalus scorpius



NES Dive Site:

West Arm Mud Bank Wall



The West Arm Mud Bank Wall is only accessible by boat, as it is situated on a large mud flat in the centre of the West Arm of Cambridge Bay. Two dives were undertaken at this site on August 25, 2015.

Chart: Cambridge Bay, CHS # 7750 Coordinat

Coordinates: 69.10348°N, 105.16048°W

Travel method and details: Two team members took boat (5m skiff on loan from the Arctic Research Foundation) to the road accessible beach west of the airport where they were met by the other half of the team with the dive gear in the truck. The boat was loaded at the beach and then proceeded with the entire team to the dive site, where it was anchored in 5m of water.

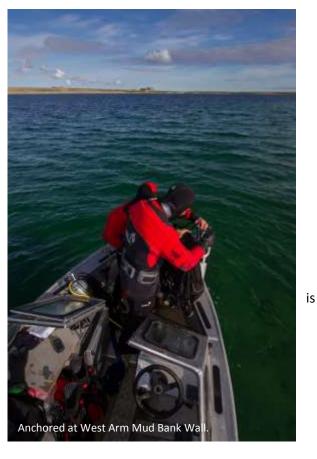
Weather: Sunny, light wind, 6°C

Sea state: Calm

Salinity: Not measured

Planning considerations and hazards: Mud bank clearly marked on the chart, but care needs to be taken while navigating in the area as the water get very shallow at points.

Cultural notes, landmarks or features of interest: The mud bank can be seen from high points on the north shore of the West Arm.

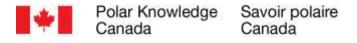


Terrestrial flora and/or fauna observed: Nothing noteworthy.

Other notes: A future dive on the mud bank itself (without exploring the wall) might be of interest.

Dive details:

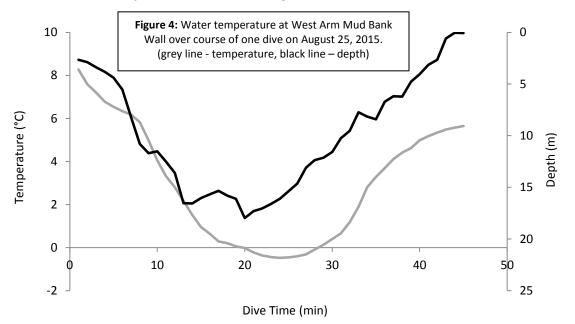
NES - 2015





Maximum depth reached: 18m

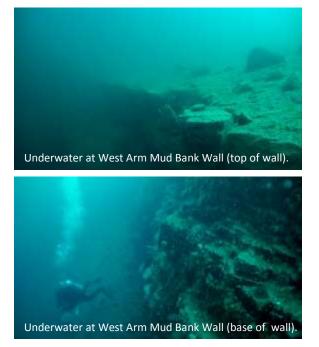
Minimum water temperature: -0.49°C (See Figure 4.)



Estimated horizontal visibility: 25m

General topography and substrate type: The mud bank is flat and silt-covered with occasional drop stones, then after swimming at a depth of ~5m for a distance of ~30m in a north-easterly direction from the boat anchor point, an abrupt wall of irregular slabs and blocks (similar to the Airport Wall dive) drops vertically to a depth of ~15m. The base of the wall transitions into a slope of rocks and boulders.

List of observed species (See Appendix A for photos of species where available.):



Fucus sp. undetermined algae

NES - 2015

woody stiped

Plants rockweed





red algae

bladed red algae

Sponges bread crumb sponge orange encrusting sponge Cnidaria anemone tube-dwelling anemone rugose anemone jelly polyps jelly folded stomach jelly sea gooseberry comb jelly double bubble jelly lobed sea gooseberry translucent comb jelly Worms cone worm dwarf calcareous tubeworm **Moss animals** bryozoan Molluscs Arctic saxicave chalky macoma chiton limpet margarite snail Arthropods polar lebbeid lyre crab **Echinoderms** wrinkled cushion star red spiky sea star green urchin scarlet sea cucumber Tunicates leopard tunicate round opaque tunicate pelagic sea tunicate **Fishes**

NES - 2015

Halichondria sp. undetermined sponge Urticina spp. Pachycerianthus borealis? Hormathia nodosa

undetermined jelly Solmissus sp. Ptychogastria polaris Pleurobrachia sp. Mertensia ovum Halitholus cirratus Bolinopsis infundibulum Beroe cucumis

Pectinaria sp. *Pileolaria* sp.

encrusting bryozoan

Hiatella arctica Macoma calcarea Tonicella spp. Tectura sp. Margarites sp.

Lebbeus polaris Hyas coarctatus

Pteraster militaris Icasterias panopla Strongylocentrotus droebachiensis Psolus fabrici

undetermined tunicate undetermined tunicate *Oikopleura* sp.





Greenland cod Arctic staghorn sculpin Gadus ogac Gymnocanthus tricuspis





NES Dive Site:

West Arm South Side



The West Arm South Side is easily accessible by a short boat ride from Cambridge Bay. Two dives were undertaken at this site on August 26, 2015.

Chart: Cambridge Bay, CHS # 7750

Travel method and

details: Boat (*Ugyuk*, 8m sturdy, aluminium opendeck skiff) hired from Cambridge Bay resident John Lyall Jr., who also acted as boat operator and guide. Loaded boat at Cambridge Bay dock beach. Dives were conducted as live-boat dives.

Weather: Sunny, light wind 7°C

Sea state: Rippled

Salinity: Not measured

Coordinates: 69.10102°N, 105.07816°W



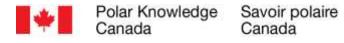
Planning considerations and hazards: Live-boating requires a careful boat operator and close attention to the divers' location.

Cultural notes, landmarks or features of interest: Inuksuk on high point of land adjacent to dive site.

Terrestrial flora and/or fauna observed: Nothing noteworthy.

Other notes: Shore diving is a possibility, but transport to the site by would most likely require the use of 'quads' and a local guide. The two dives undertaken at this site were separated by ~900m. The first at

NES - 2015



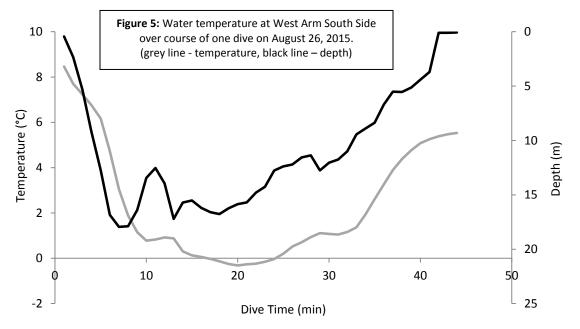


the point at the east end of the West Arm, the second at the point on the south side of the West Arm opposite the airport (slightly east of the Airport Wall site). The dives were combined for this report as there were practically identical in topography and in the species observed. Future surveys may separately itemise these sites if deemed useful.

Dive details:

Maximum depth reached: 18m





Estimated horizontal visibility: 25m

General topography and substrate type: A moderate (~15°) rocky slope interspersed with patches of silt.

List of observed species (See Appendix A for photos of species where available.):







Plants

brown algae coralline algae **Sponges** bread crumb sponge Cnidaria Arctic crimson anemone anemone tube-dwelling anemone Arctic lion's mane comb jelly jelly plankton lobed sea gooseberry Worms dwarf calcareous tubeworm Moss animals bryozoan bryozoan Molluscs Arctic saxicave chiton Iceland cockle limpet wavy snail margarite snail dendronotid nudibranch Arthropods Hyperid amphipod polar lebbeid lyre crab barnacle **Echinoderms** rose star small yellow star with orange tips red spiky sea star small brittle star green urchin **Tunicates** pelagic sea tunicate

encrusting brown Corallina sp.

Halichondria sp.

Cribrinopsis similis Urticina spp. Pachycerianthus borealis? Cyanea sp. Mertensia ovum undetermined jellies Bolinopsis infundibulum

Pileolaria sp.

encrusting bryozoan branching bryozoan

Hiatella arctica Tonicella spp. Clinocardium ciliatum Tectura sp. Buccinum sp. Margarites sp. Dendronotus sp.

jelly riding amphipod Lebbeus polaris Hyas coarctatus Balanus sp.

Crossaster papposus Poraniomorpha tumida Icasterias panopla undetermined brittle star Strongylocentrotus droebachiensis

Oikopleura sp.





Fish Arctic cod Arctic shanny

Boreogadus saida Stichaeus punctatus



Canada



Summary

By all accounts, the inaugural Nearshore Ecological Survey was a success. New dive sites were explored and many dozens of different marine species were identified, catalogued and photographed. Useful logistical strategies were developed and many local connections and friendships were made.

There were some challenges too. Difficulties with equipment shipments meant that some crucial equipment did not make it to Cambridge Bay in time. (It did, in fact, arrive the day the team left!) Unforeseen and unavoidable circumstances prevented the survey team from reaching dives sites further afield, as was initially planned and unexpected dive equipment problems caused some concern and will need to be addressed prior to future Arctic diving projects.

However, despite the trials and tribulations, this report demonstrates that a great deal of information can be gathered in a short period of time; information that will hopefully serve as a baseline and guide for future projects.

As well, it goes without saying, that the additional of the scientific support infrastructure that CHARS is bringing to Cambridge Bay will a vital asset for ongoing research, both above and below the sea.





Online Resources

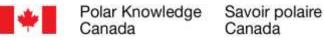
Google Map:

https://www.google.ca/maps/@69.1043732,105.1081355,3265m/data=!3m1!1e3!4m2!6m1!1s zS27KXL83vIQ.kgCbzUZnKKxE

Rough cut video highlights of dives:

NES 2015 – Dock	ł
NES 2015 - West Arm Tank Farm 1	ł
NES 2015 - West Arm Tank Farm 2	
NES 2015 - West Arm Airport Wall	ł
NES 2015 - West Arm Mud Bank Wall	ł
NES 2015 - West Arm South Side	ł

https://youtu.be/fDfUXG1bjLo https://youtu.be/HJb6fWNxZ9I https://youtu.be/kH1VBFw1cRM https://youtu.be/lzfQHkMQTs4 https://youtu.be/IOkQOQFrb9Q https://youtu.be/W52uCJb2erg





Acknowledgements

The authors would like to thank:

The Hamlet of Cambridge Bay for a warm welcome.

POLAR/CHARS – Heather Dewar and her team for invaluable support of all aspects of the NES.

Arctic Research Foundation – Adrian Schminowski and the crew of the *Martin Bergmann* for providing us with a dive boat when we needed one.

Cambridge Bay Fire Department – Keith Morrison for filling our scuba tanks.

Parks Canada *H.M.S. Erebus* dive team – Joe Boucher, Fil Ronca and Aaron Griffin for filling scuba tanks for us at short notice.

Nunavut Arctic College for providing space for specimen holding.

John Lyall Jr. for taking us out diving.

Ekaluktutiak Hunters & Trappers Organization for allowing us to collect specimens.

Kitnuna Corporation for oxygen for specimen shipment.

Charlie Gibbs and Laura Borden for their work on the Cambridge Bay Taxon Report.

Our colleagues at the Vancouver Aquarium who assisted in innumerable ways.

All photos in this report were taken by Danny Kent, Donna Gibbs, and Jeremy Heywood.





Appendices

- A. Species ID photo sheets
- B. Detail of chart of Cambridge Bay, showing field annotations
- C. Google map picture of NES dive sites
- D. NES Dive Record field log sheet template
- E. Photographs of specimen holding system assembled at Nunavut Arctic College
- F. Cambridge Bay Taxon Report





Appendix A - Species ID photo sheets

Species were identified in consultation with recognized experts. However some specimens remain unidentified, and some, despite best efforts, may be misidentified. Please contact the authors with proposed identifications or corrections.



Fucus sp.





Encrusting Brown Algae sp.

Filamentous Red Algae sp.

Bladed Red Algae sp.



Corallina sp.



Undetermined "Thread" Algae sp.





Hormathia sp.



Halichondria sp.



Pachycerianthus sp.



Cribrinopsis similis



Urticina sp.











Cyanea sp.



Undetermined Jellyfish sp. Polyp



Alcyonium sp.

Sarsia sp.



Ptychogastria polaris



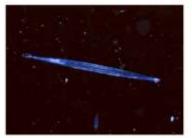
Halitholus cirratus



Beroe abyssicola







Parasagitta sp.



Undetermined Cone Worm sp.



Mertensia ovum



Undetermined Tubeworm sp.







Undetermined Encrusting Bryozoan sp.



Hiatella arctica







Hiatella arctica siphons



Macoma calcarea



Clinocardium ciliatum







Buccinum sp.



Margarites sp.



Undetermined Longitudinal Ridged Snail



Clione limacina

Dendronotus sp.



Polar Knowledge Savoir polaire Canada Canada





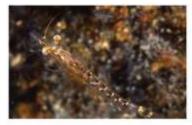
Hyperid Amphipod sp.



Undetermined Amphipod sp.



Stegocephalus inflatus



Undetermined Mysid sp.



Lebbeus polaris



Eualus gaimardii





Balanus sp.



Icasterias panopla

Hyas coarctatus



Urasterias lincki



Crossaster papposus



Pteraster militaris (5-arm)

NES - 2015







Pteraster militaris (6-arm)



oraniomorpha sp



Aleutihenricia beringiana



Undetermined Brittle Star sp.



Strongylocentrotus droebachiensis



Psolus fabrici



Undetermined 'Leopard' Tunicate sp.



Oikopleura sp.



Pholis fasciata







Myoxocephalus scorpius

Gadus ogac

Boreogadus saida









Lumpenus lumpretaeformis



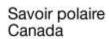
Eumesogrammus praecisus



Gymnocanthus tricuspis

Stichaeus punctatus

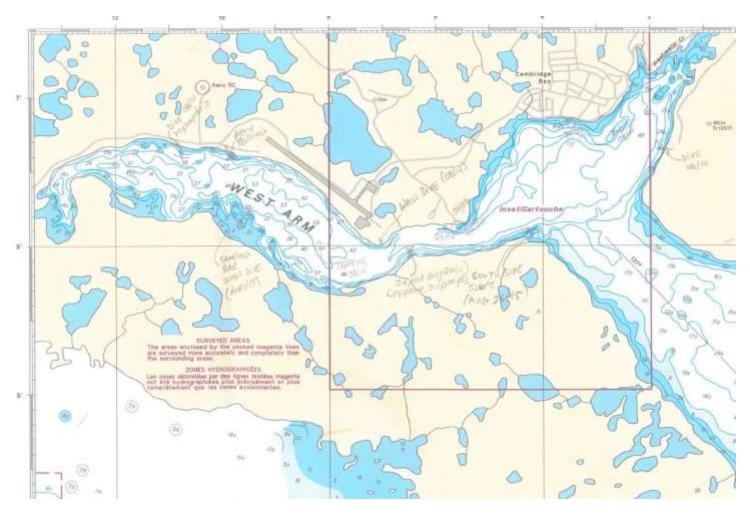






Appendix B

Detail of chart of Cambridge Bay, showing field annotations







Appendix C

Google map picture of NES dive sites







Appendix D

NES Dive Record field log sheet template

Nearshore Ecosystem Survey - Dive Record Dive site same:: Dive function:: Dive function: Dive function:: Dive function:: <tr< th=""><th>m.</th></tr<>	m.
Dive Number: 09-2015 Immu in: time Out: Lander: Cambridge Bay, Numanit Deer 50% Cambridge Bay, Numanit Date: DivS Cambridge Bay, 27750 Caadhaster: Date: August:	
abale: Cambridge Bay, Nursual. hart: DVS Cambridge Bay # 7250 Caadkurses: Nate: Aquat : , 2015 herstored and rdes: Damy Kent 0 & T , Jeremy (Keywood 0 & T , Doma Gibbs 0 & T , Anne Gib	
here: CMS Cannings Bay # 7750 Coordinanes: here: August:::, 2015 Water temperature:: here: August:::, 2015 Water temperature:: here: Masker:::D.S.T., John (Here:::D.S.T., John & Globs:::D.S.T., John &	
Note: Rugust 1, 2015 Water remperature: Visibility: tensorial and rotes: Damy Kent 0 1 T., Jerren // Heywood 0 B.T., Doma Gibbs 0.5 T., Doma Gi	
Versonnel and roles: D S T , John Lyali Jr. (gibbs and basic sparsetor) Auckande Nande D S T , John Lyali Jr. (gibbs and basic sparsetor) Images gatherest: Investi method and details: Press, John Lyali Jr. (gibbs and basic sparsetor) Average considerations and hazards: Animages gatherest:	
Austanzie Naake D S T , John Lydillt (gidde and boat operator) howel method and details: Weather, we state, alriemperature: Auseing considerations and hazards: Autoral estes:	
Tevenis method and details: Neather, sea state, air temperature: Terenig considerations and hazards: Attanet octes: Attanet octes: Beneral topography and substatic type: Plants/signe observed: Animolis observed:	
Neather, sea stain, air iomponatant: Panning considerations and hazards: Datural notes:	
Animals observed:	
andmanks or features of interest:	
(eirestrial floria and/or flauna observed)	
Other metes ar sketches (any and all additional observations are useful):	
Other dive observations:	
a ar	

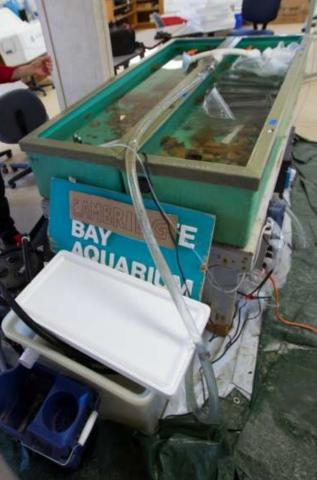




Appendix E

Photographs of specimen holding system assembled at Nunavut Arctic College.









Appendix F

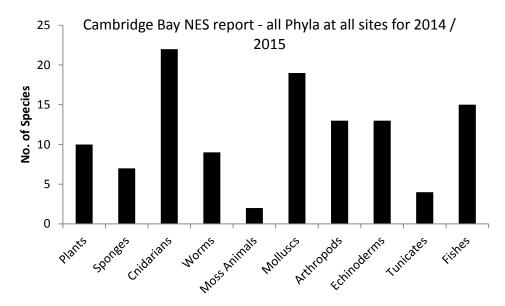
Cambridge Bay Taxon Report for 2014 -2015

In addition to site specific species lists, two types of species quantifications were calculated. These data include an additional eight sites that were surveyed in 2014, however these were not concentrated taxon surveys but still provide important information on ecological composition changes over time. A binary quantification of presence-absence (presence = 1, absence = 0) for each species was derived from a complete list of all species at all dive sites. A second quantification, abundance score, provides a weighted average to give the relative abundance of each species to each other at each site. A six-point scoring system (described below) is used to quantify the abundance of each species during the dive and these scores are accumulated for every species for all dives in the summary. The totals are then multiplied by 100 and divided by six, giving a relative abundance score between zero and 100, inclusive. Amounts of zero are indicated by a single period.

Quantification

Score Abundance

- 0 none
- 1 few (<10)
- 2 some (<25)
- 3 many (<50)
- 4 very many (<100)
- 5 abundant (<1000)
- 6 very abundant (>1000)



Processed and prepared by Charlie Gibbs, Donna Gibbs and Laura Borden.





	2014	2014	1014	2014	2014		2014		2014		2014		2014	2014		14/15	14/15		2015		2015	2015	
	West Arm near end	near Cape Colborne		Old Dump	Town Reef		Simpson		tow 1 2014		tow 2 2014		tow 3 2014	trap 2014		West Arm Airport Wall	Dock		West Arm		West Arm Mud Bank Wall	West Arm	South Side
	P AS	P AS	F	P AS	Р	AS	Р	AS	Р	AS	Р	AS	P AS	P /	٩S	P AS	Р	AS	ΡA	s	P AS	Р	AS
										Plant	s												
brown algae, encrusting brown	0.	ο.	(Э.	0		0		0		0		0.	0		1 4	0		1 1	3	0.	1	8
Rockweed, Fucus sp.	0.	1 6	C	О.	0		0		0		0		0.	0	•	1 4	1	6	0		1 8	0	•
sugar kelp, Saccharina Iatissima	0.	0.	(Э.	0		0		0		0		0.	0		0.	1	6	0		0.	0	
thread algae, undetermined algae	0.	0.	(Э.	0		0		0		0		0.	0		1 7	1	6	12	0	0.	0	
woody stiped, undetermined algae	0.	0.	(Э.	0		0		0		0		0.	0		0.	0		0		18	0	
coralline algae, Corallina sp.	0.	16	(Э.	0		0		0		0		0.	0	•	1 7	0		1 1	6	0.	1	8

1





red algae, bladed red algae	0	•	0		1	8	0	0		0		0		0		0		1	4	0		0		1	8	0	
red algae, branching rockweed-like	0		0		0		0	0		0		0		0		0		0		0		1	6	0		0	
red algae, filamentous red algae	0	•	0	•	0	·	0	0		0		0		0	•	0		1	4	0		0		0	·	0	
red algae, undetermined red algae	0	·	0		0	·	0	0		0		0	•	0	•	0		0		1	6	0		0	·	0	
										Sp	pong	es															
vase sponge, Sycon sp.	0		0		0		0	0		0	•	0		0		0		1	4	1	3	0		0	·	0	
Sponge, Haliclona sp.	0	•	0	•	0	·	0	0		0		0	•	0		0		1	4	0		0		0	·	0	
bread crumb sponge, Halichondria sp.	0		0		0		0	0		0		0		0		0		1	4	0		0		1	8	1	8
Sponge, undetermined sponge	0		0		0		0	0		0		0		0		0		1	9	0		0		0		0	
yellow-orange blob sponge, undetermined	0	·	0	•	0	·	0	0	·	0	•	0	·	0	•	0	•	0		1	3	0		0	·	0	•





orange encrusting sponge, undetermined	0		0		0	·	0	•	0		0		0	·	0	•	0		0		0		0		1	8	0	
gray encrusting sponge, undetermined	0	•	0		0		0		0		0		0		0		0		1	4	0	•	0		0		0	
											Cr	nidari	ans															
Arctic crimson anemone, Cribrinopsis similis	0		0		0	·	0		0	·	0		0	·	0	•	0		1	4	0		0	•	0	·	1	8
Anemone, Urticina sp.	0		1	6	0		0		0		0		0		0		0		1	4	0		0		0		0	
Anemone, Urticina spp.	0	•	0	•	0	·	0	•	0	·	0		0	·	0		0		1	9	0		0		1	8	1	8
tube-dwelling anemone, Pachycerianthus	0		1	13	0		0	•	0		0		0	·	0		0		1	23	1	6	1	13	1	8	1	8
snail-dwelling anemone, Allantactis	0		0		0		0		0		0		1	8	0		0		1	4	0		1	20	0		0	
Arctic burrowing anemone, Halcampa arctica	0	•	0		0		1	8	0		0		0		0		0		1	4	1	6	0		0		0	
rugose anemone, Hormathia nodosa	0	•	0		0	·	0	•	0	·	0		0	·	0		0	·	1	14	0	·	0		1	8	0	





red or white soft coral, Gersemia sp.	0		0	·	0	·	0		0	·	1	8	0	·	0		0		0		0	•	0		0		0	
pale soft coral, Alcyonium sp.	0	•	0		0		0		0		0		0	·	0		0	•	0		0		1	6	0		0	
Hydroid, Obelia sp.	0		0		0		0		0		0		0		0		0		1	4	0		0		0		0	
jelly polyps, undetermined jelly	0		0		0		0		0		0		0		0		0		0		0		0		1	8	0	
Jelly, Solmissus sp.	0		0		0		0		0		0		0		0		0		0		0		0		1	8	0	
Arctic lion's mane, Cyanea sp.	0		0		0		0		1	8	0		0		0		0		1	2	1	3	0		0		1	8
folded stomach jelly, Ptychogastria	0		0		1	20	0		0		0		0		0		0		0		0		1	26	1	16	0	
jellyfish thimble, Sarsia sp.	0		0		0		0		0		0		0		0		0		0		1	6	1	6	0		0	
double bubble jelly, Halitholus cirratus	0		0		0		0		0		0		0		0	•	0		1	4	1	3	1	6	1	8	0	
sea gooseberry, Pleurobrachia sp.	0		0		0		0		0		0		0		0		0		0		0		0		1	8	0	
	NE	S - 2	015	(Caml	oridge	e Bay	[,] Тахо	on Re	eport	for 2	2014	-201	.5										4				





comb jelly, Mertensia ovum	0	0		0	0	0		0		0		0		0	1	4	1	6	1	20	1	8	1	8
jelly plankton, undetermined jellies	0	0		0	0	0		0		0	·	0		0	1	11	1	13	1	20	0	·	1	8
lobed sea gooseberry, Bolinopsis	0	0	•	0	0	0		0	•	0		0	•	0	0		1	6	1	13	1	8	1	8
purple Beroe, Beroe abyssicola	0	0		0	0	0	•	0		0	·	0		0	0		0		1	3	0	·	0	
translucent comb jelly, Beroe cucumis	0	0		0	0	0		0		0		0		0	0		0		0		1	8	0	
									Worn	ns														
ribbon worm, Cerebratulus sp.	0	0		0	0	0		0		0		0		0	0		0		1	3	0		0	
arrow worm, Sagitta elegans	0	0		0	0	0		0		0		0		0	0		0		1	13	0		0	
cone worm, Pectinaria sp.	0	0	•	0	0	0		0		0		0		0	1	4	1	6	0	•	1	8	0	•
dwarf calcareous tubeworm, Pileolaria sp.	0	0		0	0	0		0		0		0		0	0		0		0		1	8	1	8





Lugworm, Arenicola?	0		0	0		0		0		0		0		0	0	0		0		1	3	0		0	
scale worm, Hormothoe sp.	0		0	0		0		0		0		0		0	0	0		0		1	3	0		0	
scale worm, undetermined scale worm	0	•	0	0	·	0	•	0	·	0	•	1	8	0	0	0	•	0		0		0		0	·
Tubeworm, undetermined tubeworm	0	•	0	0		0		0		0		0		0	0	1	4	0		0		0		0	
Tubeworm, Euchone sp.	0		0	0		0		0		0		0		0	0	1	4	0		0		0		0	
										Мо	ss Ani	imals													
Bryozoan, encrusting bryozoan	0	·	0	0	•	0		0	·	0		0	•	0	0	1	4	1	3	1	6	1	8	1	8
Bryozoan, branching bryozoan	0	•	0	0		0		0		0		0	•	0	0	0		0		0		0	·	1	8
										Ν	/lollus	scs													
Arctic saxicave, Hiatella arctica	0		0	0		0		0		0	•	0		0	0	1	23	1	16	1	40	1	25	1	20
chalky macoma, Macoma calcarea	0		0	0		0		0		0		0		0	0	0		0		1	6	1	8	0	





Chiton, Tonicella spp.	0		0		0		0		0		0		0		0	0	1	4	0		1	10	1	8	1	8
undetermined chiton, undetermined	0		0		0		0	•	0		0	•	0		0	0	1	4	0		0		0		0	
Mussel, undetermined mussel	0		0		0		0	•	0		0	•	1	8	0	0	0		0	•	0		0		0	
Scallop, undetermined scallop	0		0		0		0		0		0		1	8	0	0	0		0		0		0		0	
Iceland cockle, Clinocardium cilatum	0	•	0		0		0		0	·	0		0	·	0	0	0		0	•	0		0		1	4
Clam, undetermined clam	0		0		0	•	0		0		1	8	0		0	0	0		0		0		0		0	
Limpet, Tectura sp.	0		0		0		0		0		0		0		0	0	1	9	0		1	16	1	8	1	8
2 to 3 species of unidentified snails, <i>Gastropod</i>	0		0		0		0		0		1	8	0		0	0	1	4	0		0		0		0	
wavy snail, Buccinum sp.	0		0		0		0		0		0		0	·	0	0	1	2	0		1	3	0		1	8
snail with longitudinal ridges, undetermined snail	0		0		0		0		0		0		0	•	0	0	1	2	0	•	0		0		0	
	NE:	S - 20	015	(Camb	oridge	e Bay	/ Тахо	on Re	eport	for 2	2014	-201	.5								7				



vancouver aquarium...

lamellarid snail, undetermined univalve	0		1	3	0	·	0		0	·	0		0		0		0		0		0	·	0		0	·	0	
margarite snail, Margarites sp.	0		0		0		0		0		0		0	•	0		0		1	4	0	•	1	10	1	8	1	8
Velutina, Velutina sp.	0		0		0		0		0		0		0		0		0		1	2	0		0		0		0	
snail whelk, undetermined univalve	0	•	0		0		0		0		0		1	8	0		0		0		0		0		0		0	
sea angel, Clione limacina	0		0		0		0		1	8	0		0	•	0		0		1	2	1	3	1	6	0	•	0	
aeolid nudibranch, undetermined nudibranch	0		0		0		0		0		0		0		0		0		1	9	0		0		0		0	
dendronotid nudibranch, Dendronotus sp.	0	•	0		0		0	•	0				0		0		0	•	1	14	0		1	10	0		1	8
											Ar	throp	ods															
Amphipod, Onissimus sp.	0		0		0		0		0	·	0		0		0	•	1 2	25	0	•	0		0		0	•	0	
Amphipod, undetermined amphipod	0		0		0		0		0		1	8	0	·	0		0		1	2	1	3	0		0		0	





Hyperid amphipod, jelly riding amphipod	0		0		0		0		0		0		0		0		0		0		1	13	0		0		1	8
lsopod, Munnopsis isopod	0	•	0		0	·	0		0	·	0		1	4	0	•	0	·	0		0		0		0	·	0	
Mysid, undetermined mysid	0		0		0		0		0		0		0		0		0		1	4	1	6	1	3	0		0	
Cumacean, Diastylis sp.	0		0		0		0		0		0		0		0		0		1	2	0		0		0		0	
spiny lebbeid, Lebbeus groenlandicus	0		1	3	0		0		0		0		0		0		0		0		0		0		0		0	
polar lebbeid, Lebbeus polaris	0		0		0	•	0		0	•	0		0	•	0		0		1	11	0	•	1	6	1	8	1	8
punctate blade shrimp, Spirontocaris	0		0		0	·	0		0	·	0		0		0		0		1	4	0		0		0		0	
tank shrimp, Sclerocrangon boreas	0		0		0		0		0		1	8	0		0		0		1	2	0		0		0		0	
Shrimp, undetermined shrimp	0		0		0		0		0		0		0		1	8	0		1	4	0		1	6	0		0	
lyre crab, Hyas coarctatus	0		0		0		0		0	·	0	·	0		0	•	0		1	7	0		1	10	1	8	1	8
	NE	S - 2	015	(Caml	oridge	e Bay	/ Тахо	on Re	eport	for	2014	-201	5										9				





Barnacle, Balanus sp.	0		0	0		0		0	0		0	0.	0.	:	L 2	0		1	16	0		1	8
									Ech	inode	erms												
rose star, Crossaster papposus	0		0	0		0		0	0		0	0.	0.	:	L 9	0		1	6	0		1	4
blood star, undetermined seastar	0		0	0		0		0	0		0	0.	0.	:	L 4	0		0		0		0	
Arctic blood star, Aleutihenricia beringiana	0		0	0		0		0	0		0	0.	0.	:	L 4	0		0		0		0	
wrinkled cushion star, Pteraster militaris	0		0	0		0		0	0		0	0.	0.	:	L 4	0		1	6	1	8	0	
small yellow star with orange tips, Poraniomorpha	0	•	0	0		0		0	0		0	0.	0.	:	L 4	0		1	10	0	·	1	4
frilled sea star, Urasterias lincki	0		0	1	8	0		0	0		0	0.	0.	:	L 4	1	6	1	6	0		0	
red spiky sea star, Icasterias panopla	0	•	0	0		0	·	0	0		0	0.	0.	1	L 7	1	6	1	6	1	4	1	4
small brittle star, undetermined brittle star	0	•	0	0		0		0	1	8	0	0.	0.	:	L 9	0		1	26	0		1	8





brittle star, undetermined brittle star	0		0		0		0		0		0		0		0	0	1	4	0		0		0		0	
green urchin, Strongylocentrotus droebachiensis	0		0		0		0		0		1	8	0		0	0	1	7	1	3	1	13	1	16	1	8
sea cucumber, Chiridota sp.?	0	•	0		0	·	0		0	·	0	•	1	4	0	0	0		0	·	0		0	·	0	
scarlet sea cucumber, Psolus fabrici	0		0		0		1	8	0		0		0		0	0	1	11	0		1	3	1	8	0	
sea cucumber, Sclerodactyla? briareus?	0		0		0	·	0	•	0	·	0	•	0	·	0	0	1	4	0	·	1	6	0	·	0	
											т	unica	tes													
long clear delicate tunicate, undetermined	0		0		1	8	0		0		0		0		0	0	0		0		0		0		0	
leopard tunicate, undetermined tunicate	0		0		0		0		0		0		0		0	0	0		0		0		1	16	0	
round opaque tunicate, undetermined	0		0		0		0		0		0		0		0	0	0		0		0		1	8	0	
pelagic sea tunicate, Oikopleura sp.	0		0	·	0		0		0		0		0	·	0	0	1	11	1	6	1	40	1	25	1	25
												Fishe	S													





Arctic cod, Boreogadus saida	0		0		0		0		0		0		0		0		0		1	4	0		1	3	0		1	4
Greenland cod, Gadus ogac	0		1	6	0		0		0		0		0		0		0		1	9	1	3	1	10	1	4	0	
Eelpout, Gymnelus sp.?	0	•	0		0		0		1	8	1	8	0		0		0		0		0		0		0	·	0	•
Arctic shanny, Stichaeus punctatus	0		0		0		0		1	8	0		0		0		0		1	4	1	6	1	10	0		1	4
fourline snakeblenny, Eumesogrammus	0	•	1	6	0	•	0		0	·	0		0		0	•	0	•	1	9	1	6	0		0		0	•
snake blenny, Lumpenus lumpretaeformis	0		0		0		0		0		0		0		0		0		1	4	1	3	0		0		0	
banded gunnel, Pholis fasciata	0		0		0		0		0		0		0		0		0		1	4	1	10	0		0		0	
ribbed or moustache sculpin, Triglops pingelii? T.	0	•	0		0	•	0		0		1	8	0		0		0		0		0		0		0		0	
shorthorn sculpin, Myoxocephalus scorpius	0	•	0		0		0		0		0	•	0		0		0		1	4	1	3	0		0		0	
Arctic staghorn sculpin, Gymnocanthus	0		0		0		0		0	·	1	8	0		0	•	0		0		0		0		1	4	0	•
	NES	- 20)15	С	amb	ridge	Bay	Тахо	n Re	port f	for 2	014 -	201	5									-	12				





Sculpin, Myoxocephalus sp.	0	0		0	0		0		0		0		0		0		0		0		1	10	0	0	
Poacher, undetermined poacher	0	0		0	0		0		0		1	4	0		0		0		0		0		0	0	
Atlantic spiny lumpsucker, Eumicrotremus	0	0		0	0		0		1	4	0		0		0		0		0		0		0	0	
leatherfin Iumpsucker, Eumicrotremus	0	1	3	0	0		0		0		0		0		0		0	•	0		0		0	0	
Unidentified juvenile lumpsucker,	0	0	•	0	0	•	0	·	0	·	0		1	4	0	•	0		0	•	0		0	0	