

Coastal Ecological Survey of Fishes in Western Coronation Gulf, Nunavut

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NUNAVUT

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ABSTRACT

M^cNicholl, D.G., Dunmall, K.M. and Reist, J.D. 2019. Coastal ecological survey of fishes in western Coronation Gulf, Nunavut. Can. Tech. Rep. Fish. Aquat. Sci. 3300: vi + 17 p.

A survey of coastal fishes was conducted in western Coronation Gulf in the fall of 2017 in order to assess community composition of nearshore fishes and identify their habitat associations. Fishes were collected at coastal sites in close proximity to the Rae (67°55' N and 115°20' W), and Coppermine (67°49' N and 115°05' W) rivers, near the community of Kugluktuk, Nunavut from September 1st to 7th, 2017. This report summarizes species occurrences, basic biological information for captured individuals, and the environmental characteristics at their locations of capture (i.e., depth, total dissolved solids, and temperature). Overall, 14 species were collected (total fish collected n = 96) in which Arctic Cisco (*Coregonus autumnalis* (Pallas, 1776)) and Saffron Cod (*Eleginus gracilis* (Tilesius, 1810)) were most abundant. The composition of species represent both marine-associated (e.g., Pacific Herring; *Clupea pallasii* Valenciennes, 1847) and freshwater-associated (e.g., Lake Trout, *Salvelinus namaycush* (Walbaum, 1792)) fishes where the Coppermine and Rae rivers enter the Coronation Gulf. Preliminary collection of baseline data to assess marine fish habitats will contribute to the development of a monitoring plan for nearshore ecosystems. Linking this work to studies of Arctic Char (*Salvelinus alpinus* (Linnaeus, 1758)) will enable assessment of habitat usage across marine and freshwater ecosystems that are used by subsistence fishes and co-occurring species.

RÉSUMÉ

M^cNicholl, D.G., Dunmall, K.M. and Reist, J.D. 2019. Coastal ecological survey of fishes in western Coronation Gulf, Nunavut. Can. Tech. Rep. Fish. Aquat. Sci. 3300: vi + 17 p.

À l'automne 2017, un relevé a été effectué dans la partie ouest du golfe Coronation afin d'évaluer la composition des collectivités de poissons du littoral et de déterminer les habitats qu'ils fréquentent. Du 1^{er} au 7 septembre 2017, des poissons ont été recueillis dans des sites côtiers situés à proximité des rivières Rae (67° 55' N et 115°20' O) et Coppermine (67° 49' N et 115°5' O), près de la collectivité de Kugluktuk (Nunavut). Le présent rapport résume les occurrences d'espèces, les renseignements biologiques de base sur les individus capturés et les caractéristiques environnementales des lieux de capture (c.-à-d. la profondeur, les solides dissous totaux et la température). Dans l'ensemble, 14 espèces ont été prélevées (total des poissons prélevés n = 96) parmi lesquelles le cisco arctique (*Coregonus autumnalis* [Pallas, 1776]) et la morue franche (*Eleginus gracilis* [Tilesius, 1810]) étaient les plus abondantes. La composition des espèces présente à la fois des poissons associés à l'eau salée (p. ex. le hareng du Pacifique; *Clupea pallasii* [Valenciennes, 1847]) et des poissons associés à l'eau douce (p. ex. touladi, *Salvelinus namaycush* [Walbaum, 1792]) aux endroits où les rivières Coppermine et Rae se jettent dans le golfe Coronation. La collecte préliminaire de données de référence pour évaluer les habitats des poissons d'eau salée contribuera à l'élaboration d'un plan de surveillance des écosystèmes du littoral. L'établissement d'un lien entre ces travaux et les études sur l'omble chevalier (*Salvelinus alpinus* [Linnaeus, 1758]) permettront d'évaluer l'utilisation de l'habitat dans les écosystèmes d'eau salée et d'eau douce par les poissons visés par une pêche de subsistance et les espèces coexistantes.

1.0 INTRODUCTION

The Coronation Gulf, located in western Nunavut (Figure 1), is an ecologically and economically important region of the Canadian Arctic. The Gulf receives substantial marine input from the Amundsen Gulf to the west, which is augmented by freshwater outflows from the Coppermine, Rae and Richardson rivers (Figure 2). This area provides important habitat for anadromous Arctic Char, *Salvelinus alpinus* (Linnaeus, 1758) and other subsistence species used by Indigenous Peoples of the Kitikmeot Region of Nunavut (Department of Environment 2010). In recent years, this region has also grown in economic importance as a shipping corridor for large and small vessels travelling through the southern Northwest Passage (Department of Environment 2010).



Figure 1. Map of the Coronation Gulf, situated in western Nunavut. Study site is indicated within the black rectangle.

1.1 PROGRAM OBJECTIVES

The Coronation Gulf coastal fish survey was developed in 2017, in response to a request from the Kugluktuk Hunters and Trappers Organization (KHTO), to better understand the ecology of fishes used for subsistence purposes and the interactions of those fishes in the marine environment. The primary objectives of the survey were to:

- 1) Sample populations of coastal fishes to describe species diversity and relative abundance, and to collect sub-samples (otoliths, muscle tissue and stomachs) for follow-on analyses;
- 2) Describe the environmental parameters of the water column (depth, temperature, turbidity and dissolved oxygen) where fishes were captured in the coastal region.

2.0 METHODS

2.1 STUDY AREA

Areas used for subsistence harvest, and those used by anadromous fishes to travel between freshwater and marine environments were selected for this assessment. This included Richardson Harbour (67°55' N, 115°20' W) and Kugluktuk Harbour (67°49' N, 115°05' W). The coastal fish study was designed to assess the community of fishes and their habitat associations. It was also completed in collaboration with Arctic Char research focused in the Rae, Richardson and Coppermine rivers.

2.2 SAMPLING OF COASTAL FISHES

This survey of coastal fishes was designed to sample a wide variety of habitats and identify the species of fishes present. Local, compiled knowledge from the Nunavut Coastal Resource Inventory in 2010 provided a baseline for known freshwater and marine species found in the Coronation Gulf and in the Kugluktuk region. The survey outlined in this document aimed to collect and sub-sample coastal fishes associated with major river systems and compliment local knowledge of fish biodiversity and habitat use.

Field operations were conducted out of Kugluktuk, NU, between September 1st and 7th, 2017. The sampling team consisted of Fisheries and Oceans (DFO) researchers and two community-based technicians hired through the KHTO. Travel and specific net placement were dependent upon weather and ocean conditions. Nets were also placed in areas that would minimize interference with subsistence harvesters in the area. Community-based technicians were able to provide advice during sampling as to where historical fishing sites were and where nets could be safely deployed and retrieved. For example, the crew was generally limited to the sheltered region around Kugluktuk Harbour, opposed to sampling more extensively around the Rae and Richardson rivers.

2.2.1 Net Deployment

Nets were set for durations of 1 to 8.5 hours, with the exception of one net that was set for 24 hours because weather prevented an earlier retrieval. Table 1 describes the sampling effort and depth at which each net was set. Variety in mesh sizes allowed for a wide range of species and size distributions to be captured in order to best describe species composition and diversity in the region.

Specifications of Sampling Gear:

The nets used were 60 m long sinking gill nets comprised of 6 panels (10 m each), stitched together; 25, 38, 64, 89, 114 and 140 mm (1, 1.5, 2.5, 3.5, 4.5 and 5.5 inch) stretched mesh; 3/8"

float line and #40 lead line (1 lb per 12 feet or ~16.5 lbs per net). All meshes were multifilament nylon 210 D/3.

2.2.2 Processing of Fish Samples

A maximum of 30 fishes per species was collected for lethal sample processing. Once that target number was reached, the remaining fishes were identified, measured and live released. In the event that a fish died in the net, it was processed for biological samples. Fishes collected for processing were immediately taken to the lab in Kugluktuk to be measured, weighed, and tissues were sub-sampled and preserved. These tissues included a sample of dorsal muscle (frozen), stomachs (frozen) and a fin clip from char and trout for genetics analysis (preserved in 95% ethanol). Otoliths were also taken from each processed fish for future ageing and other analyses. Processed otoliths, muscle and stomachs were shipped to the Freshwater Institute in Winnipeg for analysis, including ageing, stable isotopes and contents respectively (not summarized in this report).

2.3 ENVIRONMENTAL PARAMETERS

Coastal sites where the Rae, Richardson and Coppermine rivers meet the marine environment of the Coronation Gulf support both freshwater- and marine-adapted species. There is little information regarding the habitat associations of coastal fishes in this area and the conditions in which they co-occur. Therefore, in addition to collection and sub-sampling of fishes, water column profile and benthic sedimentary data (not included in this report) were collected to better understand the habitat characteristics of this region.

Tidbit (TidbiT® v2 Temp-UTBI-001) data loggers were deployed with gill nets to collect time-series temperature data at different locations and depths. Temperature was recorded every 5 min, and the average and standard deviation of temperature over the course of each set are summarized in Table 1. Water column profile data at sites where nets were placed were collected using a YSI Pro DSS. At each site, temperature (°C), turbidity (TDS mg/L) and dissolved oxygen (DO mg/L) were recorded at each one meter interval. Deployment of probes was dependent on calm conditions. At each of these stations, a benthic dredge was deployed to collect sediment samples and benthic invertebrates which were frozen for future analyses.

3.0 RESULTS

3.1 FISHES

3.1.1 Sampling Effort

Nets were set to minimize mortality of fishes and improve success of live release if subsistence species were collected in abundance. Additionally, environmental conditions at the time of sampling influenced the sampling design and only sites where nets could be safely deployed and

retrieved were sampled by the field crew. Figure 2 summarizes the area sampled, while Table 1 provides specific details of net set locations and effort.

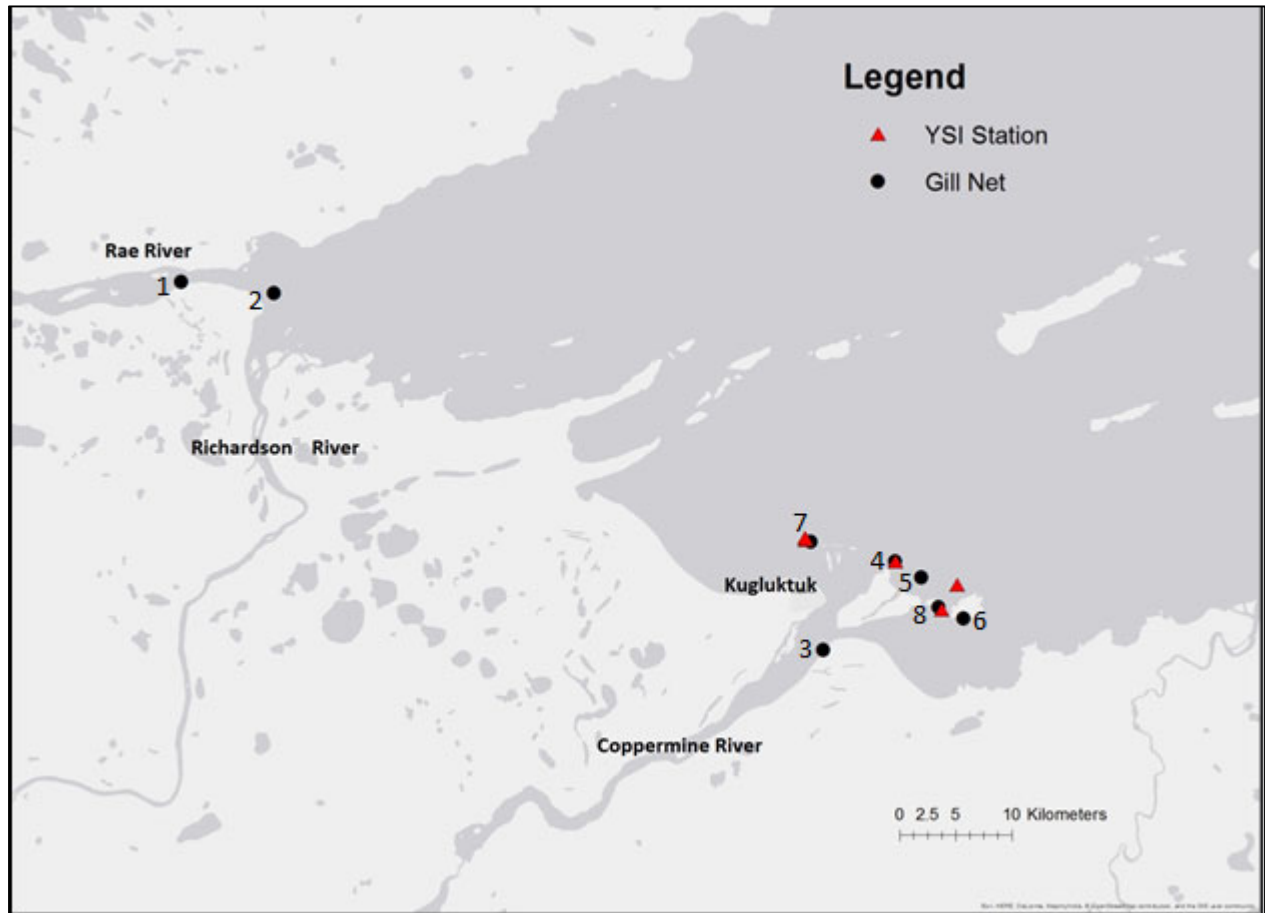


Figure 2. Map of sampling area during coastal survey in September 2017. Gill net stations (black circles) and YSI stations (red triangles) are indicated.

Table 1. List of gillnets deployed in proximity to Kugluktuk Harbour, NU during the coastal survey in September 2017. Total fishing effort, sample coordinates, time of net deployment, depth, and mean temperature was included for each net set. Missing data are indicated by dashes.

Set	Date Set (Y-M-D)	Time Set	Time Retrieved	Total Effort	Latitude (DD)	Longitude (DD)	Depth (m)	Mean Temperature (°C) +/- SD
1	2017-09-02	13:13	16:04	2:51	67.9183	-115.5926	1.3	-
2	2017-09-02	13:52	16:54	3:02	67.9149	-115.5187	1.3	8.3 +/- 0.6
3	2017-09-03	11:33	20:08	8:35	67.8074	-115.0793	3	-
4	2017-09-03	12:50	15:36	2:46	67.8341	-115.0218	16.5	-
5	2017-09-03	13:07	13:15	24:08	67.8292	-115.0011	6.5	8.7 +/- 0.06
6	2017-09-03	13:37	14:52	1:15	67.8169	-114.9670	18.5	8.6 +/- 0.3
7	2017-09-04	13:08	14:58	1:50	-	-	1.6	9.2 +/- 0.03
8	2017-09-06	10:42	-	-	67.8401	-115.0894	17.5	-

3.1.2 Species Diversity and Abundance

Of the 14 species observed over the course of the survey, Arctic Cisco was the most abundant. Table 2 summarizes the number of individuals collected for each fish species. Figure 3 provides a visual representation of the proportion of species diversity observed in this study. Table 3 provides detailed information as to the number of individuals captured in each net.

Table 2. Total number of fish species collected between September 1st and 7th, 2017.

Common Name	Scientific Name	Total
Arctic Char	<i>Salvelinus alpinus</i> (Linnaeus, 1758)	2
Arctic Cisco	<i>Coregonus autumnalis</i> (Pallas, 1776)	22
Arctic Flounder	<i>Liopsetta glacialis</i> Pallas, 1776	1
Arctic Grayling	<i>Thymallus arcticus</i> (Pallas, 1776)	1
Fourhorn Sculpin	<i>Myoxocephalus quadricornis</i> (Linnaeus, 1758)	3
Greenland Cod	<i>Gadus ogac</i> Richardson, 1836	1
Pacific Herring	<i>Clupea pallasii</i> Valenciennes, 1847	13
Lake Trout	<i>Salvelinus namaycush</i> (Walbaum, 1792)	1
Rainbow Smelt	<i>Osmerus mordax</i> (Mitchill, 1814)	2
Saffron Cod	<i>Eleginus gracilis</i> (Tilesius, 1810)	20
Lake Whitefish	<i>Coregonus clupeaformis</i> (Mitchill, 1818)	11
Round Whitefish	<i>Prosopium cylindraceum</i> (Pallas, 1784)	3
Shorthorn Sculpin	<i>Myoxocephalus scorpius</i> (Linnaeus, 1758)	1
Starry Flounder	<i>Platichthys stellatus</i> (Pallas, 1787)	15
Total		96

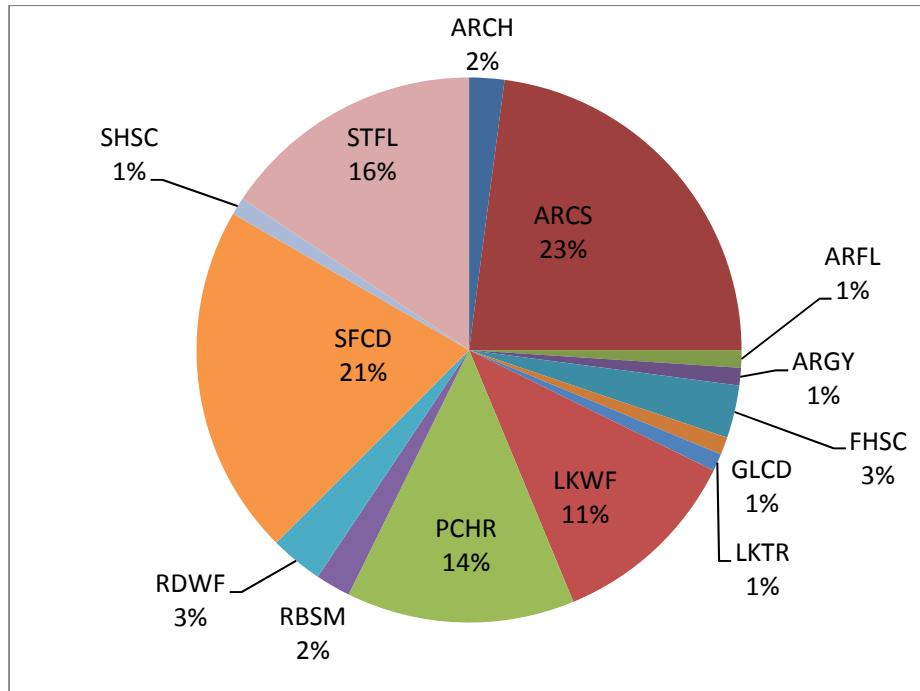


Figure 3. Proportions of species diversity observed in total for all samples from the coastal habitats of Kugluktuk Harbour and the Rae and Richardson estuaries, September 2017.

Table 3. Summary of species collected for each net set during the 2017 field program in western Coronation Gulf. The total number of individuals for each net and for each species are indicated in bold. (ARCH = Arctic Char; ARCS= Arctic Cisco; ARFL = Arctic Flounder; ARGY = Arctic Grayling; FOSC = Fourhorn Sculpin; GRCO = Greenland Cod; LKTR = Lake Trout; LKWF = Lake Whitefish; PCHR = Pacific Herring; RBSM = Rainbow Smelt; RDWF = Round Whitefish; SFCD = Saffron Cod; SHSC = Shorthorn Sculpin; STFL = Starry Flounder), refer to Table 2 for scientific names. * While gill nets were set, n = 2 SFCD were collected by rod and reel.

Set #	ARCH	ARCS	ARFL	ARGY	FOSC	GRCO	LKTR	LKWF	PCHR	RBSM	RDWF	SFCD	SHSC	STFL	Total
1		3										1	1		5
2					1				1						2
3				1			1	6			2				10
4		2							1			2		1	6
5	1	8	1			1		5	11	2	1	6		3	39
6												8		2	10
7	1	8			1									3	13
8		1			1							1	6		9
															94

Despite only being able to set nets and collect fish for four days of the sampling program, 14 species were observed and 94 fishes were collected. This suggests that the coastal areas in close proximity to Kugluktuk Harbour have a high diversity of fishes where both marine-associated and anadromous species co-occur.

Among the 14 species captured, some are noteworthy due to their previously limited presence or rarity. The Nunavut Coastal Resource Inventory (NCRI) Report for Kugluktuk (Department of Environment 2010) contained no records of Rainbow Smelt in Kugluktuk Harbour. Also, the catch of a Lake Trout at the mouth of the Coppermine River is worthy of mention, despite the likely low salinity due to freshwater inputs. It is possible that this individual displays anadromous tendencies, which has been documented in traditional knowledge reports for the region, as well as elsewhere in the Arctic (Swanson et al. 2010). Possible anadromy of this individual will be investigated further in collaboration with Dr. H. Swanson (University of Waterloo). The invertebrate samples collected and preserved as part of this program may also add to the diversity of macrofauna previously described in the NCRI report once they are processed.

3.1.3 Basic Biological Characteristics

Standard sampling protocols for fishes were followed in order to determine length, mass, sex and sexual maturity, and to subsample tissues. All fishes collected in the coastal program were dissected within 24 hours of capture, tissues were frozen, and otoliths were removed and aged at a later date. Data presented in Table 4 summarize the basic morphological characteristics of the species collected.

Table 4. Catch data and basic biological parameters of fishes captured in the western Coronation Gulf. Mean total length includes individuals measured after capture; mass (total, liver and gonad) data were obtained after dissection. Maturity classification is outlined in Appendix A; refer to Table 2 for scientific names.

Species	n	Total Length ± SD (mm)	Mean Mass ± SD (g)	Liver Mass ± SD (g)	Gonad Mass ± SD (g)	Sex (M:F)	Maturity (M:F)				
							Unknown	Immature	Mature	Ripe	Spent
Arctic Char	2										
Arctic Cisco	22	314.1 ± 107.1	313.4 ± 276.2	3.8 ± 3.7	3.4 ± 4.4	8:5	9	5:2	3:0	0:0	0:3
Arctic Flounder	1	328.0	279.0	9.5	23.5	0:1	0	0:1	0	0	0
Arctic Grayling	1	65.0	208.0	0.5	0.2	0:1	0	0:1	0	0	0
Fourhorn Sculpin	3	243.0 ± 59.9	124.6 ± 80.2	3.8 ± 3.6	2.5 ± 2.6	2:1	0	0:2	1:0	0	0
Greenland Cod	1	362.0	476.7	23.1	6.7	1:0	0	1:0	0	0	0
Pacific Herring	13	332.2 ± 23.4	284.9 ± 57.8	3.7 ± 1.5	22.2 ± 15.5	6:7	0	0:7	6:0	0	0
Lake Trout	1	-	376.0	-	-	1:0	0	1:0	0	0	0
Lake Whitefish	11	359.2 ± 70.5	424.0 ± 199.3	3.3 ± 1.8	0.71 ± 0.5	7:4	0	7:3	0:1	0	0
Rainbow Smelt	2	269.0 ± 43.8	119.5 ± 60.4	2.3 ± 0.8	3.2 ± 3.6	2:0	0	1:0	1:0	0	0
Round Whitefish	3	185.7 ± 28.3	43.3 ± 19.0	0.3 ± 0.1	-	1:0	2	1:0	0	0	0
Saffron Cod	20	296.4 ± 96.0	262.2 ± 229.9	9.3 ± 10.4	14.0 ± 21.4	6:10	4	1:10	5:0	0	0
Shorthorn Sculpin	1	118.0	10.7	0.2	-	-	1	0	0	0	0
Starry Flounder	15	255.7 ± 65.8	287.6 ± 189.5	6.6 ± 6.5	11.7 ± 17.3	7:6	2	2:6	5:0	0	0

Among the fishes collected, Arctic Cisco was the most abundant and displayed the greatest range in total length and mass. Some of these fishes were juvenile, therefore introducing a larger standard deviation in size and mass. Saffron Cod was the second most abundant species. Even though most of the Saffron Cod were mature, they also displayed a wide range of size and mass. For several species, only one individual was collected (Arctic Flounder, Arctic Grayling, Greenland Cod, Lake Trout and Shorthorn Sculpin); thus, no averages could be calculated.

Generally the maturity of these fishes was either mature or immature; none displayed ripe gonads. Sex ratios were generally equal across species. Additionally, most of the individuals collected were adults.

3.1.4 Fish Ages

The age of each fish was determined at the Freshwater Institute in Winnipeg, using the whole dried otoliths that were collected in the field. Fishes were aged by examining a section of the saggital otolith, using the break and burn method. Figures 4 to 8 describe the age-length relationship among individuals for each species. Increasing total length with respect to age was observed among species with larger sample sizes, while these patterns were less apparent among species with $n < 10$. Ages are reported individually in Table 5 for species for which < 5 individuals were sampled. Only ages from individuals that could be determined with a high level of confidence by two independent readers are provided.

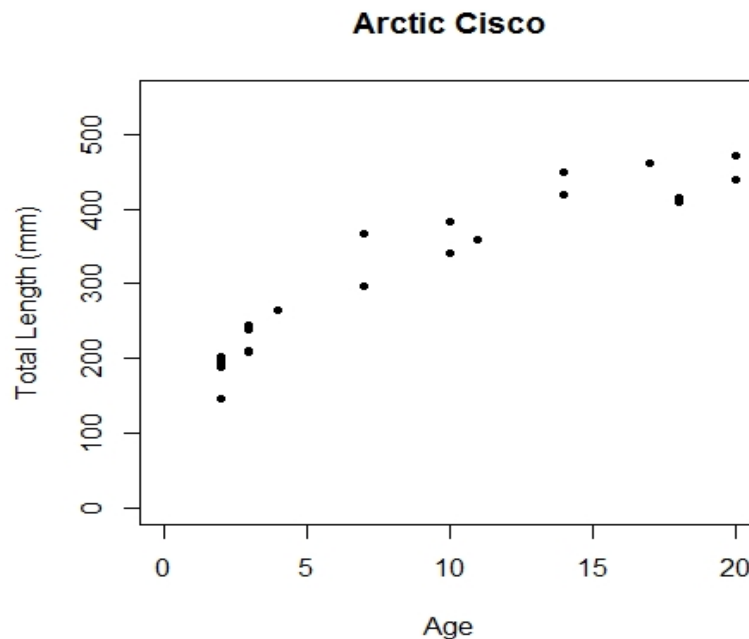


Figure 4. Total length (mm) at age for Arctic Cisco collected in the western Coronation Gulf in September 2017 ($n = 22$).

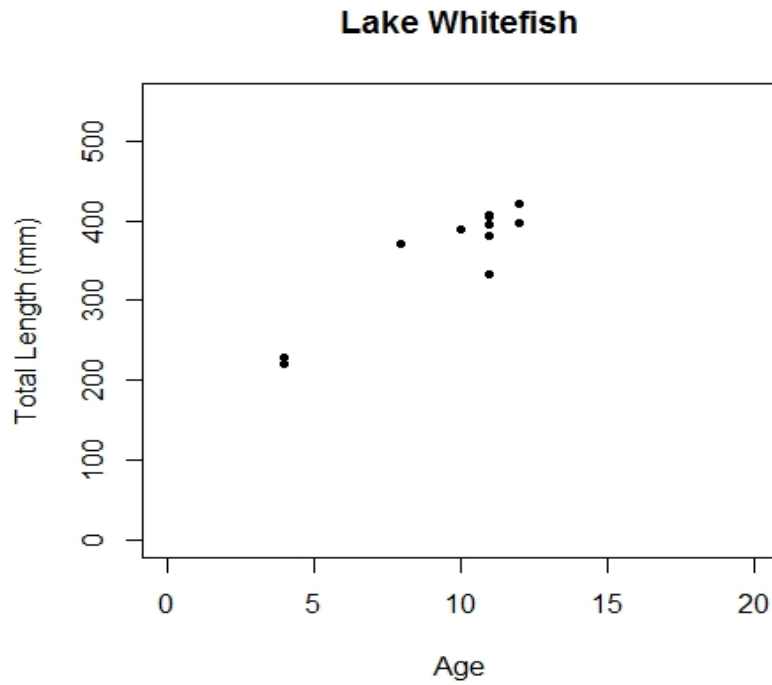


Figure 5. Total length (mm) at age of Lake Whitefish collected in the western Coronation Gulf in September 2017 (n = 11).

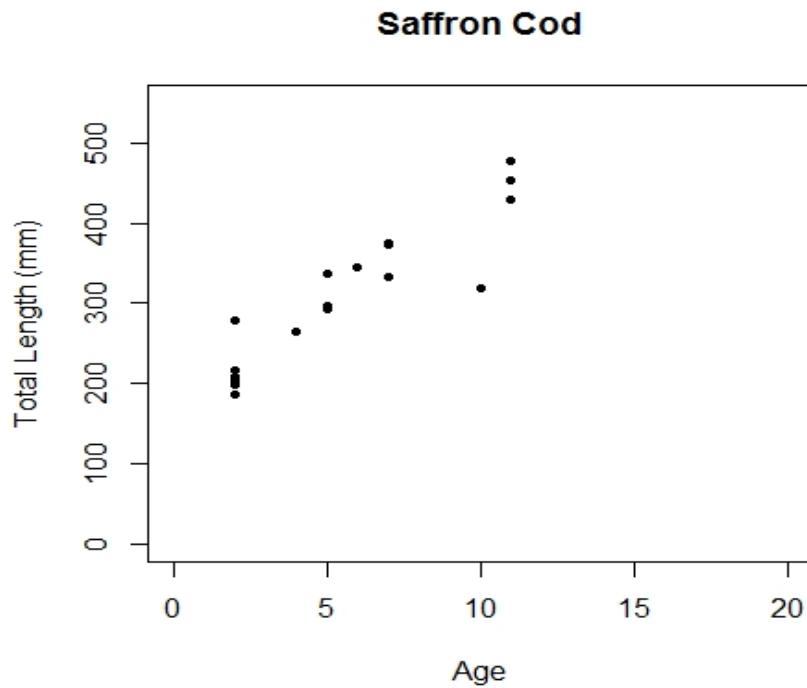


Figure 6. Total length (mm) at age for Saffron Cod collected in the western Coronation Gulf in September 2017 (n = 20).

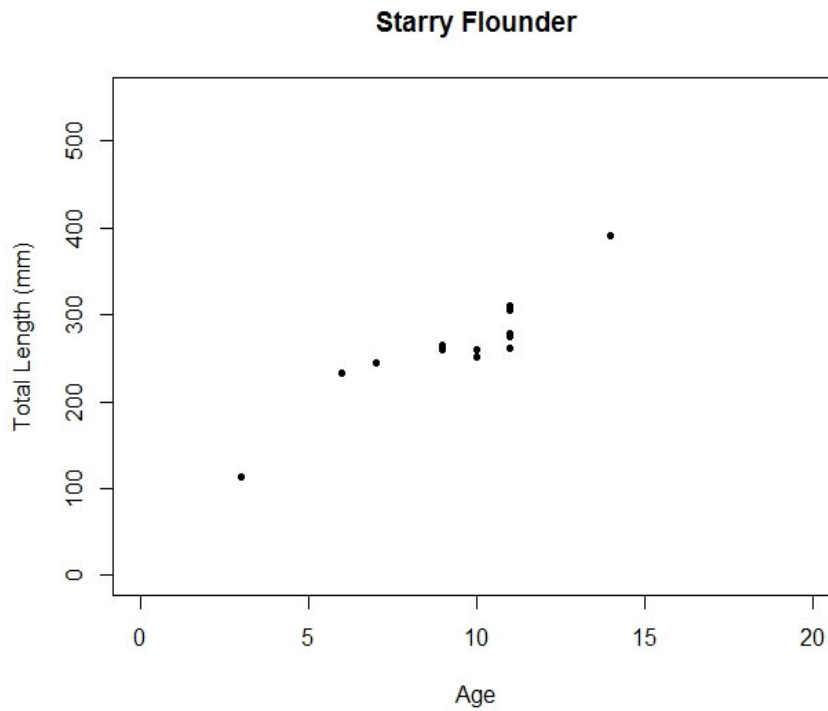


Figure 7. Total length (mm) at age for Starry Flounder collected in the western Coronation Gulf in September 2017 (n = 14).

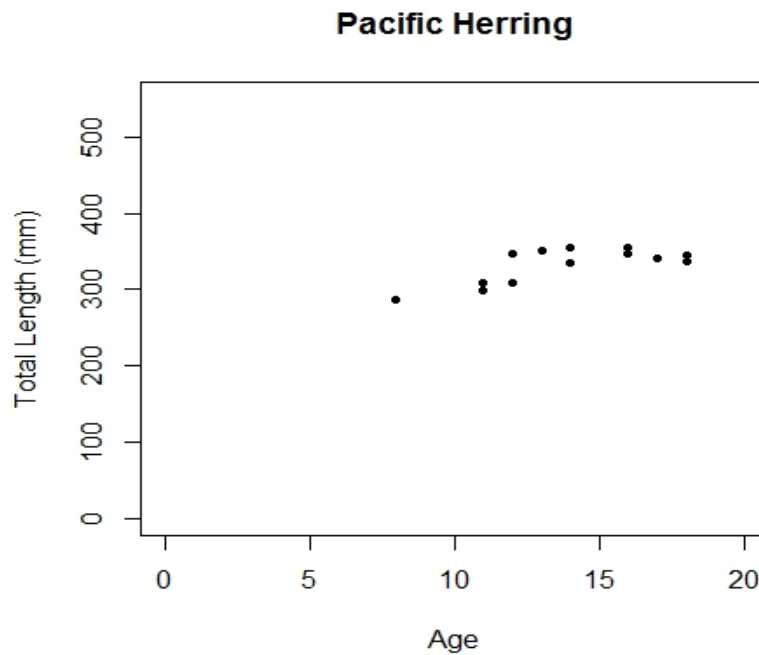


Figure 8. Total length (mm) at age for Pacific Herring collected in the western Coronation Gulf in September 2017 (n = 13).

Table 5. Total length and age of fishes collected in the western Coronation Gulf, where $n < 5$ per species. Each line for the respective species represents an individual fish. No age data are available for Lake Trout.

Species	Age	Total Length (mm)
Arctic Char	10	725
	10	640
Arctic Grayling	2	208
Arctic Flounder	11	279
Greenland Cod	3	362
Fourhorn Sculpin	1	174
	3	273
	6	282
Rainbow Smelt	10	238
	11	300
Round Whitefish	2	162
	2	178
	3	217
Shorthorn Sculpin	2	118

3.2 ENVIRONMENTAL PARAMETERS

In addition to the Tidbit (v2 Pro) temperature loggers that were used with the gillnets, a YSI Pro DSS was also deployed to collect *in situ* measurements of temperature, salinity, dissolved oxygen (DO mg/L), and total dissolved solids (TDS mg/L).

There were six successful grabs of sediment obtained from the benthic dredge among these stations (station 1, 2, 4, 5, 6, 7). The remainder of the contents were sieved to obtain epifaunal that were frozen for future analyses, including baseline consumer samples for stable isotope analysis in other DFO research programs.

Table 6 provides a summary of the water chemistry measurements recorded at five stations in the Kugluktuk Harbour area. Stations 1-3 were calibration sites and are not presented here due to the potential for inaccurate readings.

Table 6. Environmental data collected at YSI stations at 1 m depth increments for temperature, total dissolved solids (TDS) and dissolved oxygen (DO). Although salinity measurements were recorded, irregularities in the data indicated that the salinity probe was not accurately calibrated and therefore no results are available.

Station #	Latitude (DD)	Longitude (DD)	Depth (m)	Temperature (°C)	TDS (mg/L)	DO (mg/L)
4	67.819647	-114.985031	1	9.1	55510	11.2
			2	9.0	61685	11.5
			3	9.1	61815	11.8
5	67.827219	-114.972624	1	9.7	37440	11.3
			2	9.1	55315	11.6
			3	9.1	58695	11.8

Station #	Latitude (DD)	Longitude (DD)	Depth (m)	Temperature (°C)	TDS (mg/L)	DO (mg/L)
			4	8.9	61750	11.9
			5	8.8	63115	12.1
			6	8.7	63635	12.3
			7	8.7	63765	12.4
			8	8.6	63895	12.4
			9	8.6	64024	12.5
			10	8.6	64220	12.3
			11	8.4	64414	12.3
			12	8.3	64675	12.4
6	67.840776	-115.093345	1	9.7	49725	10.9
			2	9	57135	11.0
			3	8.8	60905	11.1
			4	8.8	61620	11.1
			5	8.7	62075	11.2
			6	8.7	62725	11.0
			7	8.8	57135	11.0
			8	8.8	56680	10.9
			9	8.8	56355	10.7
			10	8.8	56290	10.7
			11	8.8	56095	10.7
7	67.840671	-115.093628	1	9.8	49855	11.0
			2	8.9	60905	11.0
			3	8.8	61815	11.0
			4	8.7	62140	11.0
			5	8.7	63180	11.1
			6	8.6	63960	11.0
8	67.841334	-115.094123	1	9.6	50505	10.9
			2	9	56850	11.2
			3	8.9	60255	11.3
			4	8.8	61425	11.3
			5	8.7	61945	11.3
			6	8.6	63375	11.2
			7	8.6	63765	11.3
			8	8.6	64035	11.2
			9	8.5	64220	11.2
			10	8.5	64220	11.2
			11	8.4	64280	11.2
			12	8.5	64350	11.3
			13	8.4	64500	11.3
			14	8.4	64480	11.2

4.0 CONCLUSION

Fishes and valuable information were successfully collected by the coastal survey of the Kugluktuk Harbour area. This included the transition zones between the marine environment of the Coronation Gulf with the Coppermine, Rae and Richardson rivers. Sites sampled in this study are generally data poor, and the characteristics of fishes in coastal areas of this region are not well understood. It is important that baseline studies, such as this, are conducted in these areas to document environmental parameters, biodiversity, and the characteristics of coastal ecosystems. This information is baseline data that will be important for future monitoring studies and potential development in the Kugluktuk Harbour area. Future monitoring work will be necessary to evaluate the impacts and opportunities associated with climate change, including increased shipping traffic and development.

Fish biodiversity and biological data collected from this survey suggest that this region is rich in both marine and anadromous fish species. The movement of these species among habitats and the extent to which their dietary niches overlap remains unknown. Future analyses of samples collected in this study may be able to address some of these knowledge gaps. Data collected during this study can assist in interpreting change in the future as these coastal areas respond to warming temperatures. This survey was designed as an opportunity to test coastal sampling methods in a new location, and provided that few surveys of this kind have been conducted in the past, the scope was limited geographically and temporally. Therefore, the results presented in this study are expected to under represent the potential biodiversity of fishes, and their associated habitat parameters. To accurately assess the ecology and interactions among fishes and their environment in the western Coronation Gulf, more extensive studies are needed.

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6.0 REFERENCES

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APPENDIX A- FISH MATURITY INDEX

Maturity State	Female (2)		Male (1)	
	Code	Description	Code	Description
Immature	1	<ul style="list-style-type: none"> - Ovaries granular in texture - Hard and triangular in shape - Up to full length of body cavity - Membrane full - Eggs distinguishable 	6	<ul style="list-style-type: none"> - Testes long and thin - Tubular and scalloped shape - Up to full body length - Putty-like firmness
Mature	2	<ul style="list-style-type: none"> - Current year spawner - Ovary fills body cavity - Eggs near full size but not loose - Eggs not expelled by pressure 	7	<ul style="list-style-type: none"> - Current year spawner - Testes large and lobate - White to purplish color - Centers may be fluid - Milt not expelled by pressure
Ripe	3	<ul style="list-style-type: none"> - Ovaries fill body cavity - Eggs full size and transparent - Eggs expelled by slight pressure 	8	<ul style="list-style-type: none"> - Testes full size - White and lobate - Milt expelled by slight pressure
Spent	4	<ul style="list-style-type: none"> - Spawning complete - Ovaries ruptured and flaccid - Developing oocytes visible - Some retained eggs 	9	<ul style="list-style-type: none"> - Spawning complete - Testes flaccid with some milt - Blood vessels obvious - Testes violet-pink in color
Resting	5	<ul style="list-style-type: none"> - Ovary 40-50% of body cavity - Membrane thin, loose, and semi-transparent - Healed from spawning - Developing oocytes apparent with few atretic eggs - Some eggs may be retained in body cavity 	10	<ul style="list-style-type: none"> - Testes tubular, less lobate - Healed from spawning - No fluid in center - Usually full length - Mottled and purplish in color
Female or Male				
Unknown	0	<ul style="list-style-type: none"> - Cannot be sexed - Gonads long or short and thin - Transparent and translucent 	11	<ul style="list-style-type: none"> - Resting fish - Spawning complete, gonads not regenerated - Sexing not possible