REPORT

2018 Milne Ore Dock Fish Offset Monitoring Report

Fisheries Act Authorization 14-HCAA-00525

Submitted to:

Fisheries and Oceans Canada
Fisheries Protection Program
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1663724-084-R-Rev0

21 December 2018

Distribution List

Fisheries and Oceans Canada

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1.0 INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) is currently operating in the Early Revenue Phase (ERP) of the Mary River Project (the Project), an iron ore mine located in the Qikiqtani Region of Nunavut, Canada. Project Certificate No. 005, amended by the Nunavut Impact Review Board (NIRB) on 28 May 2014, authorizes the Company to mine up to 22.2 million tonnes per annum (Mtpa) of iron ore from Deposit No. 1. Of the 22.2 Mtpa, Baffinland is authorized to transport 18 Mtpa of ore by rail to Steensby Port for year-round shipping through the Southern Shipping Route (via Foxe Basin and Hudson Strait), and 6.0 Mtpa of ore by truck to Milne Port for open water shipping through the Northern Shipping Route during the open water season (July – October) using chartered ore carrier vessels.

During the environmental assessment for the Project, the proposed infilling of the marine environment resulting from construction of the ore dock at Milne Port was predicted to result in the permanent loss of 24,847 m^2 of marine fish habitat, or 6,003 Habitat Equivalent Units. It was subsequently determined by DFO that the habitat loss associated with the ore dock placement would result in serious harm to fish that are considered part of a commercial, recreational or Aboriginal (CRA) fishery, or a permanent change to ecosystem productivity that supports such a fishery and as such, offsetting measures would be required.

Baffinland submitted to DFO an application for an authorization under paragraph 35(2)(b) of the *Fisheries Act* for installation of the ore dock. The application included a Fish Offset Plan, which proposed the addition of coarse rock material around the perimeter of the ore dock to increase habitat complexity in Milne Port and serve as functional habitat for marine benthic invertebrate and fish species. DFO approved the Fish Offset Plan and issued a *Fisheries Act* Authorization (FAA) (#14-HCAA-00525) for the ore dock on June 30, 2014 (Appendix A). The FAA also required Baffinland to undertake monitoring and reporting of the structural stability and biological utilization of offsetting measures at the Milne Port ore dock, in accordance with Section 7 of the FAA, which states the following:

- 7.1 - The Proponent shall conduct monitoring of the offsetting measures according to the approved schedule and criteria below:
  - 7.1.1 - During Year 1, 3 and 5, the integrity of the coarse rock substrate will be monitored using video surveys (drop camera).
  - 7.1.2 - During Year 2, 4 and 6, video surveys (drop camera) of the coarse rock substrate will be used to document the types and percent coverage of the aquatic vegetation colonizing the substrate. Benthic invertebrates and fish recorded in the video will be identified and quantified.
  - 7.1.3 - The production of benthic invertebrates and the occurrence of fish larva will be monitored by setting artificial and natural substrate collection baskets in the vicinity of the coarse substrate.
  - 7.1.4 - Continuous video monitoring of the rock substrate shall be undertaken to demonstrate the association of fish with the rock substrate.
- 7.2 - The Proponent shall report to DFO that the offsetting works were conducted according to the conditions of this Authorization by providing the following:
  - 7.2.1 - Monitoring report shall be submitted to the DFO-Yellowknife Office by December 31 of each year monitoring is carried out.

Monitoring the effectiveness of the offsetting habitat began in 2015. Sikumiut Environmental Management Limited (SEM) conducted Year 1 (2015) and Year 2 (2016) of habitat offset monitoring on behalf of Baffinland, with results presented in Baffinland's annual fish offset monitoring reports (SEM 2015; 2017a). Golder Associates Ltd. (Golder) completed Year 3 of habitat offset monitoring on behalf of Baffinland (Golder 2017). This report presents the results of Year 4 of habitat offset monitoring by Golder undertaken in Milne Port during the open-water season of 2018. A more extensive overview of the regulatory context for the FAA is provided in SEM's 2016 habitat offset monitoring report (SEM 2017a).

2.0 OBJECTIVE

The objective of the 2018 offset monitoring program was to complete Year 4 monitoring and reporting of offsetting measures according to the approved schedule and criteria below:

- During year 4, video surveys (drop camera) of the coarse rock substrate will be used to document the types and percent cover of the aquatic vegetation colonizing the substrate. Benthic invertebrates and fish recorded in the video will be identified and quantified.
- The production of benthic invertebrates and the occurrence of fish larvae will be monitored by setting artificial and natural substrate collection baskets in the vicinity of the coarse substrate.
- Continuous video monitoring of the rock substrate shall be undertaken to demonstrate the association of fish with the rock substrate.

3.0 METHODS

Monitoring was conducted from 29 July 2018 to 27 August 2018. The monitoring team consisted of two Golder biologists and a local boat operator and field technician from Pond Inlet. Field sampling was conducted from a 28-foot aluminum vessel based out of the Milne Port facility. The following scientific data collection permits were obtained from the Nunavut and federal government prior to the start of the monitoring program:

- DFO Licence to Fish for Scientific Purposes Permit #: S-18/19-1028-NU
- DFO Animal Use Protocol Permit # FWI-ACC-2018-42
- Nunavut Research Institute Scientific Research Licence # 02 009 18R-M

3.1 Underwater Video

Underwater video was collected along shore-parallel transects adjacent to the ore dock to document the types and percent cover of aquatic vegetation colonizing the coarse rock substrate, and to identify and enumerate marine biota (e.g., benthic invertebrates and fish) utilizing the offset habitat. For consistency, sampling methods used during the 2015, 2016 and 2017 video surveys were replicated to the extent possible, including monitoring along the same transects and depth ranges monitored in previous years. One change for the 2018 survey included the use of a remotely operated vehicle (ROV) to collect video footage rather than a simple drop camera.

The ROV is a maneuverable, propulsion-powered tool which allows for greater control and collection of higher quality video footage during a video survey.

The underwater video system used for the survey consisted of two high resolution video cameras (NTSC standard definition with 3x optical zoom) mounted on a lightweight Seamor Chinook 300F industrial-grade inspection ROV equipped with spotlights, integrated pressure/depth sensor, magnetic compass, and scaling lasers (spaced at 15 cm) that allowed for accurate scaling of seabed features and biota (Figure 1). The video camera on the ROV was connected via umbilical to a video monitor set-up on the deck of the 28 ft aluminum field vessel, where video data was recorded on an external hard drive. The ROV was operated by a trained, subcontracted ROV technician (Andy Clark - Ocean Dynamics Inc.) using manual and automatic thruster, tilt, pitch and heading controls built into a top-side deck-mounted control box (Figure 2).

Figure 1: Seamor Chinook 300F ROV on deck of vessel (left) and during ROV survey (right)

Figure 2: Andy Clark (Ocean Dynamics Inc.) Operating the ROV aboard the MV Aupillattunnguag

Between 4 and 6 August 2018, ROV surveys were conducted along a total of three transects on the west side of the ore dock and four transects on the east side of the ore dock (Table 1; Figure 3). On each side of the ore dock, multiple video transects were conducted to capture habitat conditions: 1) directly over the coarse rock substrate, to be used for identification and quantification of aquatic vegetation and benthic invertebrates and fish; and, 2) at the intersection of the coarse rock substrate and the seafloor to identify any additional aquatic vegetation, benthic invertebrates and fish and to further assess the structural integrity of the coarse rock. The transects conducted at the base of the coarse rock (T3 and T7) were not used for quantification of aquatic vegetation or biota.

Table 1: Ore Dock Video Transect Locations

Location	Transect Name	Start / End	UTM Coordinates (Zone 17W)		Depth Range† (m)	Length of Video Recording (mm:ss)
			Easting	Northing		
West Side of Ore Dock	T1	start	503216	7976624	-1.2 to -4.8	19:32
		end	503215	7976543		
	T2	start	503214	7976542	-0.6 to -2.5	17:51
		end	503138	7976491		
	T3*	start	503135	7976498	-2.2 to -5.7	21:14
		end	503210	7976620		
East Side of Ore Dock	T4	start	503367	7976683	-1.4 to -5.2	18:32
		end	503428	7976630		
	T5	start	503420	7976632	-0.8 to -2.1	13:01
		end	503489	7976594		
	T6	start	503492	7976594	-0.4 to -1.6	24:05
		end	503302	7976512		
	T7*	start	503308	7976511	-0.9 to -7.1	29:53
		end	503371	7976677		

*Transects T3 and T7 were not used for calculation of percent cover of aquatic vegetation or enumeration of benthic invertebrates or fish.
†Depths are recorded to chart datum.

Underwater video was also collected using the ROV at 12 stationary video locations within the offset habitat in locations surveyed in previous years (Figure 3;Table 2). For the stationary video surveys, the ROV was maneuvered into a stationary position on the coarse rock substrate around the ore dock and video was collected with the camera facing into the water column above the coarse rock for a minimum of ten minutes at each of the twelve survey locations (Table 2). The methods used for the stationary video collection followed those established by SEM during previous monitoring years (SEM 2016).

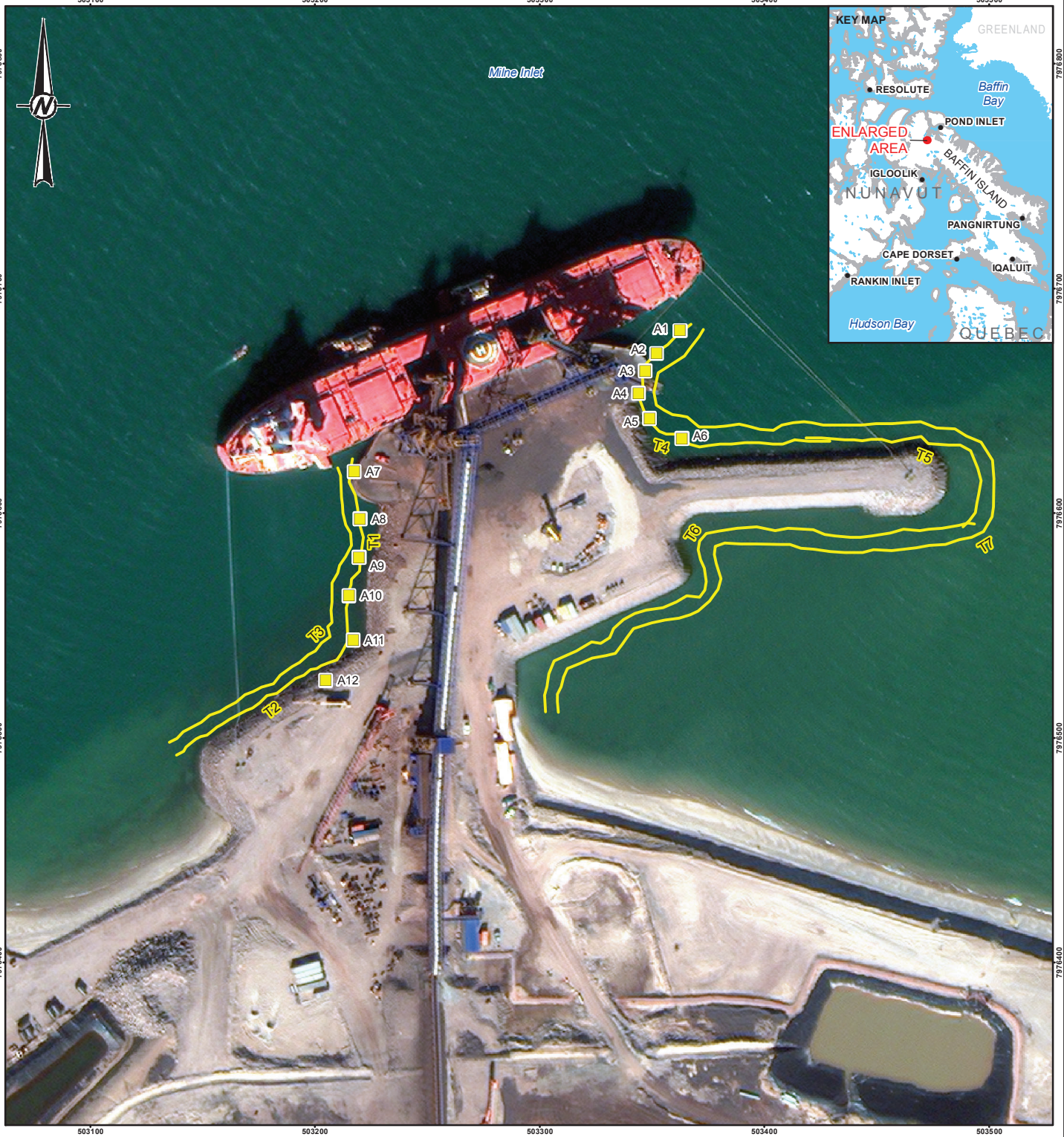
Table 2: Stationary Video Locations

Location	Station Name	UTM Coordinates (Zone 17W)		Length of Video Recording
		Easting	Northing	
East Side of Ore Dock	A1	503362	7976681	10:08
	A2	503352	7976671	10:19
	A3	503347	7976663	10:13
	A4	503344	7976653	10:02
	A5	503349	7976642	10:10
	A6	503363	7976633	10:02
West Side of Ore Dock	A7	503218	7976619	10:07
	A8	503220	7976597	10:01
	A9	503220	7976581	10:00
	A10	503215	7976563	10:11
	A11	503217	7976544	10:01
	A12	503205	7976526	10:02

Video data from the ROV transects was post-processed by a qualified professional marine biologist (Golder) to document the types and percent cover of aquatic vegetation colonizing the coarse rock substrate and to identify and enumerate benthic invertebrates and fish occupying the offset habitat. Results of the video survey were interpreted and compared to Year 2 data reported in 2016 by SEM to provide a high-level comparison of potential changes in the percent cover of aquatic vegetation, and types and quantity of benthic invertebrates and fish over time. Video data from the stationary video locations was post-processed by the same Golder biologist to provide a general overview of fish utilization of the offset habitat.

During the video analysis, the following information was recorded:

- Aquatic vegetation percent cover was categorized as: 0 to 10%, >10 to 25%, >25 to 50%, >50 to 75% and >75 to 100%.
- Aquatic vegetation species was identified to the lowest practical taxonomic level (LPL).
- Benthic invertebrates and fish were identified and enumerated to the lowest practical taxonomic level (LPL).
- Representative photographs of the coarse rock substrate, aquatic vegetation, benthic invertebrates, and fish were captured from video footage.



LEGEND

- DROP CAMERA VIDEO LOCATION
- TOWED VIDEO PATH

0 50 100

1:2,500 METRES

REFERENCE(S)

SATELLITE IMAGERY BY DIGITALGLOBE (AUGUST, 2016), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017.
HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – HABITAT OFFSET MONITORING PROGRAM

TITLE
UNDERWATER VIDEO LOCATIONS FOR FISH HABITAT OFFSET MONITORING, MILNE ORE DOCK, 2018

CONSULTANT
GOLDER

YYYY-MM-DD	2018-12-20
DESIGNED	JS
PREPARED	AA
REVIEWED	JS
APPROVED	EJ

PROJECT NO.	CONTROL	REV.	FIGURE
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3.2 Settlement Baskets and Plates

During the 2018 field season, Golder recovered three settlement baskets that had been originally deployed by SEM in 2016 from the west side of the ore dock, adjacent to the caisson (Figure 6; Table 3). The baskets were initially deployed by SEM in August 2016 and recovered by Golder in September 2017, at which point it was determined an insufficient amount of colonization had occurred on the rocks to allow for sample collection and analysis. A total of five settlement plates were attached to the line in to provide additional surface area for colonization and the baskets were redeployed by Golder in September 2017 on the west side of the ore dock for recovery in 2018. The baskets and plates were recovered on 13 August 2018 for sample collection after a total deployment period of approximately 24 months.

Golder also recovered an additional three settlement baskets that had been deployed in September 2017 on the east side of the ore dock adjacent to the caisson (Figure 6; Table 3). The rocks in the baskets on the east side of the ore dock contained a lower amount of colonization than those from the baskets on the west side, likely due to a shorter deployment time, however, colonization was deemed sufficient enough to allow for sample collection and analysis. The baskets and plates were recovered on 13 August 2018 for sample collection after a total deployment period of approximately 11 months.

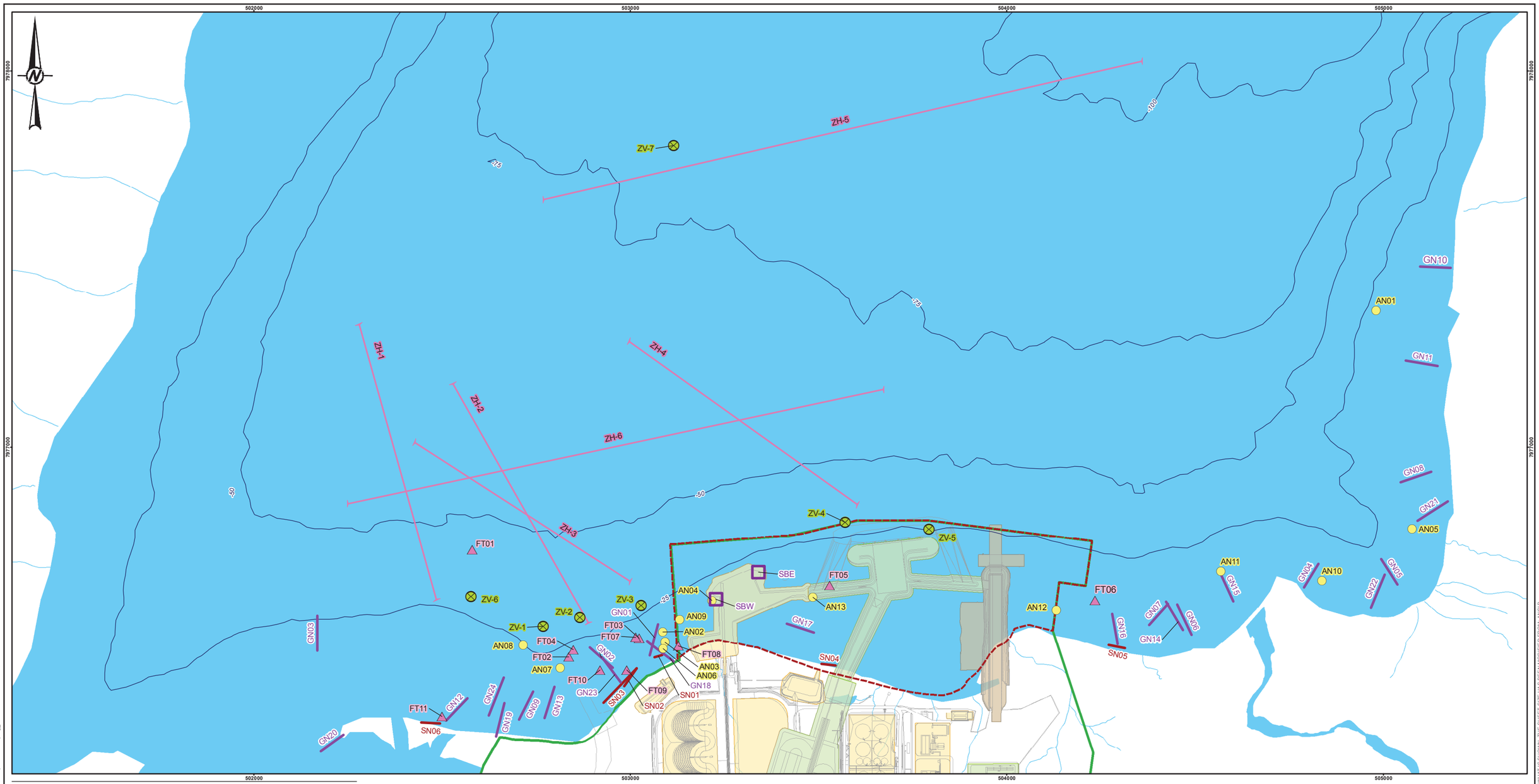
The amount of epifaunal colonization on rocks and plates in both locations was relatively low (Figure 4). After observation of the rocks and plates and consultation with the taxonomic laboratory, it was deemed that submission of whole rocks and plates rather than scraped epifaunal samples would result in the highest quality samples for taxonomic analysis (Figure 5). As a result, whole rocks and plates were collected and preserved in 10% formalin to allow for sample integrity to be preserved. A single composite sample from each location was collected and submitted to Biologica Environmental Services Ltd. (Biologica) for enumeration and identification to the lowest practical taxonomic level (Table 3). In each location, settlement baskets and settlement plates were redeployed after sample collection for recovery in 2019.

Table 3: Settlement Basket Recovery Locations

Location	Sample Name	UTM Coordinates (Zone 17W)		Deployment Period
		Easting	Northing	
East Side of Ore Dock	SBEO-1	503229	7976590	24 months
West Side of Ore Dock	SBWO-1	503346	7976648	12 months

Figure 4: Settlement Baskets Recovered from East Side of Ore Dock

Figure 5: Rock Collected from Settlement Basket from West Side of Ore Dock



LEGEND

- ANGLING (JIGGING) SAMPLE LOCATION
- FUKUI TRAP SAMPLE LOCATION
- SETTLEMENT BASKET SAMPLE LOCATION
- ZOOPLANKTON VERTICAL HAUL SAMPLE LOCATION
- GILL NET SAMPLE LOCATION
- SEINE NET SAMPLE LOCATION
- ZOOPLANKTON OBLIQUE TOW SAMPLE LOCATION
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- PDA / QIA COMMERCIAL LEASE
- WATERCOURSE
- EXISTING FREIGHT DOCK AND CAUSEWAY
- EXISTING ORE DOCK
- NEW ORE DOCK AND CAUSEWAYS
- INAC FORESHORE LEASE
- WATERBODY

0 250 500
1:10,000 METRES

REFERENCE(S)

BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 28, 2018, AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

CONSULTANT
GOLDER

YYYY-MM-DD	2018-12-20
DESIGNED	JS
PREPARED	AA
REVIEWED	JS
APPROVED	EJ

PROJECT
MARY RIVER PROJECT – HABITAT OFFSET MONITORING PROGRAM

TITLE
FISH AND ZOOPLANKTON SAMPLING LOCATIONS, MILNE ORE DOCK, 2018

PROJECT NO.	CONTROL	REV.	FIGURE
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3.3 Fish Sampling

3.3.1 Adult and Juvenile Fish

Fish and fish larvae surveys were conducted in the Milne Port area from 29 July 2018 to 27 August 2018 using both active (gill netting, angling, beach seine, zooplankton nets) and passive (Fukui traps) capture methods (Figure 6). Fish sampling locations and methods were, in general, consistent with the methods used in previous years. All fish were captured live, identified to the lowest practical taxonomic level, and released in the same location. Any incident mortalities resulting from the capture methods were retained and submitted to an analytical laboratory for stomach contents and body burden analyses. The effort was spread over four weeks to capture as much of the open-water season as possible. Table 4 represents summary statistics for fishing effort for all fishing methods used.

Table 4: Summary Statistics of Fishing Efforts by Fishing Method

Method	Number of Stations	Effort Statistic (hour: minute)				
		Min	Max	Mean	SD	Total
Angling	13	0:20	1:25	0:45	0:19	9:47
Fukui Traps	11	48:15	191:30	143:16	46:31	1,576:04
Gill Net†	24	1:55	7:45	4:21	2:05	151:45
Seine Net	6	0:05	0:10	0:05	0:02	0:35
Total Effort						1,712:31

†Gill net effort at GN08 was deployed for an extended period of time due to weather conditions and was excluded from calculation of mean deployment time

3.3.1.1 Gill nets

Standardized monofilament gill nets were used to sample shallow (i.e., up to 15 m deep) subtidal areas for characterization of pelagic fish communities present in the Milne Port area. A total of 24 gill net samplings occurred from 29 July 2018 to 26 August 2018. Each gill net consisted of six panels with each panel measuring 15.2 m in length and 2.4 m in width, with mesh sizes of each panel consisting of 2.5 cm, 3.8 cm, 5.1 cm, 6.4 cm, 7.6 cm and 10.2 cm. The gill nets were deployed in a shore-perpendicular orientation (smallest mesh size closest to shore) and suspended just below the water surface and were checked every two hours for fish presence over the duration of deployment. Sampling locations were recorded using a Garmin GPS and logged in a field notebook. Total soak durations ranged from 1 hour and 55 minutes to 7 hours and 45 minutes with an average soak duration of 4 hours and 20 minutes (Table 4). An exception was gill net setting GN08, which was deployed for 25 hours and 40 minutes due to weather conditions (strong wind) that prevented timely checking and retrieval of the net. The total duration of the gill net effort was 151 hours and 45 minutes.

3.3.1.2 Fukui Traps

Fukui traps were used to sample demersal fish in the Milne Port area from 10 to 27 August 2018. Sampling was conducted with sets consisting of five traps connected with a line, each trap measuring 61 cm x 46 cm x 20 cm, with 1.25 cm stretch mesh and equipped with a bait container. Traps were baited with Arctic char and deployed for several days at each station. Traps were periodically checked (normally every day) and, upon retrieval, bait containers were refilled if necessary, prior to redeployment. There were 11 Fukui trap stations in total (Table 4). The fishing locations were captured using a Garmin GPS and recorded in a field notebook.

3.3.1.3 Angling

Angling (jigging and trolling) was conducted over six days between 10 and 27 August 2018 to sample bottom and demersal fish in the Milne Port area. The duration of sampling was activity dependent; with the single trolling event occurring for 60 minutes, and jigging events occurring between 20 and 85 minutes (n=12; Table 4). Sampling start and end positions were recorded using a Garmin GPS and logged in a field notebook. Jigging occurred from a stationary position with one or two rods and lines deployed from the vessel. Baited hooks or spoon lures (flashers) were allowed to hit the bottom and were then flicked upward to attract bottom fish. Trolling occurred along a pre-determined depth contour where lines with flashers were cast over the side of the vessel and were spooled in towards the vessel at a known depth to attract pelagic fish.

3.3.1.4 Beach Seine

Seine nets were used to sample fish in near shore habitat in Milne Port on 21 and 26 August in six sampling events. Sampling was conducted using a 1.5 m by 10 m seine net with a ¼" mesh deployed from shore by two field staff wading into the subtidal zone. Sampling effort took an average of 5 minutes (Table 4) to sample total areas ranging from 200 m^2 to 750 m^2 at a mean depth of 1 m. Sampling locations were recorded using a Garmin GPS and logged in a field notebook.

3.3.2 Larval Fish

Ichthyoplankton (larval fish) were identified from zooplankton samples collected during the Aquatic Invasive Species (AIS) monitoring program (Figure 6). Zooplankton samples were collected in Milne Port in deep water and in one location adjacent to a moored carrier at the ore dock using a combination of vertical hauls and oblique tows. Vertical hauls were conducted by lowering a 0.3 m diameter plankton net with a 63 μm mesh to a few metres above the bottom and hauling the net by hand to the surface at a rate of approximately 1 m/s. Three replicate vertical hauls were conducted at each station and combined into a single composite sample following the methods used in previous monitoring surveys (Golder 2017). Oblique tows were conducted by towing a 0.5 m diameter net with a 250 μm mesh at a speed of approximately 8-10 km/h for a period of at least ten minutes per tow. Oblique tows were conducted in a sinusoidal fashion such that the net was weighted down with a number of lead weights and the boat was operated alternating between 1 minute towing and 1 minute idling to allow the net to rise and sink within the water column. Oblique tows were collected as a single composite sample at each AIS monitoring location. Plankton samples were preserved in 5% formalin and submitted to Biologica for taxonomic identification and enumeration including separate screening for and identification of ichthyoplankton.

The list of ichthyoplankton collected in 2018 was compared to the list of species collected in previous years. If new species were found, they were examined to identify whether they were possibly invasive. In addition, taxa were compared against a global invasive species database (Molnar et al. 2008), as well as a known invasive species list within the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014).

4.0 RESULTS

A summary of the biological colonization of the coarse rock substrate observed during video surveys of the ore dock offset habitat in 2018 is provided below in Section 4.1, including the types and percent cover of aquatic vegetation (Section 4.1.1) and the types and quantity of benthic invertebrates and fish (Section 4.1.2) observed during the survey. A brief summary of the structural integrity of the coarse rock substrate is provided in Section 4.2. A summary of the production of benthic invertebrates from settlement baskets and plates and the occurrence of larval fish is provided in Section 4.3. A summary of the association of fish with the offset habitat based on continuous video monitoring and fish sampling is provided in Section 4.4.

4.1 Biological Colonization of the Offset Habitat

4.1.1 Percent Cover of Aquatic Vegetation

In general, the overall percent cover of aquatic vegetation was relatively high throughout the offset habitat and was comparable to or greater than the percent cover reported from previous monitoring years (SEM 2016). The types and distribution of aquatic vegetation, however, differed from what was observed in Year 2 of the habitat offset monitoring. Larger kelps were observed to be abundant on the west side of the ore dock, which were not observed during video surveys in 2016.

Brown bladed kelp (*Laminaria* sp.) was observed at >50 to 75% cover along T1 on the west side of the ore dock in 2018. Kelp was not observed during surveys of the offset habitat in Year 2 of the monitoring program (SEM 2016), but it was observed during Year 3 surveys of the structural integrity of the coarse rock substrate (Golder 2017). The percent cover of kelp appeared to be generally greater in 2018 than in 2017 in the areas where kelp was observed; however, percent cover of kelp was not quantified in 2017 which constituted Year 3 of the monitoring program. Sour weed (*Desmarestia* sp.) was relatively abundant on both sides of the ore dock reaching up to >50 to 75% cover (T2) on the west side and up to >25 to 50% cover (T4) on the east side. Green algae (*Urospora* sp.) was abundant along some parts of the west and east sides of the ore dock. Green algae was observed at >25 to 50% cover along T2 but was not observed at all along T1 on the west side of the ore dock. On the east side, green algae was observed at low cover (0 to 10%) along T4 and sparse cover (>10 to 25%) along T6 with relatively dense cover in (>50 to 75%) along T5. In general, a higher percent cover of aquatic vegetation was observed on the west side of the ore dock than on the east side, and the distribution of vegetation types varied spatially throughout coarse rock substrate. A small amount of rockweed (*Fucus* sp.) was also observed at 0 to 10% cover along T2 on the west side of the ore dock.

The presence of kelp in the offset habitat is important as kelp supports high productivity and provides three-dimensional cover and structural habitat for a variety of marine organisms (Dayton 1985; Steneck *et al*. 2002; Wernberg *et al*. 2005). The presence of kelp at a relatively high density on the west side of the ore dock suggests the offset habitat has been stable enough to allow for kelp to reach maturity, a process which usually takes between 1 and 6 years depending on the conditions (Parke 1948, Kain 1975). Spatial and temporal variation in kelp distribution at the ore dock suggests variability in recruitment patterns between kelp and other aquatic vegetation in Milne Port which could be caused by spatial variation in physical parameters (e.g. light, temperature, salinity) or by species-specific dispersal and colonization patterns (Orberg *et al*. 2018; Beuchel and Gulliksen 2008).

Table 5: Aquatic Vegetation Percent Cover, Milne Ore Dock Offset Habitat

Taxa	Common Name	Percent cover (%)†				
		West Ore Dock		East Ore Dock		
		T1	T2	T4	T5	T6
Desmarestia sp.	sour weed	>25 to 50	>50 to 75	>25 to 50	>10 to 25	0 to 10
Laminaria sp.	bladed brown kelp	>50 to 75	–	–	–	–
Urospora sp.	green algae	–	>25 to 50	0 to 10	>50 to 75	>10 to 25
Fucus sp.	rockweed	–	0 to 10	–	–	–

†Aquatic vegetation percent cover was categorized as: 0 to 10%, >10 to 25%, >25 to 50%, >50 to 75% and >75 to 100%.

4.1.2 Benthic Invertebrates and Fish

A total of 101 benthic epifaunal invertebrates from 12 distinct taxa and 7 fish from 3 distinct taxa were identified and quantified during video survey transects of the ore dock offset habitat in 2018 (Table 6). Compared against Year 2 of the habitat offset monitoring program, a greater quantity and diversity of benthic invertebrates and fish were observed utilizing the offset habitat in 2018 than in 2016 (SEM 2016).

Benthic invertebrates observed in the offset habitat in 2018 were largely dominated by large numbers of euphausid shrimp (krill) and unidentified jellyfish, which were observed both in the water column and on the coarse rock substrate at high densities. As a result of the high density of krill and jellyfish, these taxa were not quantified during video analysis but the overall density of each was observed to be comparable to the densities observed in 2016 and 2017. Barnacles were observed attached to the coarse rock substrate at a density of >25 to 50% cover along T1 on the west side of the ore dock, predominantly in the same areas where brown bladed kelp was abundant, and at lower densities along T2 (0 to 10%). Barnacles were present at a lower density on the east side of the ore dock along T4 (>10 to 25%) and T5 (0 to 10%). Barnacles were not identified during video surveys of the offset habitat in 2016 (SEM 2016); however, they were observed but not quantified during surveys of the structural integrity of the coarse rock in 2017 (Golder 2017). Unidentified bryozoans were present at a low density on the coarse rock substrate on the west side of the ore dock along T1 (>10 to 25%) and T2 (0 to 10%). Bryozoans were also observed on the coarse rock substrate along T4 and T5 on the east side of the ore dock at 0 to 10% cover. Calcareous tube worms (Serpulidae) were abundant on the coarse rock on the west side of the ore dock, with 24 and 6 tubeworms observed along T1 and T2, respectively, and less abundant on the east side of the ore dock. A number of wrinkled rock borer (*Hiatella arctica*) and several unidentified clams were observed throughout the offset habitat along with a few whelks of the family Buccinidae. Other epifauna taxa observed included sea butterfly (*Limacina helicina*), brittle stars (*Ophiura* sp.), tunicates (*Polycarpa* sp.), and sea urchins.

Table 6: Benthic Invertebrates and Fish Observed During Video Surveys of Milne Ore Dock Offset Habitat

Taxa	Common Name	Abundance (# of organisms)				
		West Ore Dock		East Ore Dock		
		T1	T2	T4	T5	T6
Euphausiacea	krill	abundant	abundant	abundant	abundant	abundant
Cnidaria	unidentified jellyfish	abundant	abundant	abundant	abundant	abundant
Echinoidea	sea urchin	1	2	4	1	–
Balanomorpha	barnacles	>25 to 50%	>0 to 10%	>10 to 25%	>0 to 10%	–
Bryozoa	unidentified bryozoan	>10 to 25%	>0 to 10%	>0 to 10%	–	–
Ophiura sp.	brittle star	1	–	1	–	–
Hiatella arctica	wrinkled rock borer	6	2	3	3	1
Limacina helicina	sea butterfly	11	4	8	1	–
Polycarpa sp.	tunicate	5	–	2	–	–
Buccinidae	whelk	–	–	1	–	–
Bivalvia	unidentified bivalve	2	1	3	5	–
Serpulidae	calcareous tube worm	24	6	3	–	–
Myoxocephalus quadricornis	fourhorn sculpin	1	–	3	1	–
Myoxocephalus scorpius	shorthorn sculpin	–	1	–	–	–
Gadus ogac	Greenland cod	1	–	–	–	–

Overall, a greater diversity and larger number of invertebrates were observed on the coarse rock substrate in Year 4 than in Year 2 of the monitoring program (SEM 2016). Sessile invertebrates (e.g., barnacles, bryozoans, clams) were largely absent in 2016 but had colonized several areas of the coarse rock substrate in 2018 suggesting that biological colonization is actively ongoing. The large numbers of krill observed on the coarse rock substrate in 2016 were also observed in 2018 suggesting that overall biological productivity has remained high.

4.2 Structural Integrity of the Offset Habitat

Underwater video collected during video transects around the ore dock primarily documented the types and percent cover of aquatic vegetation and biota; however, the video was also analyzed at a high-level to identify changes in the structural integrity of the coarse rock placed during construction of the ore dock.

No evidence of movement or slumping of the coarse rock was observed in the video surveys conducted in 2018. The placement of the coarse rock appeared to be unaltered and functioning as constructed. Transects surveyed

along the seafloor adjacent to the ore dock showed no evidence of loose or stray rocks in the sediment. There was generally a large amount of algal growth and epifaunal colonization on the rocks along the east and west sides of the ore dock. Sediment deposition was generally minor with greater amounts of fine particulates observed along the southern portion of the east side of the ore dock. In general, patterns of biological growth and sediment deposition on the coarse rock in 2018 suggest the rocks have been in a relatively stable position since their initial placement.

4.3 Production of Benthic Invertebrates and Occurrence of Larval Fish

4.3.1 Settlement Baskets and Plates

A total of 1,733 encrusting epifauna from 8 distinct taxa were identified from samples collected from settlement baskets and settlement plates recovered from the Milne Ore Dock in 2018 (Table 7). The majority of encrusting epifauna collected were unidentified barnacles of the suborder Balanomorpha which included a total of 1,674 juveniles. The next most abundant taxa was juvenile wrinkled rock-borer (*Hiatella arctica*) of which a total of 29 juveniles were observed. Wrinkled rock-borer was a commonly observed bivalve species during subtidal video transects conducted as part of the MEEMP program in previous monitoring years. Other epifauna identified included adults from four colonial bryozoan species (*Alcyonidium gelatinosum, Alcyonidium disciforme, Disporella hispida, Infundibulipora prolifera*), two juvenile clams (*Mya* sp.), and two unidentified polychaetes (*Circeis* sp.).

Each epifauna taxa identified to species was cross-checked against a global database of marine invasive species and none of the taxa were identified as a globally-recognized invasive species (Molnar et al. 2008) or an invasive species in Canada according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada By Ballast Water (Casas-Monroy et al. 2014).

Table 7: Epifauna Taxa Identified From Settlement Baskets and Plates in Milne Port, 2018

Taxa	Total Abundance			Description
	A	I	J	
Alcyonidium gelatinosum	1	–	–	Colonial bryozoan species; known to be distributed within the North Atlantic and Arctic (WoRMS 2018)
Alcyonidium disciforme	1	–	–	Colonial bryozoan species; known to be distributed throughout the Southern Atlantic, Northern Atlantic and Arctic (Bock and Gordon 2018a)
Balanomorpha	–	–	1,674	Unidentified barnacle; global distribution
Disporella sp.	16	–	–	Unidentified bryozoan
Disporella hispida	7	–	–	Colonial, suspension-feeding bryozoan; known distribution ranges from Northeast Atlantic and Mediterranean up to Svalbard in the Arctic
Hiatella arctica	–	–	29	Common name: wrinkled rock-borer; species of saltwater clam native to the Arctic; adult specimens observed in Milne Port during previous MEEMP surveys (Golder 2017)
Infundibulipora prolifera	1	–	–	Colonial bryozoan species; known to be distributed within the Arctic (Bock and Gordon 2018b)
Mya sp.	–	–	2	Genus of saltwater clams; wide geographic distribution including the Arctic and Atlantic
Circeis sp.	1	1	–	Unidentified polychaete

A= adult; I= intermediate (has adult features but not of typical reproductive size); J= juvenile

4.3.2 Larval Fish

Zooplankton samples collected in 2018 from seven stations in Milne Port identified a total of 11 larval fish, all of which were collected in oblique tows at ZH1, ZH2, ZH3 and ZH4 (Figure 6). Larval fish taxa identified in the plankton samples included a total of 9 unidentified cod (family Gadidae) and 2 unidentified herring (genus *Clupea*). The presence of larval cod in Milne Port indicates that a larval pool of cod exists to support the adult populations observed around the ore dock offset habitat. A summary of larval fish taxa identified in the zooplankton samples collected in 2018 is provided in Table 8.

Table 8: Larval Fish Taxa Identified in Milne Port, 2018

Taxa	Common Name	ZH-1	ZH-2	ZH-3	Zh-4
Gadidae indeterminate	unidentified cod	6	2	–	1
Clupea sp.	unidentified herring	1	–	1	

Indeterminate= taxa could not be identified below the listed taxonomic level

4.4 Association of Fish with the Offset Habitat

4.4.1 Continuous Video Monitoring

Underwater video collected along transects on the east and west sides of the ore dock, as well as at the 12 stationary video locations, was analyzed to document the association of fish with the coarse rock substrate. Two adult Greenland cod (*Gadus ogac*) were observed in the stationary video recorded on the east side of the ore dock, one at A1 (Figure 7) and one at A5 (Figure 8). The cod appeared to be using the offset habitat for both cover and foraging. No fish were observed in the stationary video recorded on the west side of the ore dock; however, one adult Greenland cod was observed during ROV transects on west side of ore dock moving between the rocks. In addition to the cod, four adult fourhorn sculpins (*Myoxocephalus quadricornis*) were observed on the coarse rock substrate on the east side of ore dock, and one adult fourhorn sculpin was observed on the west side of the ore dock. A single shorthorn sculpin (*Myoxocephalus scorpius*) was also observed sitting on the coarse rock substrate on the west side of the ore dock. All sculpins observed were either sitting atop the coarse rock or utilizing the rock for cover.

In previous years, stationary and transect video was used to satisfy the continuous video monitoring requirement outlined in Section 7.1.4 of the FAA. A potential feasibility study was recommended as a possibility for future monitoring years to evaluate the potential for longer-term continuous video surveillance of the coarse rock substrate, if deemed necessary to document the association of fish with the offset habitat. Based on the number of fish observed during the 2018 offset monitoring program, and during previous monitoring years, the stationary and transect video collected was deemed sufficient to satisfy the continuous monitoring requirement outlined in Section 7.1.4 of the FAA.

Figure 7: Greenland Cod in Offset Habitat at A1, East Side of Ore Dock

Figure 8: Greenland Cod in Offset Habitat at A5, East Side of Ore Dock

Figure 9: Fourhorn Sculpin on Coarse Rock Substrate, West Side of Ore Dock

Figure 10: Fourhorn Sculpin on Coarse Rock Substrate, East Side of Ore Dock

4.4.2 Fish Sampling

Six Arctic fish species, plus one unidentified species and three unidentified sculpins were captured during fish surveys in 2018. The relative abundance of fish species captured in the Milne Port area for all fishing methods are shown in Figure 11. Arctic char (*Salvelinus alpinus*), fourhorn sculpin (*Myoxocephalus quadricorni*) and shorthorn sculpin (*M. scorpius*) were the most abundant fish species caught, comprising almost 98% of the total catch. Arctic Char were the most abundant fish species captured, with a relative abundance of 42% of the total catch, followed closely by fourhorn sculpin with 36% of the total catch and shorthorn sculpin at 19% of the total catch. Arctic sculpin (*M. scorpioides*; three fishes), Arctic cod (*Arctogadus glacialis*; one fish), and northern sandlance (*Ammodytes dubius*; one fish) made up the remainder of identified species with relative abundances of 0.7%, 0.25% and 0.25%, respectively.

A total of 13 fish, representing 3 species were caught in angling surveys (Table 9). Shorthorn sculpin (*Myoxocephalus scorpius*) was the most abundant fish species caught during angling surveys followed by fourhorn sculpin (*M. quadricorni*) and Arctic sculpin (*M. scorpioides*). These three species were the same species caught in 2017 angling surveys and were all captured in previous monitoring surveys in the Milne Port area. Relative abundance, as indicated by catch per unit effort (CPUE;), was highest for shorthorn sculpin, the most abundant catch in angling surveys, with 0.69 fish/h (± 1.25 SD), followed by fourhorn sculpin with 0.54 fish/h (± 1.14 SD).

A total of 4 fish were caught in Fukui trap surveys. As in the 2017 surveys, fourhorn sculpin and sandlance (*Ammodytes spp.*) were caught during the Fukui trap survey. Additionally, a single Arctic sculpin was captured. This species was not captured in 2017 Fukui trap surveys. Due to the high fishing effort, relative abundance, indicated by CPUE, was low for all species (Table 9). The highest CPUE was for fourhorn sculpin, with 0.0015 fish/h (± 0.0035). CPUE was 0.0006 fish/h (± 0.0021) for northern sandlance and 0.0004 fish/h (± 0.0016) for Arctic sculpin.

As in previous years, gill nets proved to be the most effective method of fish sampling and yielded the highest number of fish caught (Table 9). As in 2017, Arctic sculpin, Arctic char, fourhorn sculpin and shorthorn sculpin were captured in gill net surveys. Additionally, an Arctic cod and an unidentified sculpin were captured. Arctic cod has not been caught in previous gill net surveys in the Milne Port area. Arctic char were the most abundant fish species caught in gill net surveys (n = 169), this species was not captured by any other survey method. Fourhorn sculpin was the next most abundant species caught in gillnet surveys (n = 137), followed by shorthorn sculpin (n = 67). The highest CPUE was for Arctic char with 1.57 fish/h (± 2.19), followed by 1.27 fish/h (± 2.09) for fourhorn sculpin and 0.53 fish/h (± 0.73) for shorthorn sculpin (Table 9).

Beach seine was the most efficient fish sampling method, particularly for juvenile fish. A total of ten fish were captured in seine net efforts, shorthorn sculpin, fourhorn sculpin, an unknown sculpin species and an unidentified fish (Table 9). Shorthorn sculpin were the most abundant (n = 4), followed by fourhorn sculpin (n = 3). The highest beach seine CPUE was for shorthorn sculpin at 8 fish/h (± 9.80), followed by fourhorn sculpin at 6 fish/h (± 10.04), with the overall beach seine CPUE of 20.00 ± 23.60 fish/h, the highest for all fishing gear used (Table 9).

A summary of the fish caught in Milne Port fish capture surveys from 2010 to 2018 is provided in Table 10. Total catch in 2018 was significantly greater compared to previous years with 403 fish captured, more than double the previous highest total captured in 2016 (197 fish). This was mostly due to greater gill net effort and higher gill net CPUE in comparison to previous years (Figure 12). Total catches and CPUE for Fukui traps were lower than in the previous years (Figure 13).

Arctic char was the most abundant fish captured in 2018 surveys, similar to 2015 and 2016, where Arctic char comprised 60% and 80% of the total catch, respectively. As in previous survey years, sculpin species were the most abundant fish caught aside from Arctic char. Relative abundance among the sculpin species is variable with survey years, however, shorthorn sculpin and fourhorn sculpin consistently are the two most abundant sculpin species.

Since 2010, thirteen different fish species have been identified in surveys. Arctic cod was identified in 2018 fish surveys and has not previously been captured in the Milne Port area fish surveys; however, it had been observed in large schools in the Milne Port area (SEM 2017a) and in Arctic char stomach contents in 2016 (SEM 2017b).

The majority of fish in 2018 were captured in the shallow (i.e., up to 15 m deep) subtidal areas adjacent to sandy beaches within 1-km distance west of the ore dock and 1.5-km east of the ore dock. The highest CPUE for gill nets of 20 fish/h and 12.5 fish/h were achieved in gill nets GN-23 and GN-17, respectively, located in areas adjacent to the ore dock offset facility (Figure 6). Fourhorn sculpin represented 86% of fish caught in these gill nets, followed by shorthorn sculpin (13%).

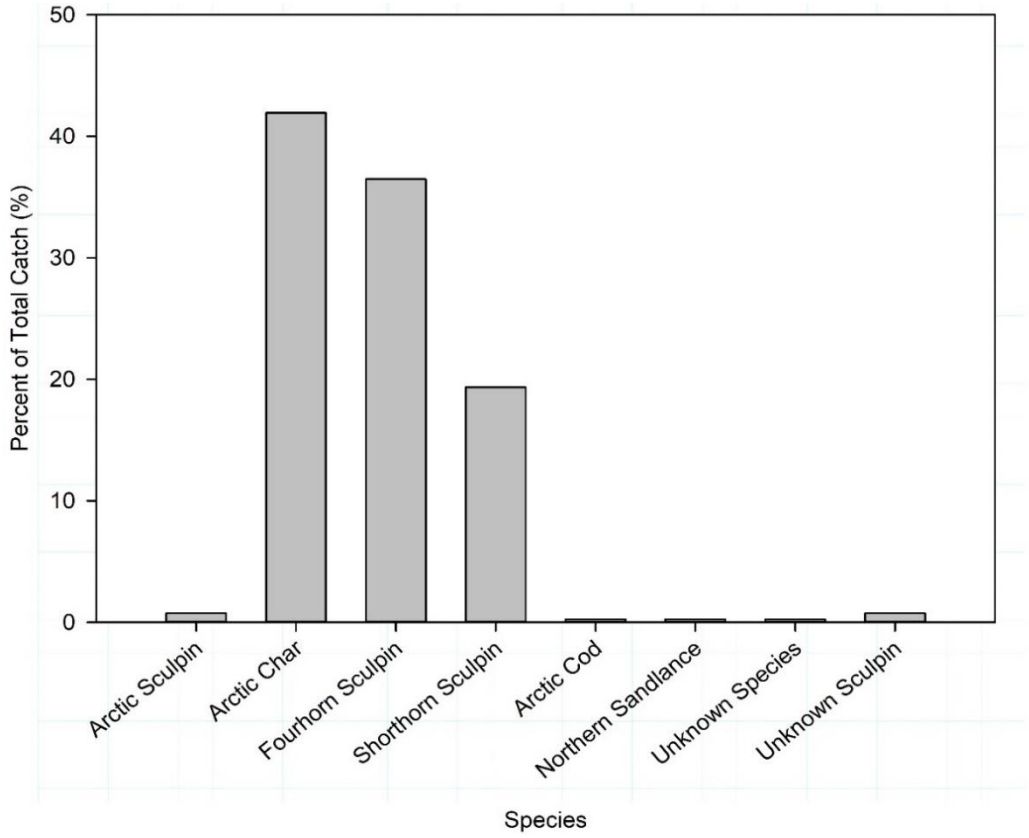

Figure 11: Relative Abundance of Fish Species Captured in Milne Port Area During 2018 Fish Surveys

Table 9: Statistics (Total Catch and CPUE) of Main Fish Species per Fishing Gear

Method	Variable	Arctic Char	Fourhorn Sculpin	Shorthorn Sculpin	Other Species	All Species
Angling	Total N (fish counts)	-	5	7	1	13
	CPUE mean ± SD (fish/h)	-	0.54 ± 1.14	0.69 ± 1.25	0.15 ± 0.55	1.39 ± 1.85
Fukui Traps[1]	Total N (fish counts)	-	2	-	2	4
	CPUE mean ± SD (fish/h)	-	0.001 ± 0.003	-	0.001 ± 0.003	0.003 ± 0.005
Gill Net	Total N (fish counts)	169	137	67	2	376
	CPUE mean ± SD (fish/h)	1.57 ± 2.19	1.27 ± 2.09	0.53 ± 0.73	0.01 ± 0.04	3.38 ± 3.35
Seine Net	Total N (fish counts)	-	3	4	3	10
	CPUE mean ± SD (fish/h)	-	6.00 ± 10.04	8.00 ± 9.80	6.00 ± 14.70	20.00 ± 23.60

Table 10: Total Fish Catch per Year in the Milne Port Area 2010 to 2018

Common Name	Taxonomic ID	2010	2013	2014	2015	2016	2017	2018
Arctic Char	*Salvelinus alpinus*	11	6	3	67	157	23	169
Arctic Sculpin	*Myoxocephalus scorpioides*	0	0	4	1	0	9	3
Shorthorn Sculpin	*Myoxocephalus scorpius*	50	4	9	8	18	45	78
Fourhorn Sculpin	*Myoxocephalus quadricorni*	7	3	39	13	18	40	147
Arctic Staghorn Sculpin	*Gymnocanthus tricuspis*	3	0	0	2	0	0	0
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	0	2	4	2	2	0	0
Arctic Hookear Sculpin	*Artediellus atlanticus*	0	0	5	1	0	0	0
Unidentified Sculpin	Cottidae	0	0	0	12	0	0	3
Greenland Cod	*Gadus ogac*	4	0	1	0	0	0	0
Common Lumpfish	*Cyclopterus lumpus*	0	0	1	0	0	0	0
Fishdoctor	*Gymnelis viridis*	0	1	0	3	0	0	0
Fourline Snakeblenny	*Eumesogrammus parecisus*	0	0	1	2	2	0	0
Sandlance	*Ammodytes spp.*	0	0	0	0	0	1	1
Artic Cod	*Arctogadus glacialis*	0	0	0	0	0	0	1
Unidentified Species	-	0	0	0	0	0	0	1
Total		75	16	67	111	197	118	403

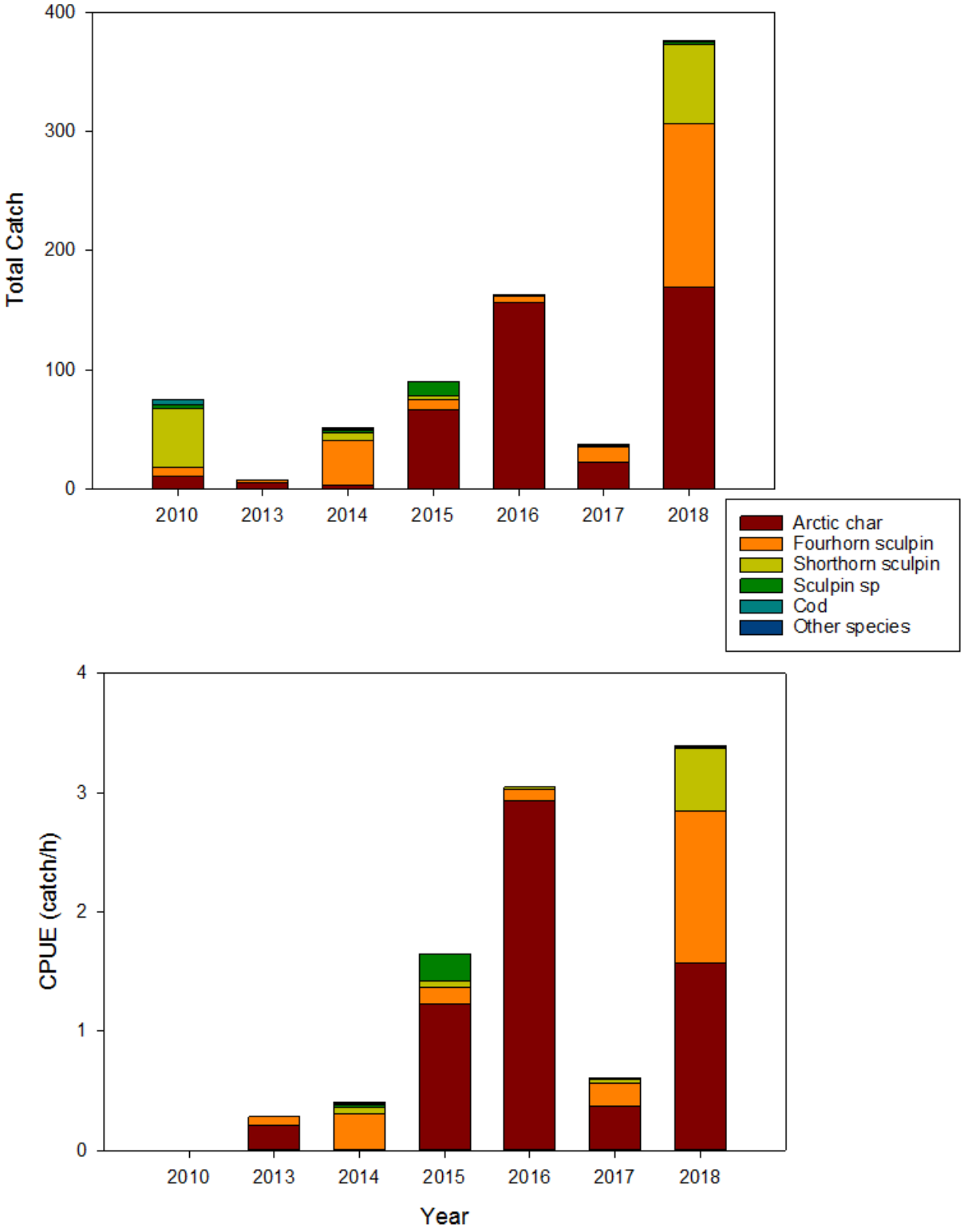

Figure 12: Total Catch and Catch Per Unit of Effort (CPUE) for Gill Nets in the Milne Port Area, 2010 to 2018

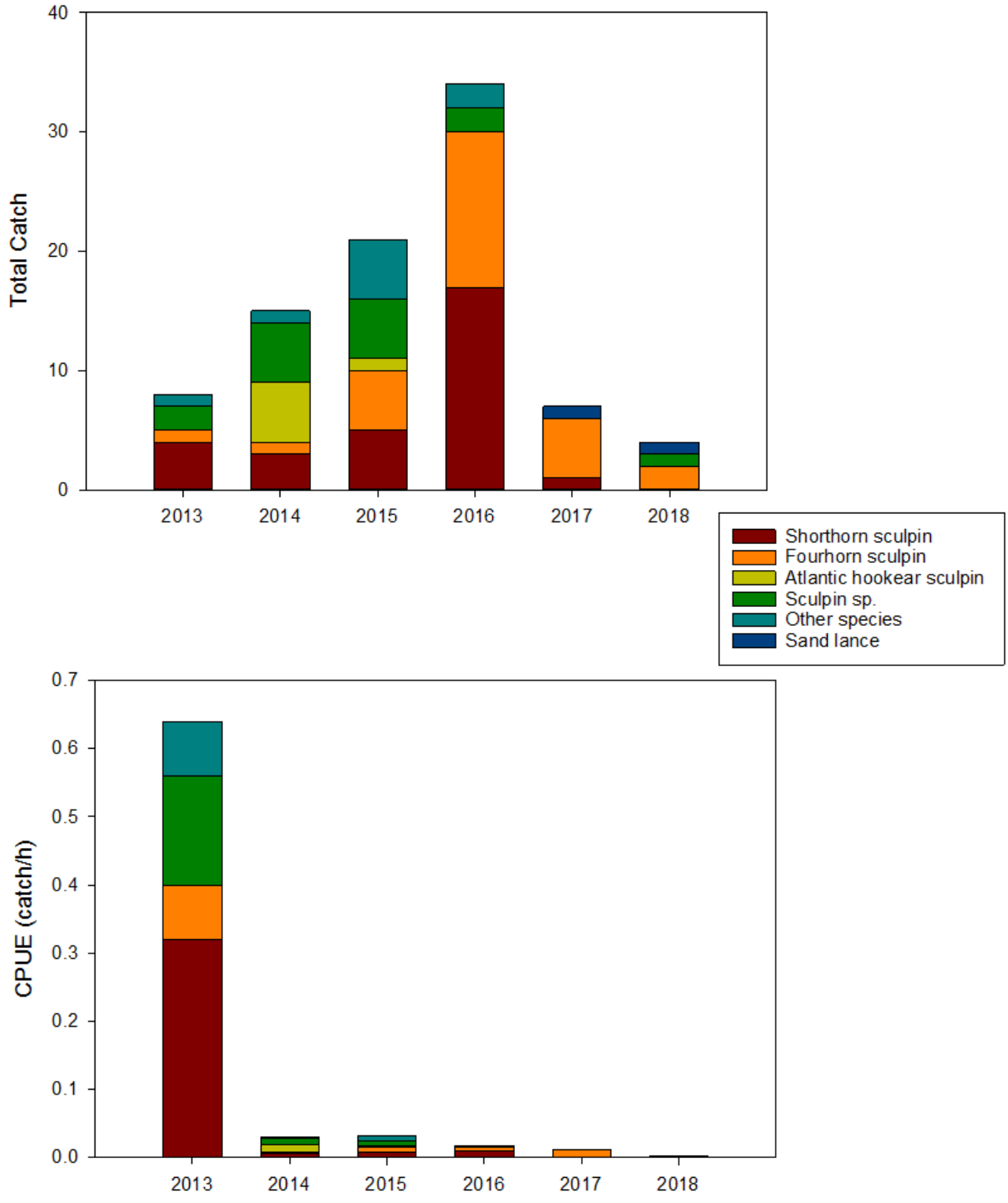

Figure 13: Total Catch and Catch Per Unit of Effort (CPUE) for Fukui Traps in the Milne Port Area, 2010 to 2018

5.0 SUMMARY

The 2018 effectiveness monitoring survey of the offset habitat was designed to fulfil Sections 7.1 and 7.2 requirements of FAA# 14-HCAA-00525 for Year 4, including documenting the types and percent cover of aquatic vegetation colonizing the coarse rock substrate, the types and numbers of benthic invertebrates and fish occupying the offset habitat, the association of fish with the rock substrate, and the biological productivity of encrusting epifauna in the offset habitat. A summary of the monitoring requirements of FAA# 14-HCAA-00525 and the monitoring of the offset habitat completed to date is provided in Table 11.

Table 11: Summary of *Fisheries Act* Authorization Requirements and Monitoring Completed to Date

FAA Requirement	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Monitoring Requirement Met (Y/N)
During Year 1, 3 and 5 the integrity of the coarse rock substrate will be monitored using video surveys.	√	N/A	√	N/A	Y – Year 1 and Year 3 monitoring completed. Year 5 monitoring will occur in 2019.
During Year 2, 4 and 6, video surveys of the coarse rock substrate will be used to document the types and percent coverage of aquatic vegetation colonizing the substrate. Benthic invertebrates and fish will be identified and quantified.	N/A	√	N/A	√	Y – Year 2 and Year 4 monitoring completed. Year 6 monitoring will occur in 2020.
The production of benthic invertebrates and the occurrence of fish larva will be monitored by setting artificial and natural substrate collection baskets in the vicinity of the coarse substrate.	x	x	x	√	Y – Year 4 monitoring completed†
Continuous video monitoring of the rock substrate shall be undertaken to demonstrate the association of fish with the rock substrate.	√	√	√	√	Y - Monitoring completed in all years††

Notes: √=completed; x=not completed; N/A=condition not required during monitoring year; Y=Monitoring requirement met; N= Monitoring requirement not met. †Settlement basket monitoring was not completed in Years 1, 2 or 3 due to insufficient colonization and loss of settlement baskets deployed in Year 1 (SEM 2016). †† Continuous video monitoring was completed via stationary and transect video recordings at multiple locations around the ore dock following the methods initially developed by SEM.

Video surveys confirmed that biological utilization of the offset habitat is occurring and that the offset habitat is stable and serving as functional habitat for benthic invertebrates and fish. The diversity and percent cover of aquatic vegetation in the offset habitat has increased over time and the presence of kelp on the coarse rock substrate suggests the rock is stable enough to provide sufficient habitat for the colonization and growth of larger aquatic vegetation species (i.e., kelp), which in turn is providing greater cover and habitat complexity for fish and benthic invertebrates utilizing the habitat. The diversity and abundance of benthic invertebrates on the coarse rock substrate has increased and sessile invertebrates (e.g., barnacles, bryozoans, clams), which were not observed in Year 2, are now present in low to moderate abundance on the coarse rock.

A number of adult fish were observed associated with the coarse rock substrate in 2018. The fish identified from continuous video monitoring included a resident species of cod and two resident species of sculpin, each of which were observed utilizing the coarse rock for cover and foraging. A variety of fish were also captured during active fish sampling in Milne Port including arctic char, three species of sculpin, sandlance and arctic cod. Results of the Year 4 monitoring program suggest that fish from a number of different species are utilizing the offset habitat.

Biological colonization and productivity was monitored through the use of settlement baskets and settlement plates. Samples collected from settlement baskets and plates showed that colonization was occurring slowly and that colonization of the rocks and settlement plates was mostly by juveniles of the same taxa observed in the offset habitat and throughout Milne Port. None of the epifauna taxa identified from settlement baskets or plates in 2018 are globally-recognized invasive species or considered invasive species in Canada. Larval fish were collected in Milne Port and identified as mostly cod of the family Gadidae suggesting that larval fish of resident species observed associated with the offset habitat are present in proximity to the ore dock.

The results of the Year 4 monitoring indicate that the offsetting habitat has been successful and contingency measures are not required at this time. Based on monitoring results collected to date, the course rock substrate placed around the perimeter of the ore dock in Milne Inlet is functioning in accordance to the conditions set out in the FAA and as designed in the Offsetting plan.

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APPENDIX A

Fisheries Act Authorization

Fisheries and Oceans Canada | Pêches et Océans Canada

DFO File No.: 14-HCAA-00525
Authorization No.:1

FISHERIES ACT 35 (2)(b)AUTHORIZATION

Authorization issued to:

Baffinland Iron Mines Corporation (hereafter referred to as the "Proponent")
Attention: Oliver Curran
2275 Upper Middle Road East Suite 300
Oakville, ON
L6H 0C3

Location of Proposed Project

Nearest community : Pond Inlet
Territory: Nunavut
Name of waterbody: Milne Inlet
UTM Coordinates: NAD 83 UTM 17 503250E 7976508N

Description of Proposed Project

The proposed project of which the work, undertaking or activity authorized is a part involves:

The Early Revenue Phase of the Mary River Project will involve the mining and shipment of up to 4.2 million tonnes per annum of iron ore via the Tote Road to the port at Milne Inlet, for shipment to European markets during the open water season.

Description of Authorized work(s), undertaking(s) or activity(ies) likely to result in serious harm to Fish

The works, undertakings, or activities associated with the proposed project described above, that are likely to result in serious harm to fish, are:

The infilling of fish habitat in Milne Inlet resulting from the construction of the ore dock and mooring structures.

The serious harm to fish likely to result from the proposed work, undertaking, or activity, and covered by this authorization includes:

Permanent destruction of 24, 847 m^2 (6015 Habitat Equivalent Units) of fish habitat.

Conditions of Authorization

The above described work, undertaking or activity that is likely to result in serious harm to fish must be carried on in accordance with the following conditions.

1. **Conditions that relate to the period during which the work, undertaking or activity that will result in serious harm to fish can be carried on:**

The work, undertaking or activity that results in serious harm to fish is authorized to be carried on during the following period:

From	To
Date of Issuance	December 31, 2020

If the Proponent cannot complete the work, undertaking or activity during this period, Fisheries and Oceans Canada (DFO) must be notified. DFO may, where it considers appropriate, provide in writing notice that the period to carry on the work, undertaking or activity has been extended.

The period during which other conditions of this authorization must be complied with are provided in their respective sections below.

2. **Conditions that relate to measures and standards to avoid and mitigate serious harm to fish resulting from the ore dock construction:**

2.1 Sediment and erosion control measures must be in place and shall be upgraded and maintained, such that release of sediment is avoided at the location of the authorized work, undertaking, or activity.

2.2 Measures and standards to avoid and mitigate serious harm to fish resulting from the construction of the ore dock shall be implemented prior to the commencement of in-water works.

2.3 While conducting vibratory pile driving, dredging and infilling a marine mammal exclusion zone of 200m radius will be established. Field measurements will be undertaken to verify that underwater noise levels are below the 100db threshold.

2.4 The marine mammal exclusion zone will be monitored for marine mammal presence starting 30 minutes prior to the commencement of vibratory pile driving, dredging or infilling activities. All activities shall cease if marine mammals are observed within or approaching the exclusion zone and only recommence when the marine mammals have left the area.

2.5 If measured underwater noise levels exceed the 100db threshold the following contingency measures shall be considered for implementation: expansion of the marine mammal exclusion zone and the installation of bubble curtains.

2.6 Turbidity levels shall be monitored in waters adjacent to the work zone during vibratory pile driving, infilling and dredging activities. If turbidity levels exceed Canadian Council of Ministers of the Environment (CCME) guidelines the following contingency measures shall be considered for implementation: installation of additional turbidity curtains, changes in grain size gradation of infill material, altered methods of infilling and the suspension of in-water works until turbidity levels are within the CCME guidelines.

3. Conditions that relate to measures and standards to avoid and mitigate serious harm to fish resulting from project related shipping activity (Terms and Conditions (T&C) adapted from Nunavut Impact Review Board's Project Certificate No 5 May 28, 2014):

3.1 The Proponent shall develop and implement a monitoring program to evaluate changes to marine fish, fish habitat and aquatic organisms as well as to monitor for non-native species introductions resulting from ballast water discharges. Baseline data collection shall commence prior to any ballast water discharge into Milne Inlet and monitoring shall continue for the life of the project. (NIRB T&C 87).

3.2 The Proponent shall develop and implement a monitoring program to confirm the predictions made in the Final Environmental Impact Statement – Addendum, with respect to disturbance impacts of shipping noise on the distribution of marine mammals. The survey shall be designed to monitor effects during the shipping season and include locations in Milne Inlet, Eclipse Sound and Pond Inlet. The survey shall continue over a sufficiently lengthy period of time to determine the extent to which habituation occurs for Narwhal and Bowhead whales. (NIRB T&C 109)

3.3 The Proponent shall develop and implement a monitoring protocol that includes but is not limited to acoustic monitoring, to assess the potential short term, long term and cumulative effects of vessel noise on marine mammals and marine mammal populations.(NIRB T&C 110)

3.4 The Proponent shall provide sufficient marine mammal observer coverage on project vessels to monitor marine mammal interactions with project vessels and report any accidental contact of marine mammals. (NIRB T&C 121)

3.5 The Proponent shall identify and implement measures to reduce the potential for interactions with marine mammals throughout the life of the project. These measures may include; a) changes in frequency and timing (including periodic shipping suspensions) when the likelihood of negative interactions with marine mammals are greatest or during sensitive life stages b) reduced shipping speeds where ship-marine mammal interactions are most likely to occur. (NIRB T&C 105)

4. Conditions that relate to monitoring and reporting of measures and standards to avoid and mitigate serious harm to fish from the ore dock construction:

4.1 The Proponent shall undertake monitoring and report to DFO annually by December 31st whether measures and standards to avoid and mitigate serious harm to fish were conducted according to the conditions of this Authorization, by:

4.1.1 Providing dated photographs and inspection reports to demonstrate effective

implementation and functioning of mitigation measures and standards described above to limit the serious harm to what is covered by this authorization.

4.1.2 Providing details of any contingency measures that were followed, to prevent impacts greater than those covered by this authorization in the event that mitigation measures did not function as described.

5. Conditions that relate to monitoring and reporting of measures and standards to avoid and mitigate serious harm to fish from project related shipping:

5.1 The Proponent shall undertake monitoring and report to DFO annually. The submission of monitoring reports shall coincide with the Proponent's submission of their Annual Monitoring Report to the Nunavut Impact Review Board.

6. Conditions that relate to the offsetting for the serious harm to fish likely to result from the authorized work, undertaking or activity:

6.1 Course rock substrate will be placed around the perimeter of the ore dock and moorings at Milne Inlet to provide 6003 HEU of fish habitat.

6.2 All fish habitat offsetting measures shall be completed and functioning according to the criteria below by December 31, 2020.

6.2.1 Coarse rock substrate will provide additional habitat for benthic invertebrates and fish species in Milne Inlet.

6.2.2 Colonization of the rock substrate by algae and aquatic vegetation to provide a food source for benthic invertebrates and fish.

6.3 If the results of monitoring as required in condition 7 indicate that the offsetting measures are not completed by the date specified in condition 6.2, the Proponent shall give written notice to DFO and put in place contingency measures specified in condition 6.5 and associated monitoring measures, as contained within their approved offsetting plan, to ensure the offsetting is completed and functioning as required by this authorization.

6.4 If monitoring identifies deterioration in the structure, plans will be developed to repair and reinforce these areas. Annual monitoring (drop camera) will be adjusted to include repaired locations and will continue for a period of three years following any repairs.

6.5 If no quantifiable increase in use of the rock substrate by fish, benthic invertebrates or aquatic vegetation is detected by year 6 the following contingency measures will be undertaken.

6.5.1 The Proponent will create an additional 6005 HEU of artificial reefs outside the zone of influence of the ore dock within Milne Inlet.

6.6 To ensure that the above offsetting contingency measures are functioning as intended the monitoring program described in Condition 7 shall be carried out.

6.7 Offsetting measures shall be left undisturbed, and the Proponent shall not carry on any work, undertaking or activity that will adversely disturb or impact the offsetting measures.

6.8 DFO may draw upon funds set aside by the Proponent through the letter of credit provided as

part of the application for this authorization, in order to ensure conditions of this authorization related to offsetting measures, including monitoring and reporting, are met.

7. **Conditions that relate to monitoring and reporting of offsetting measures (described above in section 6:**

7.1 The Proponent shall conduct monitoring of the offsetting measures according to the approved schedule and criteria below:

7.1.1 During Year 1, 3 and 5 the integrity of the coarse rock substrate will be monitored using video surveys (drop camera). All information will be geo-referenced and any slumping or other deterioration will be documented and repaired as necessary.

7.1.2 During Year 2, 4 and 6 video surveys (drop camera) of the coarse rock substrate will be used to document the types and percent coverage of the aquatic vegetation colonizing the substrate. Benthic invertebrates and fish recoded in the video will be identified and quantified.

7.1.3 The production of benthic invertebrates and the occurrence of fish larva will be monitored by setting artificial and natural substrate collection baskets in the vicinity of the coarse substrate.

7.1.4 Continuous video monitoring of the rock substrate shall be undertaken to demonstrate the association of fish with the rock substrate.

7.2 The Proponent shall report to DFO that the offsetting works were conducted according to the conditions of this Authorization by providing the following:

7.2.1 Monitoring report shall be submitted to the DFO-Yellowknife Office by December 31 of each year monitoring is carried out.

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Authorization No. :1

Authorization Limitations and Application Conditions

The Proponent is solely responsible for plans and specifications relating to this Authorization and for all design, safety and workmanship aspects of all the works associated with this Authorization.

The holder of this authorization is hereby authorized under the authority of paragraph 35(2)(b) of the Fisheries Act. R.S.C., 1985, c.F. 14 to carry on the works, undertakings and/or activities that are likely to result in serious harm to fish as described herein. This authorization does not purport to release the applicant from any obligation to obtain permission from or to comply with the requirements of any other regulatory agencies.

This Authorization does ***not*** permit the deposit of a deleterious substance in water frequented by fish. Subsection 36(3) of the *Fisheries Act* prohibits the deposit of any deleterious substances into waters frequented by fish unless authorized by regulations made by Governor in Council.

At the date of issuance of this Authorization, no individuals of aquatic species listed under the *Species at Risk Act* (SARA) were identified in the vicinity of the authorized works, undertakings or activities. In the event that any such individuals are identified in this area, or in the event that an aquatic species found in this same area is listed under the SARA after this Authorization is issued, this Authorization does not permit the killing, harming, capture or taking of individuals of any such species (section 32 of the SARA), or the damage or destruction of residence of individuals of such species (s. 33 of the SARA) or the destruction of the critical habitat of any such species (s. 58 of the SARA).]

The failure to comply with any condition of this authorization constitutes an offence under paragraph 40(3)(a) of the *Fisheries Act* and may result in charges being laid under the *Fisheries Act*.

This authorization must be held on site and work crews must be made familiar with the conditions attached.

This authorization cannot be transferred or assigned to another party. If the work(s), undertaking(s) or activity(ies) authorized to be conducted pursuant to this authorization are expected to be sold or transferred, or other circumstances arise that are expected to result in a new Proponent taking over the work(s), undertaking(s) or activity(ies), the Proponent named in this authorization shall advise DFO in advance.

Date of Issuance: JUN 3 0 2014

Approved by:

Dave Burden
Regional Director General
Central and Arctic Region
Fisheries and Oceans Canada

golder.com