WATER QUALITY MONITORING OF REGIONAL RIVERS

2015-16

NORTHEAST AVALON ACAP

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PROJECT BACKGROUND, GOALS

Throughout the Northeast Avalon region, there are many rivers / streams that make up the 79 watersheds in the region. Northeast Avalon ACAP (NAACAP) began a three year water quality monitoring project in 2014. NAACAP had conducted water sampling at numerous locations during past projects, but no continuous water quality monitoring was conducted. The provincial Water Resources Management Division (WRMD) has some real time water quality monitoring stations (at Leary's Brook, Waterford River, and Outer Cove Brook) and also quarterly sampled sites throughout the region. With this project, we wanted to initiate regular water quality monitoring to fill in some of the monitoring gaps.

At the end of the 2015-2016 project year, there has been water quality monitoring data collected in 43 of the 79 watersheds on the Northeast Avalon, and there are 77 regular sample sites.

PARTNERSHIPS

Through a partnership with Saint Mary's University's CURA H_2O program, we received a multi-parameter water quality sonde (ie: probe) and other miscellaneous field supplies. CURA H_2O also has online training modules, geared at improving the quality of community collected data by ensuring that everyone has the same basic level of training, and an online database where data is stored and sample locations mapped. Through this partnership, we hope to act as a hub, sharing the equipment and providing training for others who would like to conduct water quality monitoring and produce comparable data.

During year 1, our partners and volunteers sampled a total of 17 sites:

-Students from MUN's Master of Applied Science in Environmental Systems Engineering and Management (MESEM) program - conducted sampling in Long Pond, Quidi Vidi Lake and on Nagle's Hill Brook

-The Kelligrews Ecological Enhancement Program (KEEP) – conducted sampling in the Kelligrews River and the Lower Gully River

-The Fluvarium (The Quidi Vidi/ Rennie's River Development Foundation) – conducted sampling in Long Pond

During year 2, our partners and volunteers sampled a total of 16 sites:

-The Kelligrews Ecological Enhancement Program (KEEP) – conducted sampling in the Kelligrews River, Lower Gully River, and Foxtrap River

-The Fluvarium (The Quidi Vidi/ Rennie's River Development Foundation) – conducted sampling in Long Pond

-The Manuels River Experience – conducted sampling in Manuels River

The provincial Water Resources Management (WRMD) was also a partner for this project, offering advice, expertise, loaning equipment and running the water quality index.



SAMPLING LOCATIONS

NAACAP selected sample sites for our monitoring efforts during the first year of the project. Some locations were altered due to access or potential safety concerns. With these issues resolved, NAACAP had 61 sites which we sampled in 2015. The region was divided into 5 driving routes, with sampling occurring weekly, meaning that all sites were visited on a 5 week schedule.

Project partners conducting sampling chose their sample sites based on their own interests and water sampling needs, and conducted sampling on schedules which suited their availability and resources.

The sample sites for 2014 can be viewed on a map at
https://www.google.com/maps/d/edit?mid=z9ER4s1iJxg0.kKBLFI8tuFZ0

The sample sites for 2015 can be viewed on a map at
https://www.google.com/maps/d/edit?mid=zmR56tMjr3Ls.kA4aeO-haiUI&usp=sharing

SAMPLING PARAMETERS

Water quality parameters collected were those that the water quality sonde (probe) measures in-situ: water temperature, pH, dissolved oxygen (mg/L and % Saturation), specific conductivity, salinity, total dissolved solids (TDS).

RESULTS SUMMARY

Collected water quality parameters were compared to CCME (Canadian Council of Ministers of the Environment) Water Quality Guidelines for the Protection of Aquatic Life or to ranges considered typical for freshwater (Table 1).

Table 1: Freshwater guidelines used in the calculation of the water quality index

Water Quality Parameter	Guideline Used
Dissolved Oxygen	no lower than 6.0 mg/L for early life stages or 5.5 mg/L for other life stages (CCME, 1999)
Specific Conductance	Less than 500µS/cm
Total Dissolved Solids (TDS)	Less than 1000 mg/L
Salinity	Less than 1 ppt
pH	6.5-9 (CCME, 2006)

Using these guidelines, a water quality index (WQI) was applied to the data to give the water quality a ranking using an index calculator developed by the provincial Water Resources Management Division. This WQI score is based on three main factors:

-Scope- the number of parameters that do not meet guidelines
-Frequency – how often the guidelines are not met
-Amplitude- the amount by which the guideline was not met

For more information on water quality index, visit
http://www.env.gov.nl.ca/env/waterres/quality/background/indices.html

Table 3 shows the water quality index (WQI) scores and associated rankings for those freshwater sites (both sampled by NAACAP and partners) that had at least 4 sample visits during the two project years. Table 2 summarizes the index scoring results for freshwater sites from 2014-2015. It should be noted that WQI scores are meant to simplify complex water quality data, thus more in-depth analysis may be required to determine trends, etc. Also, as the sample size included in each score is small and the index is based on only five water quality parameters, the scores should be regarded with caution. Additionally, the guidelines are set by the calculator user, and varying guidelines would change index results. Brackish water sites were not scored using the index as the guidelines used are for freshwater. Since brackish water has influence from both salt and fresh water environments, it is difficult to assess what is considered good water quality. This is exasperated by the fact that many of the water quality parameters assessed for the index score are known to be elevated in salt water and also in situations of poor water quality. For example, an elevated salinity level could be because of a dominating salt water influence, but could also be because of a pollution source. Therefore, increased salinity could be wrongly indicated in the index as an indicator of poor water quality when it is actually caused by natural influences.

Table 2: Summary of number of freshwater sites with each water quality index ranking

WQI Ranking	Number of Sites
Excellent	1
Good	58
Fair	16
Marginal	1
Poor	0
Total	*76*

The majority of the sample sites (76.3%) were ranked as good, with some (21.1%) ranked as fair. One site (0.01%) ranked excellent and one site (0.01%) ranked marginal. An example of why water quality indexes should be used with caution is pH. While the guideline range for pH has been determined by the CCME as ideal for the protection of aquatic life, it is common for Newfoundland water to have low pH, a characteristic related to the geology and presence of peatlands in some areas. As such, many of the sites sampled had pH values that were lower than the CCME guideline, and hence were considered to have failed that parameter in the index calculation. Further work is needed to determine what pH is typical of water throughout the Northeast Avalon. If the guideline range is adjusted, the water quality index results will also be adjusted.

Table 3: Summary of Water Quality Index (WQI) Results for sample sites with 4 or more visits from 2014 to 2015

Station	Name	Index Period	WQI	WQI Category	Total Samples	Total Test	Number of Failed Test	Parameters Failed
BCB02	Beachy Cove Brook	2014-2015	87.1	GOOD	4	20	2	pH*
BCR01	Broad Cove River	2014-2015	76.4	FAIR	7	35	3	Spc, pH*
BEN01	Bennetts Brook	2014-2015	86.4	GOOD	8	40	5	pH*
BIGR01	Big River	2014-2015	83.4	GOOD	8	39	8	pH*
BPT01	Bremigan's Pond Tributary	2014-2015	75.1	FAIR	8	40	6	Spc, pH*
BR02	Bauline River	2014-2015	84.4	GOOD	8	39	7	pH*
BRCR01	Bear Cove River	2014-2015	83.4	GOOD	8	39	8	pH*
CB01	Cross Brook	2014-2015	88.1	GOOD	8	40	2	pH*
CONB01	Conway Brook	2014-2015	88.1	GOOD	8	40	2	pH*
CPB01	Cochrane Pond Brook	2014-2015	86.1	GOOD	6	30	4	pH*
CR01	Coaker's River	2014-2015	72.2	FAIR	8	39	10	Spc, pH*
CS01	Carty's stream	2014-2015	83.4	GOOD	8	39	8	pH*
DOR02	Doyles River	2014-2015	87.1	GOOD	4	20	2	pH*
DR01	Daniel's River	2014-2015	87.1	GOOD	8	40	4	pH*
DRUR01	Druken's River	2014-2015	84.5	GOOD	8	39	7	pH*
DT02	Donovans Tributary	2014-2015	85.3	GOOD	7	35	5	Spc
FB01	Fowler's Brook	2014-2015	88.3	GOOD	7	35	1	Spc
FXR1	Foxtrap River	2014-2015	87.1	GOOD	4	20	2	pH*
FXR2	Foxtrap River	2014-2015	83.7	GOOD	4	20	4	pH*
GT02	Glendale Tributary	2014-2015	86.7	GOOD	7	35	4	Spc
GUNR01	Gunridge River	2014-2015	84.3	GOOD	8	39	7	pH*
HCB01	Horse Cove Brook	2014-2015	76.2	FAIR	8	40	4	pH*, Spc
HMB02	Half Moon Brook	2014-2015	83.4	GOOD	4	20	4	pH*
IPB01	Island Pond Brook	2014-2015	83.6	GOOD	8	40	8	pH*
JPT01	Jones Pond Tributary	2014-2015	83.7	GOOD	8	40	8	pH*
KB01	Kennedy's Brook	2014-2015	83.6	GOOD	8	40	8	pH*

Station	Name	Index Period	WQI	WQI Category	Total Samples	Total Test	Number of Failed Test	Parameters Failed
KENB01	Kenmount Brook	2014-2015	88.4	GOOD	8	39	1	pH*
KGB01	Kitty Gaul's Brook	2014-2015	88.4	GOOD	8	40	1	pH*
KR2	Kelligrews River	2014-2015	100	EXCELLENT	6	30	0	none
KR4	Nut Brook	2014-2015	70.8	FAIR	6	30	9	Spc, pH*
KR5	Nut Brook Headwaters	2014-2015	83.4	GOOD	6	30	6	pH*
LG1	Lower Gully Pond	2014-2015	76.2	FAIR	6	30	3	Spc, pH*
LG2	Lower Gully River	2014-2015	83.7	GOOD	6	30	6	pH*
LG3	Lower Gully River	2014-2015	86.1	GOOD	6	30	4	pH*
LP1	Long Pond	2014-2015	86.7	GOOD	23	115	13	pH*
LP3	Long Pond	2014-2015	74.7	FAIR	23	115	20	Spc, pH*
LP4	Long Pond	2014-2015	63.9	MARGINAL	22	110	18	DO, Spc, pH*
LP5	Long Pond	2014-2015	74.5	FAIR	21	105	19	Spc, pH*
LP6	Long Pond	2014-2015	74.8	FAIR	19	95	16	Spc, pH*
LP7	Long Pond	2014-2015	73.6	FAIR	20	100	21	Spc, pH*
MESEM 1401	Long Pond	2014-2015	73.2	FAIR	16	79	17	Spc, pH*
MESEM 1402	Nagles Hill Brook	2014-2015	83.9	GOOD	20	99	19	pH*
MESEM 1403	Quidi Vidi Lake	2014-2015	66.8	FAIR	16	80	17	Spc, Sal
MGCR01	Maggoty Cove River	2014-2015	86.3	GOOD	8	39	5	pH*
MPR01	Murray's Pond River	2014-2015	86.4	GOOD	8	40	5	pH*
MPT01	Miners Pond Tributary 1	2014-2015	83.2	GOOD	6	29	6	pH*
MR01	Main River	2014-2015	86.4	GOOD	8	40	5	pH*
MR1	Manuels River	2014-2015	88.4	GOOD	8	40	1	pH*
NAR01	North Arm River	2014-2015	88.4	GOOD	8	40	1	pH*
NEB01	Northeast Brook	2014-2015	84.4	GOOD	8	39	7	pH*
NEPR01	Northeast Pond River	2014-2015	84.9	GOOD	6	30	5	pH*
NPB01	North Pond Brook	2014-2015	83.6	GOOD	8	40	8	pH*
OPT01	Oxen Pond Tributary	2014-2015	85.4	GOOD	8	39	6	pH*

Station	Name	Index Period	WQI	WQI Category	Total Samples	Total Test	Number of Failed Test	Parameters Failed
PCB01	Pouch Cove Brook	2014-2015	85.4	GOOD	8	39	6	pH*
PHR01	Petty Harbour River	2014-2015	84.5	GOOD	8	39	7	pH*
QB01	Querry Brook	2014-2015	87.1	GOOD	8	40	4	pH*
RAYB01	Raymond Brook	2014-2015	84.6	GOOD	7	34	6	pH*
RB01	Rocky Brook	2014-2015	83.3	GOOD	8	39	8	pH*
RPT01	Robin's Pond Tributary	2014-2015	83.6	GOOD	8	40	8	pH*
RSG01	Robertson Gully	2014-2015	85.4	GOOD	8	39	6	pH*
SB01	Soldier's Brook	2014-2015	83.6	GOOD	8	40	8	pH*
SC01	Savage Creek	2014-2015	75.8	FAIR	8	40	5	Spc, pH*
SCB01	Shoe Cove Brook	2014-2015	83.4	GOOD	8	39	8	pH*
SDB01	Stone Ducky Brook	2014-2015	85.4	GOOD	8	39	6	pH*
SHR01	Shannon's River	2014-2015	83.3	GOOD	8	39	8	pH*
SPB01	Stick Pond Brook	2014-2015	73	FAIR	8	39	8	Spc, pH*
SWB02	Steadywater Brook	2014-2015	83.7	GOOD	4	20	4	pH*
TB01	Triangle Brook	2014-2015	83.5	GOOD	8	40	8	pH*
TR01	Topsail River 1	2014-2015	83.5	GOOD	8	40	8	Spc
TR03	Topsail River 3	2014-2015	88.3	GOOD	7	35	1	pH*
TWPT01	Tom Waldron's Pond Tributary	2014-2015	83.2	GOOD	8	39	8	pH*
UGR02	Upper Gully River	2014-2015	76.2	FAIR	4	20	2	pH*, TDS
VB01	Voisey's Brook	2014-2015	83.4	GOOD	8	40	8	pH*
WR02	Walls River	2014-2015	84.9	GOOD	6	30	5	pH*
WWPT01	Whiteway Pond Tributary	2014-2015	83.6	GOOD	8	40	8	pH*
YMS01	Yellow Marsh Stream	2014-2015	87	GOOD	8	39	4	pH*

*All failed pH tests were because of pH lower than guideline. This may be a source of misrepresentation of the data, as NL waters are often known to be acidic, based on the bedrock geology and the large amount of wetlands found in watersheds. A low pH may not necessarily be an indicator of poor / impacted water quality.

CABIN SAMPLING

NAACAP also conducted Canadian Aquatic Biomonitoring Network (CABIN) sampling. CABIN is an aquatic biomonitoring program, which uses benthic macroinvertebrates along with traditional chemical and physical monitoring parameters to assess water quality. More information about CABIN can be found at http://www.ec.gc.ca/rcba-cabin/ and a video outlining CABIN sampling procedures can be viewed at https://www.youtube.com/watch?v=lWRTAxcTWXE.

There was one site on the Waterford River (WFD01) which was sampled in 2014 and 2015 as part of the *Water Quality Monitoring of Regional Rivers* project. Through a partnership with the Miramichi River Environmental Assessment Association (MREAC) in New Brunswick and in-kind support from the provincial Water Resources Management Division (WRMD), NAACAP was able to conduct CABIN sampling at 6 additional sites in 2015, all located within the Waterford River and Rennies River watersheds. A map of all CABIN sample sites is available at https://www.google.com/maps/d/edit?mid=zmR56tMjr3Ls.k7vToUy3PYXg&usp=sharing

The water quality data collected in the field during CABIN sampling can be found below in Table 4. Additionally, water samples were collected and sent to a lab for testing for general water chemistry. This testing included some metals. The results of this testing are not given in this document.

Table 4: Water quality data collected in field during CABIN sampling

Site	Date	Water Temp. (°C)	pH	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/ L)	Turbidity (NTU)
WFD01	October 8, 2014	10.21	6.72	762.6	11.07	2.1
WFD01	October 6, 2015	12.10	7.33	712.7	10.66	1.0
WFD02	October 6, 2015	11.34	7.66	647.7	11.09	0.9
WFD03	October 6, 2015	9.79	7.29	543.3	11.49	1.0
STH01	October 6, 2015	9.45	7.68	278.7	12.02	3.0
REN01	October 5, 2015	10.90	7.06	597.5	10.99	1.0
LER01	October 5, 2015	9.96	6.52	255.5	11.09	0.5
KEN01	October 5, 2015	11.68	7.20	239.3	10.97	1.1

CABIN sampling also includes sampling benthic macroinvertebrates. Benthic macroinvertebrates are used as indicators of water quality, as invertebrates have varying tolerance to pollution. For example, if only invertebrates known to be pollution tolerant are found, with none that are sensitive to pollution, it can be inferred that the water may be polluted and those sensitive to pollution cannot populate the area. The percent EPT metric is often used as an indicator of the presence of pollution sensitive organisms, as the orders Ephemoptera (mayflies), Plectoptera (stoneflies), and Trichoptera (caddisflies) are known to be pollution sensitive. Invertebrate data can also help indicate stream health by looking at the composition of the invertebrate population found at a sample site. For example, if there is a low richness (a low number of different taxa found), this may be an indication that some invertebrates are thriving and outcompeting others, or that only invertebrates with a particular pollution tolerance are able to survive in the site conditions. As changes in invertebrate populations vary over time and in response to multiple conditions, they are an effective measure of overall water quality and reflect cumulative impacts to water quality.

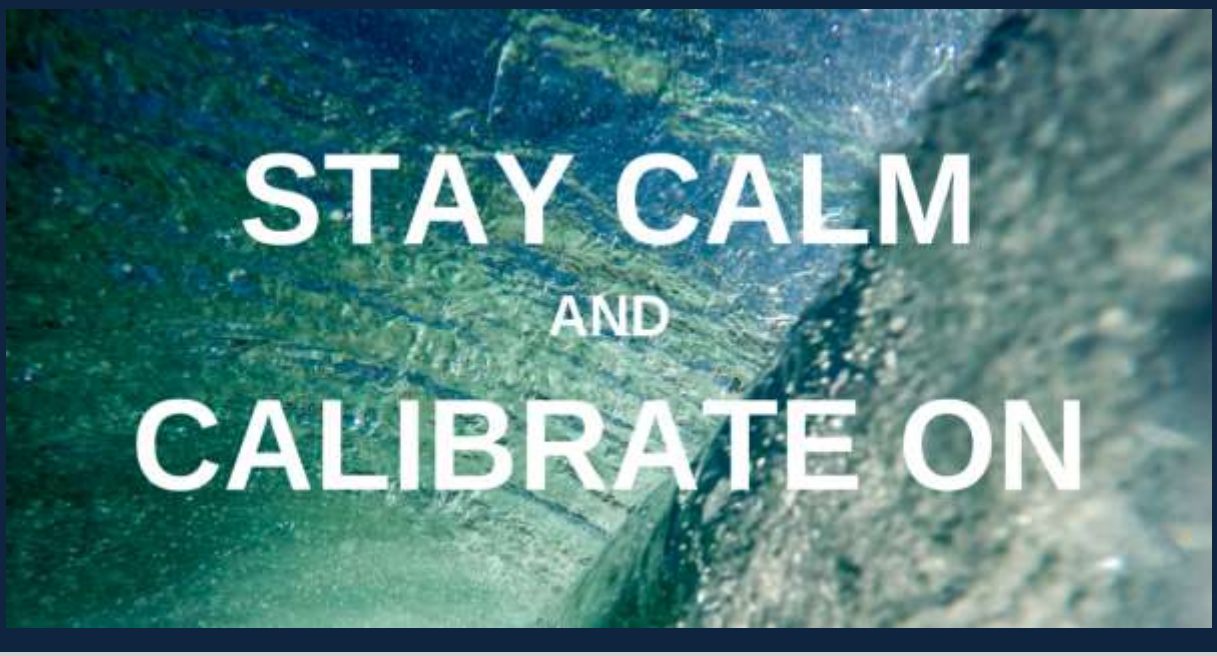
The CABIN program is designed to compare test sites to reference sites determined to be in undisturbed, natural condition. The model for such comparison for Newfoundland and Labrador had not yet been made publicly accessible. However, the CABIN database does provide some metrics that can be used to summarize the invertebrate data. A sample of these metrics is found in Table 5.

Table 5: Invertebrate metrics summarizing the results of invertebrate sampling

Site	Date	# of Taxa	Total Abundance	% EPT Individuals	% of 2 dominant taxa	% of 5 dominant taxa
WFD01	October 8, 2014	19	5433.25	28.10	61.77	84.97
WFD01	October 6, 2015	24	2446.04	47.30	42.86	73.65
WFD02	October 6, 2015	26	2809.00	35.18	38.76	70.36
WFD03	October 6, 2015	19	4428.49	12.22	65.27	85.85
STH01	October 6, 2015	18	6780.00	45.43	37.46	65.78
REN01	October 5, 2015	16	3499.94	13.52	75.47	90.88
LER01	October 5, 2015	22	2328.47	52.96	35.20	69.47
KEN01	October 5, 2015	16	2799.97	28.34	69.38	92.83

FUTURE PROJECT PLANS

The 2016-2017 project year is the last year of the three years of funding awarded for the *Water Quality Monitoring of Regional Rivers* project. However, NAACAP will be exploring funding options to continue the monitoring to have continuous data. Ideally, the collection of samples for laboratory analysis would increase the knowledge of water quality at the sample sites. It is hoped that CABIN sampling will also continue so that increasing amounts of data are collected for comparison over time. When the CABIN reference model for this province is made accessible the results of CABIN sampling will be analysed using the model.



ARE YOU INTERESTED IN GETTING INVOLVED?

If you are interested in further information about NAACAP's water quality monitoring, or would like to assist with the collection of data, feel free to contact us at info@naacap.ca or call us at 726-9673.