Environnement Canada   Environment Canada

MREAC

Application of the Canadian Aquatic Biomonitoring Network (CABIN)

The Miramichi River Environmental Assessment Committee

Synopsis 2015

Application of the Canadian Aquatic Biomonitoring Network (CABIN)

Synopsis 2015

Vladimir King Trajkovic

Miramichi River Environmental Assessment Committee

PO Box 85, 21 Cove Road
Miramichi, New Brunswick
E1V 3M2

Phone: (506) 778-8591
Fax: (506) 773-9755

Email: mreac@nb.aibn.com
Website: www.mreac.org

March 8, 2016

Acknowledgements

The Miramichi River Environmental Assessment Committee (MREAC) would like to thank Environment Canada (EC) for their support through the Atlantic Ecosystem Initiative for the Canadian Aquatic Biomonitoring Network (CABIN) project titled “The Atlantic Provinces Canadian Aquatic Biomonitoring Network (CABIN) Collaborative”. A special thank you is also extended to Lesley Carter and Vincent Mercier for their support and training during this endeavour.

MREAC
MIRAMICHI RIVER ENVIRONMENTAL ASSESSMENT COMMITTEE

Environnement Canada Environment Canada

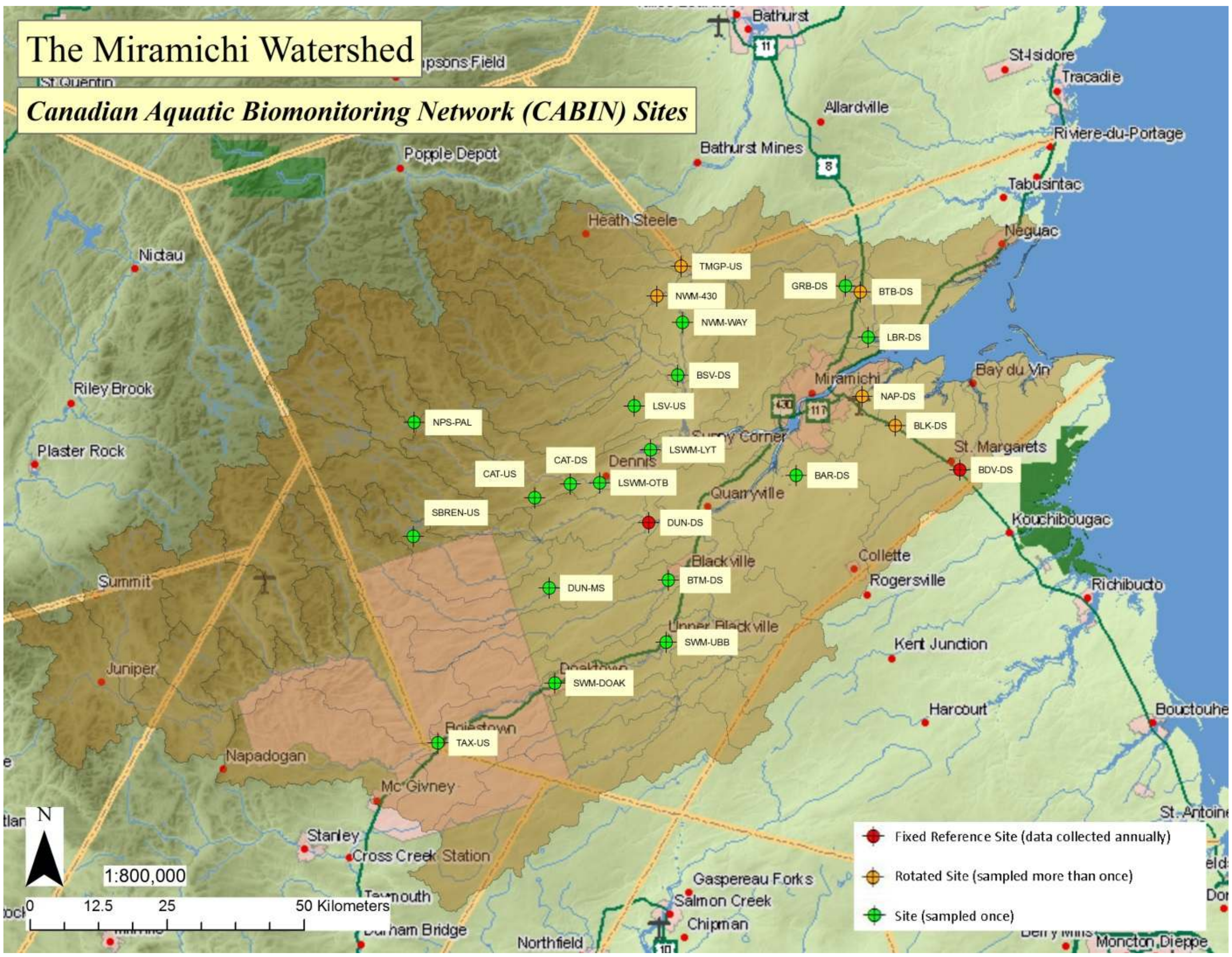
Table of Contents **Page**

Tables:

1.0 Introduction

The Canadian Aquatic Biomonitoring Network (CABIN) protocol, as developed by Environment Canada (EC), is now a nationally applied technique for assessing the biological condition of freshwater systems. The Miramichi watershed has been engaged in this protocol since 2004 and has 24 established reference and test sites that are found on major tributaries within the drainage basin (Figure 1.1).

Figure 1.1: Miramichi Watershed CABIN Sites



In 2015, with the Atlantic Ecosystem Initiative (AEI) funding contribution, MREAC led an Atlantic Provinces wide CABIN project titled “The Atlantic Provinces Canadian Aquatic Biomonitoring Network (CABIN) Collaborative”.

2.0 Background

MREAC's contribution to the development of the CABIN "Atlantic Reference Model" has been instrumental. This protocol requires annual sampling of fixed reference sites to monitor for natural changes. Test and/or reference sites suspected to be at risk could be sampled more frequently. MREAC staff has formal training in the CABIN protocol, and has on staff a CABIN certified Project Manager and Trainer.

MREAC and EC continue to provide CABIN protocol training to the New Brunswick Community College (NBCC – Miramichi) Environmental Technology year 2 students. Upon successful completion of the one day course, the students were certified at an Assistant Field Technician level (Figure 2.1), (Figure 2.2).

Figure 2.1: MREAC with NBCC Students and Instructor for the CABIN Protocol Training

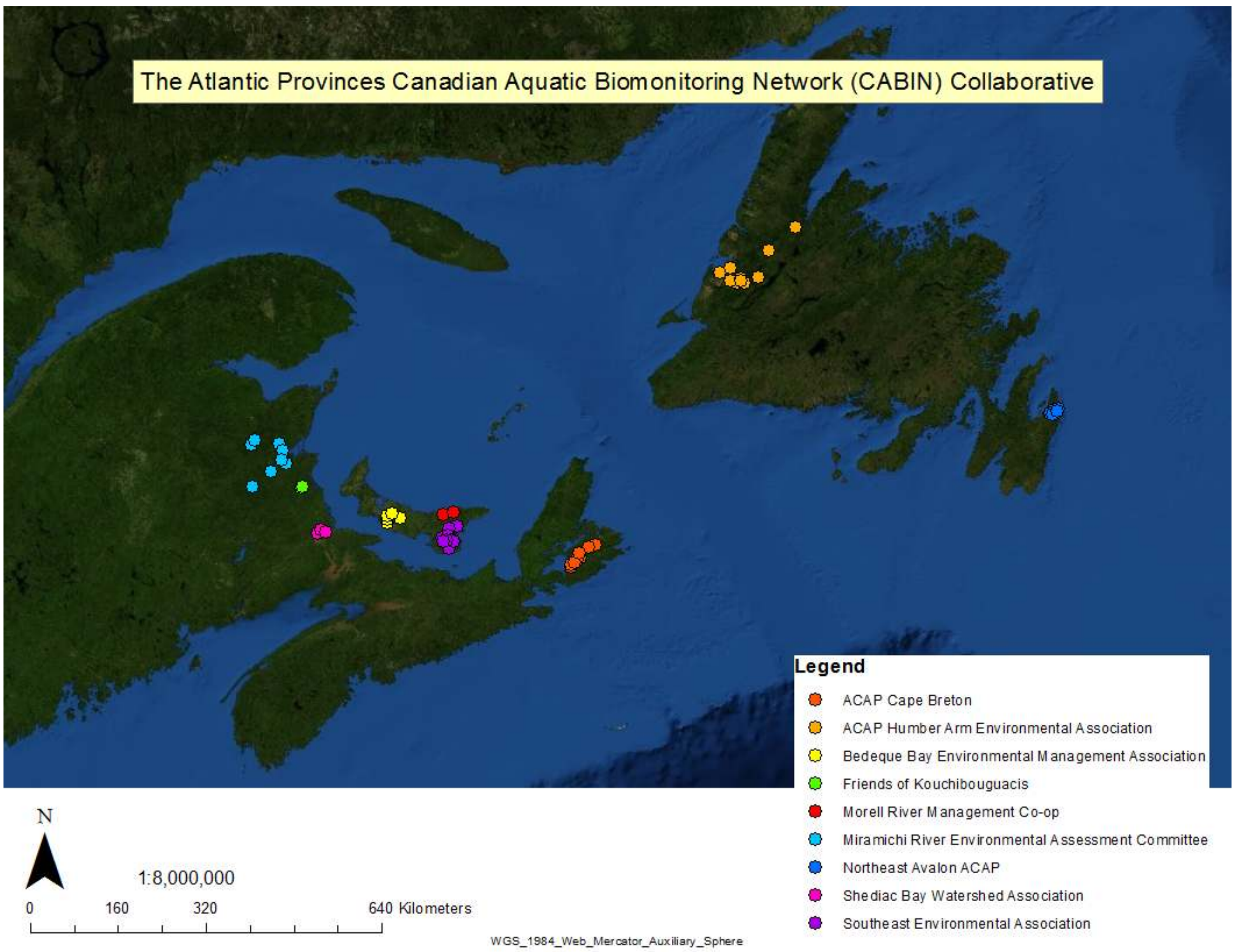
Figure 2.2: NBCC Students and EC Staff during CABIN Protocol Overview

MREAC, in collaboration with eight ENGO partners in New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island implemented the CABIN protocol to collect biological, physical, and chemical data on 57 established and/or new sampling sites (*note: 1 sample lost due to damage during shipping, data available for 56 sites*), (Figure 2.3). The project was initiated in order to assess the quality of biological conditions, and also to track changes in biological conditions over time.

1. ACAP Cape Breton (8 sites)
2. ACAP Humber Arm (10 sites)
3. Bedeque Bay Environmental Management Association (6sites)

4. Friends of Kouchibouguacis (2 sites)
5. Morell River Management Co-op (3 sites, *note: 1 sample lost due to damage*)
6. Miramichi River Environmental Assessment Committee (8 sites)
7. Northeast Avalon ACAP (7 sites)
8. Shediac Bay Watershed Association (3 sites)
9. Southeast Environmental Association (10 sites)

Figure 2.3: MREAC and ENGO Partner's CABIN Sites Across Atlantic Canada



The data collected was entered into the Environment Canada housed CABIN database, which has in turn strengthened the national CABIN dataset.

In conjunction with the Atlantic CABIN Collaborative, MREAC has used this data to run the Atlantic Reference Model (ARM) for the 56 sites. The results of the model output have increased regional ecosystem knowledge, and will be used as baseline data to monitor future variations that may be attributed to anthropogenic impacts and/or the effects of climate change within the Atlantic ecosystem.

MREAC was trained by EC staff on how to extract habitat variables using QGIS and GRASS computer software program/plugin, and how to format the CABIN benthic data set in order to run ARM in GenGIS and R computer software program/plugin.

During the fall of 2015 MREAC sampled 10 CABIN sites on the Miramichi watershed, six established and four new (Table 2.1).

Table 2.1: MREAC CABIN Sites 2015

	Site	Site ID	Lat.	Long.	Status
1	Bay du Vin River	BDV-DS	46.89465	-65.17248	Potential Reference Site
2	Dungarvon River	DUN-DS	46.81393	-65.91795	Potential Reference Site
3	Northwest Miramichi River	NWM-430	47.18638	-65.89458	Potential Reference Site
4	Tomogonops River	TMGP-US	47.23362	-65.83563	Test Site
5	Barnaby River	BAR-DS	46.88940	-65.56458	Test Site
6	Napan River	NAP-DS	47.01726	-65.40323	Test Site
7	Black River	BLK-DS	46.96920	-65.32665	Potential Reference Site
8	Green Brook	GRB-DS	47.19901	-65.43971	Potential Reference Site
9	Bartholomew River	BTM-DS	46.71947	-65.87181	Potential Reference Site
10	Little Bartibog River	LBR-DS	47.11444	-65.38700	Potential Reference Site

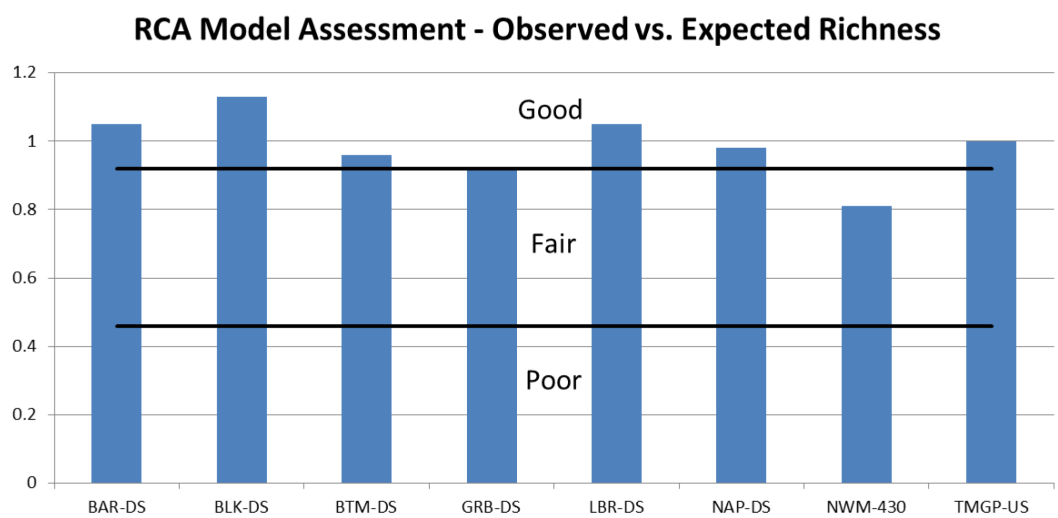
The benthic macroinvertebrate samples were sent to a professional taxonomist for identification. Two of the sites above (BDV-DS and DUN-DS) are part of the Environment Canada reference network and as such the water chemistry analysis and benthic processing are their responsibility and will be therefore excluded from this synopsis.

The Reference Condition Approach (RCA) assessment and running of the Atlantic Reference Model (ARM) was performed using GenGIS and R computer software program/plugin. This allowed for a comparison of the "Observed vs. Expected" benthic macroinvertebrate community at each of the 56 CABIN sites.

3.0 Results

The following figure illustrates the RCA Model Assessment – Observed vs. Expected Richness results for all of the eight MREAC CABIN sites (Figure 3.1).

Figure 3.1: RCA Assessment Using ARM



MREAC richness and abundance were also calculated directly from the taxonomic counts at each site and compared to the "Normal Range", as determined from the 25th to 75th percentiles (Figure 3.2), (Figure 3.3).

Figure 3.2: MREAC Richness Assessment

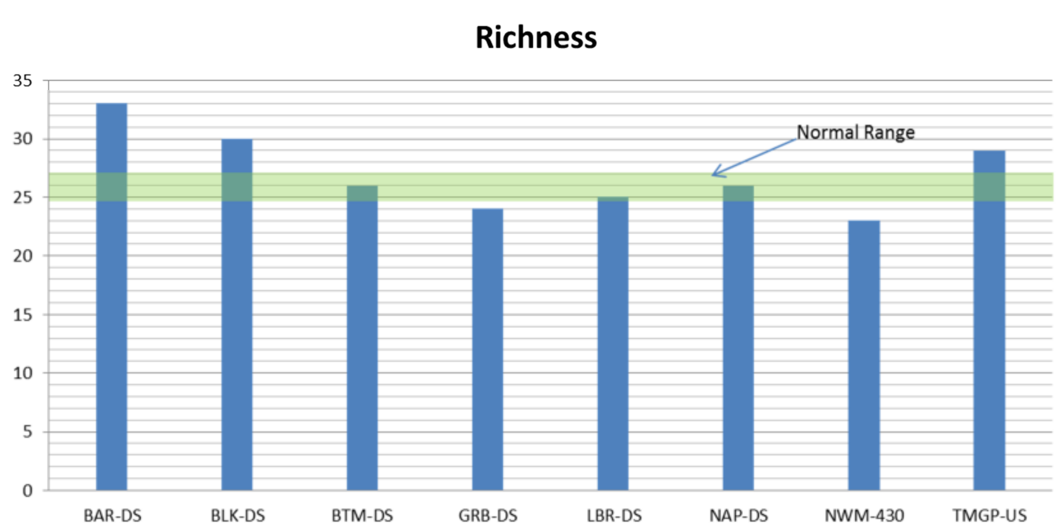
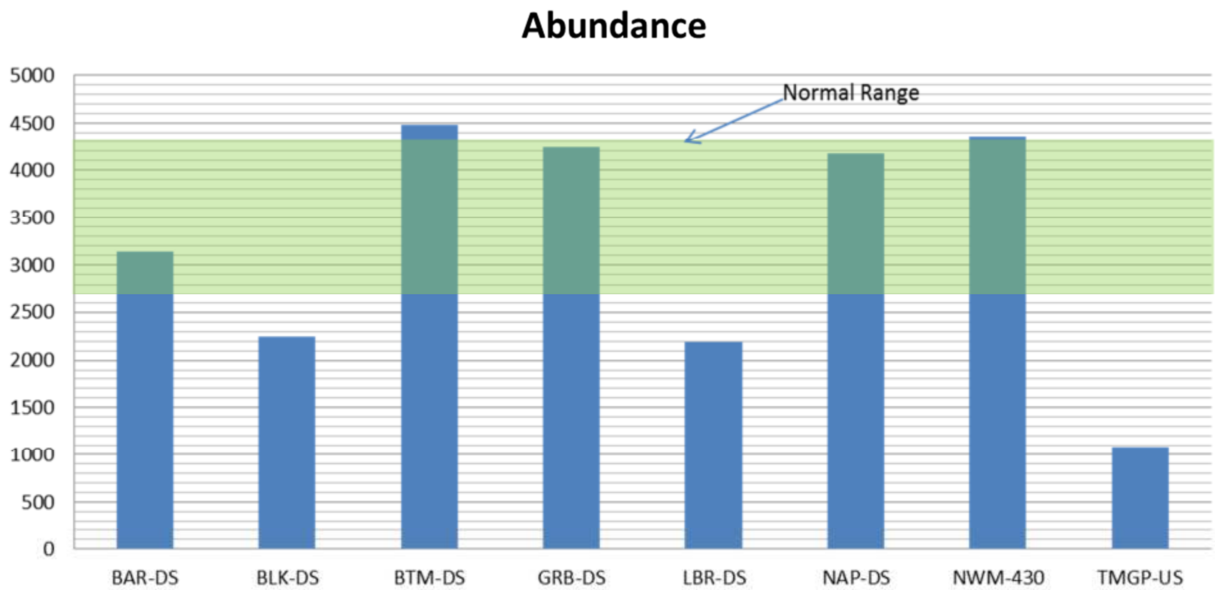


Figure 3.3: MREAC Abundance Assessment



The following figures illustrate the taxonomic composition of the benthic macroinvertebrate community and also examine the proportion of non-tolerant to pollution taxa [Ephemeroptera, Plecoptera, and Trichoptera (EPT)] to tolerant to pollution taxa (Diptera), (Figure 3.4) to (Figure 3.11).

Figure 3.4: Barnaby River Taxonomic Composition & EPT vs. Diptera

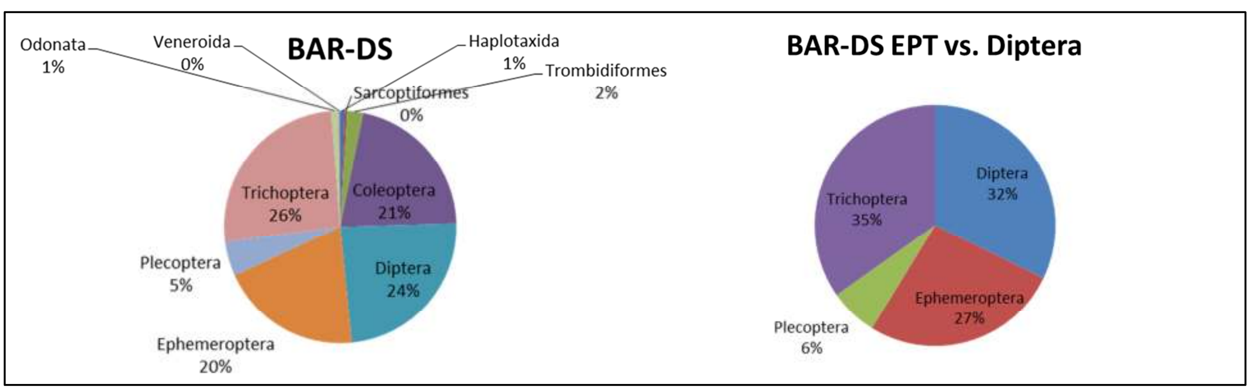


Figure 3.5: Black River Taxonomic Composition & EPT vs. Diptera

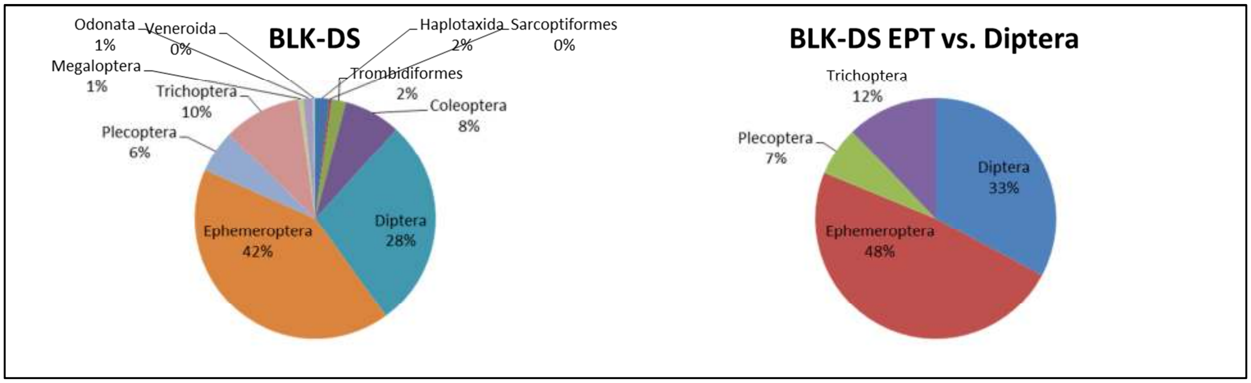


Figure 3.6: Bartholomew River Taxonomic Composition & EPT vs. Diptera

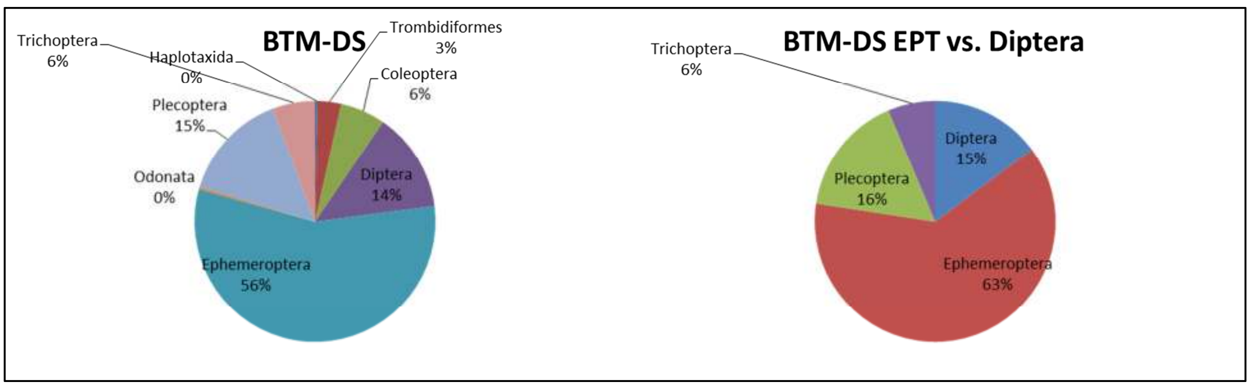


Figure 3.7: Green Brook Taxonomic Composition & EPT vs. Diptera

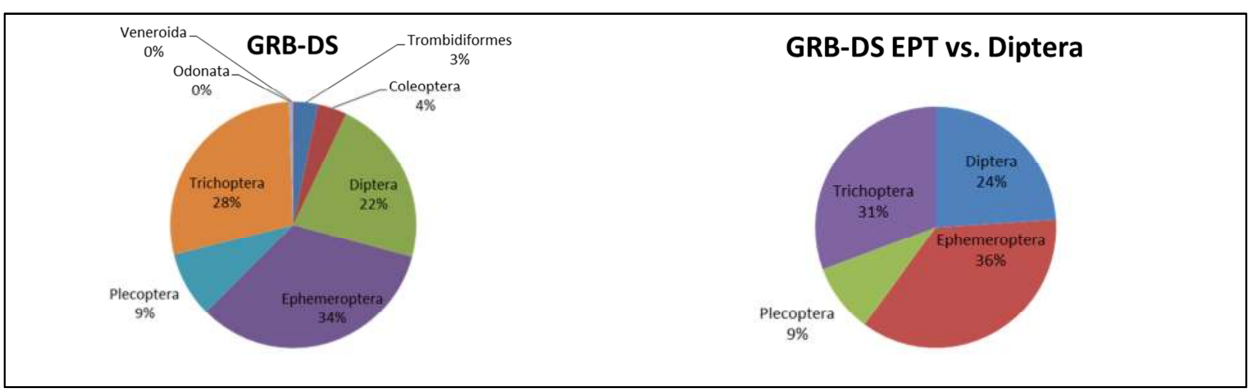


Figure 3.8: Little Bartibog River Taxonomic Composition & EPT vs. Diptera

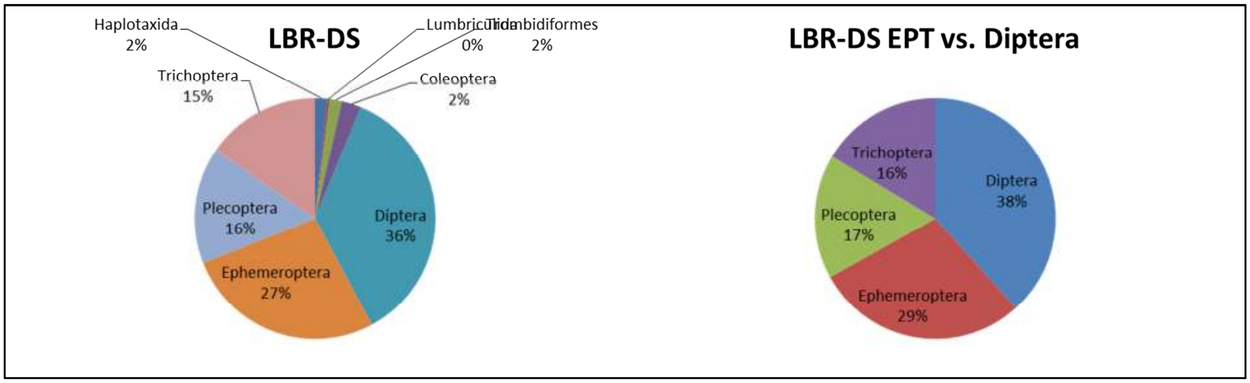


Figure 3.9: Napan River Taxonomic Composition & EPT vs. Diptera

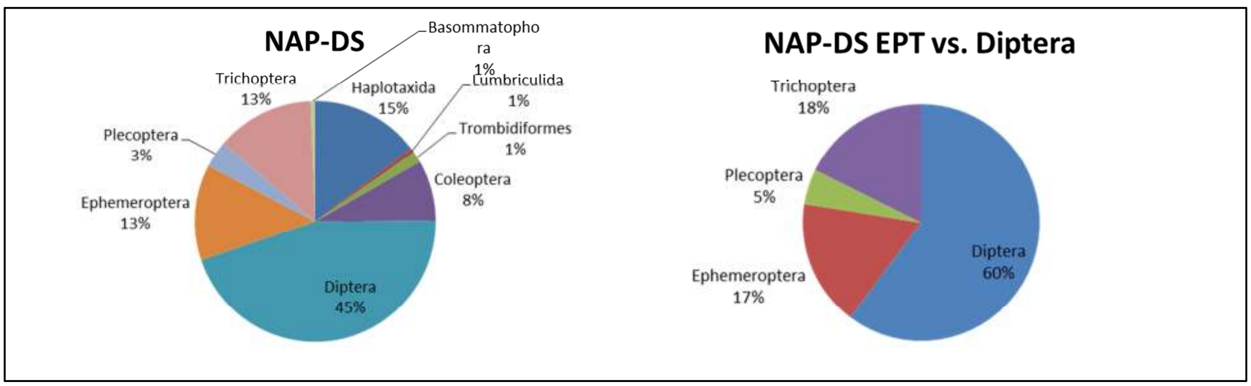


Figure 3.10: Northwest Miramichi River Taxonomic Composition & EPT vs. Diptera

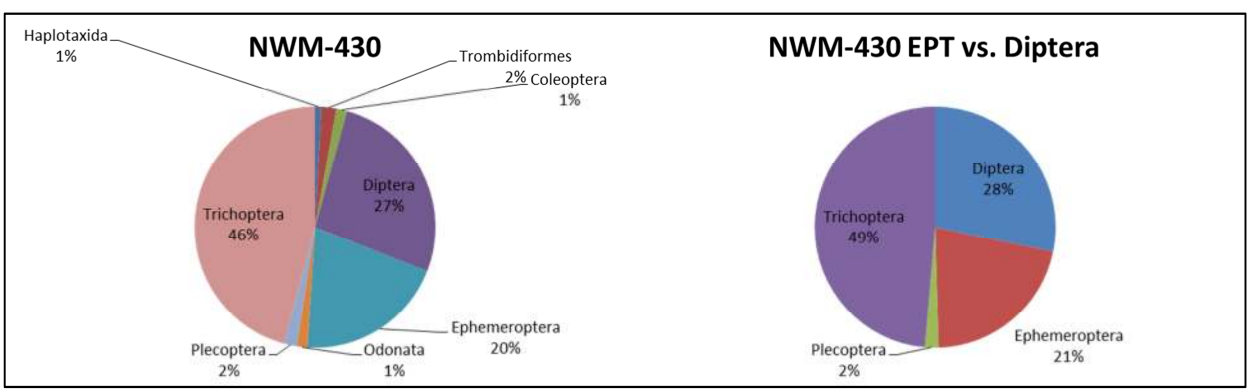
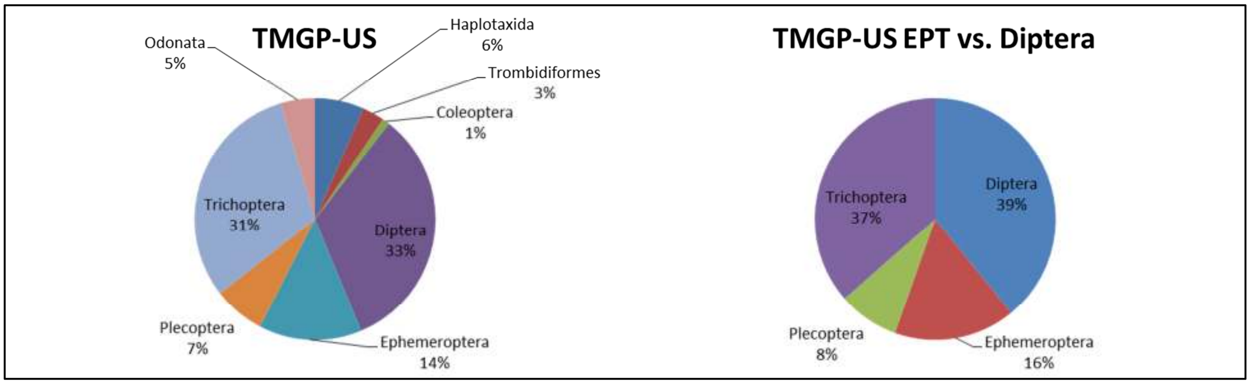
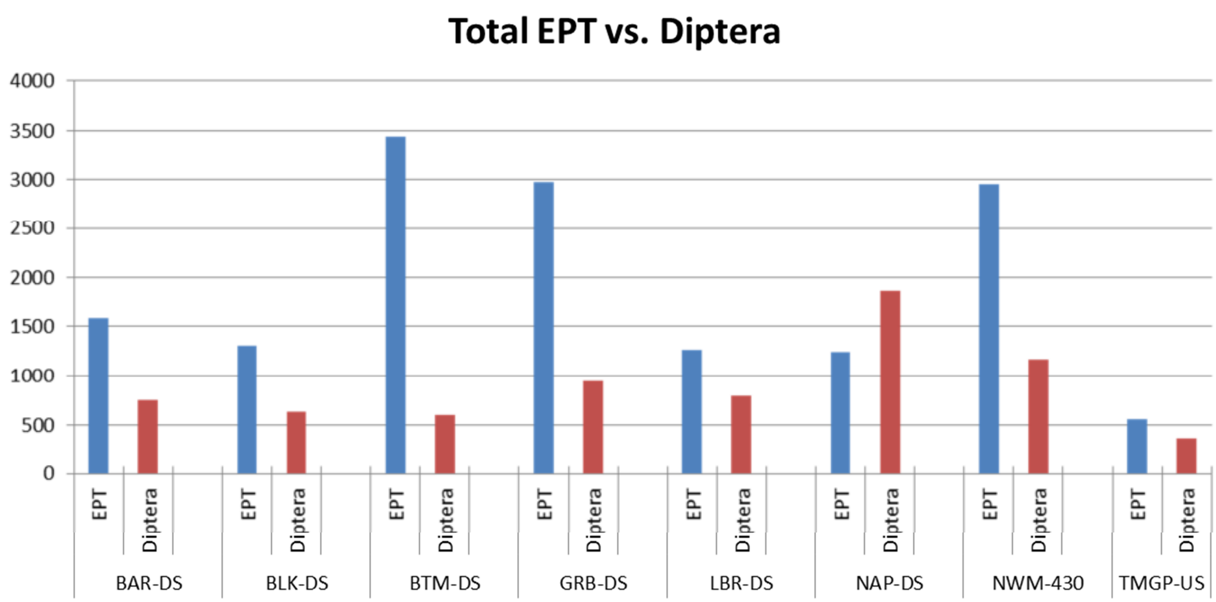


Figure 3.11: Tomogonops River Taxonomic Composition & EPT vs. Diptera



The following figure is a summary and illustrates the EPT taxa vs. Diptera for all of the eight MREAC CABIN sites (Figure 3.12).

Figure 3.12: EPT vs. Diptera (Summary)



The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.13), and also show other RCA outputs for ACAP Cape Breton (Table 3.1).

Figure 3.13: ACAP Cape Breton RCA Results O/E Richness

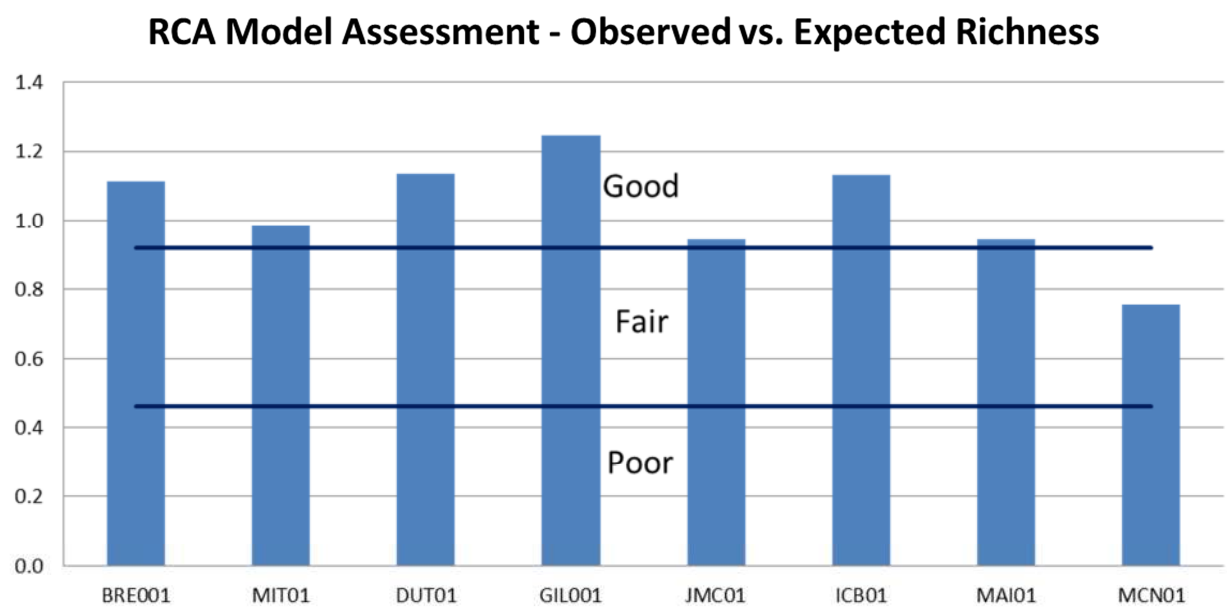


Table 3.1: ACAP Cape Breton Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Simpson	O/E Shannon	O/E Pielou
BRE001	1.11	1.19	1.13	1.16	1.13
MIT01	0.99	0.71	0.87	0.92	0.88
DUT01	1.14	1.03	1.09	1.23	1.07
GIL001	1.25	0.88	0.99	1.06	0.97
JMC01	0.94	1.73	1.34	1.51	1.42
ICB01	1.13	1.25	1.19	1.24	1.14
MAI01	0.94	1.36	1.25	1.35	1.27
MCN01	0.76	1.48	1.25	1.29	1.25

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.14), and also show other RCA outputs for ACAP Humber Arm Environmental Association (Table 3.2).

Figure 3.14: ACAP Humber Arm Environmental Association RCA Results O/E Richness

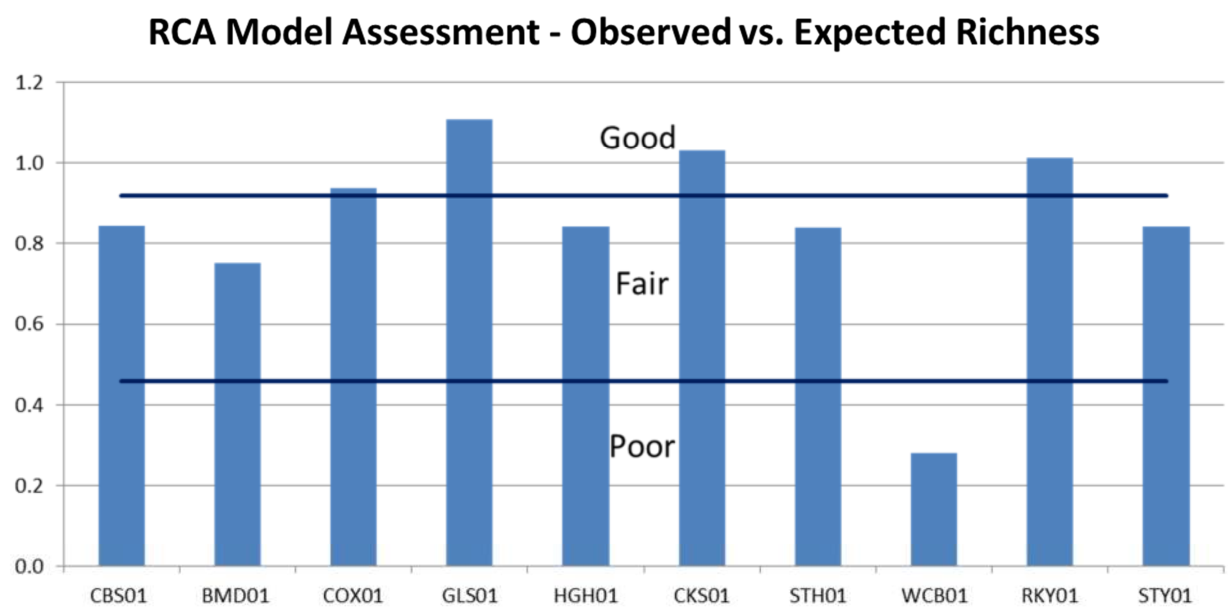


Table 3.2: ACAP Humber Arm Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Simpson	O/E Shannon	O/E Pielou
CBS01	0.84	1.12	1.09	1.02	1.01
BMD01	0.75	0.84	0.80	0.59	0.73
COX01	0.94	1.18	1.15	1.15	1.12
GLS01	1.11	0.92	1.01	1.02	1.01
HGH01	0.84	1.49	1.24	1.25	1.27
CKS01	1.03	1.27	1.17	1.12	1.09
STH01	0.84	1.24	1.17	1.16	1.20
WCB01	0.28	1.11	1.00	0.80	0.89
RKY01	1.01	1.18	1.05	0.97	1.02
STY01	0.84	1.09	1.05	0.96	0.98

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.15), and also show other RCA outputs for Bedeque Bay Environmental Management Association (Table 3.3).

Figure 3.15: Bedeque Bay Environmental Management Association RCA Results O/E Richness

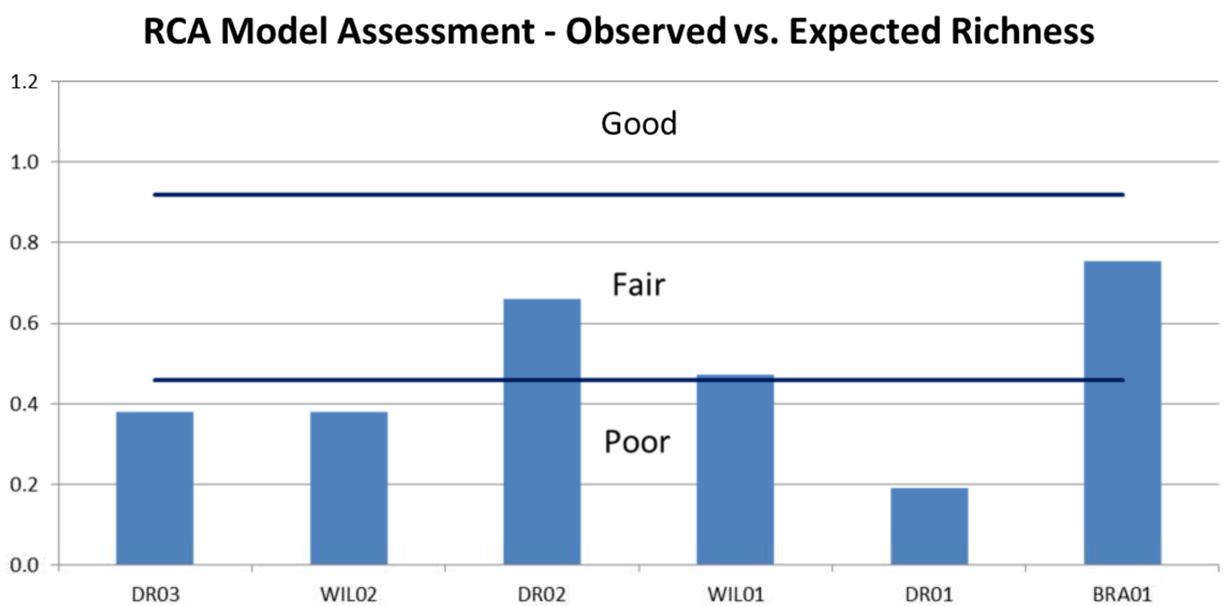


Table 3.3: Bedeque Bay Environmental Management Association Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Shannon	O/E Pielou	O/E Simpson
DR03	0.38	0.57	0.61	0.74	0.68
WIL02	0.38	0.57	0.42	0.53	0.62
DR02	0.66	1.16	0.83	0.89	0.98
WIL01	0.47	1.09	0.85	0.96	1.02
DR01	0.19	0.05	0.09	0.12	0.07
BRA01	0.75	1.57	1.21	1.20	1.24

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.16), and also show other RCA outputs for Friends of Kouchibouguacis (Table 3.4).

Figure 3.16: Friends of Kouchibouguacis RCA Results O/E Richness

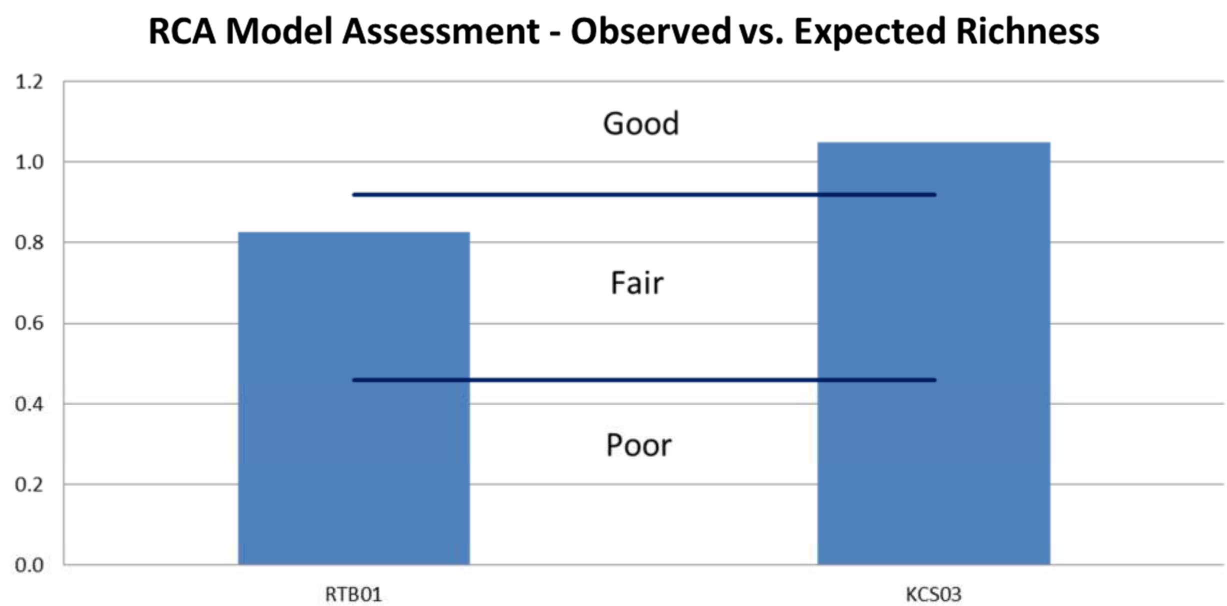


Table 3.4: Friends of Kouchibouguacis Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Shannon	O/E Pielou	O/E Simpson
RTB01	0.83	0.84	0.90	0.96	0.94
KCS03	1.05	1.37	1.24	1.19	1.19

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.17), and also show other RCA outputs for Morell River Management Co-op (Table 3.5).

Figure 3.17: Morell River Management Co-op RCA Results O/E Richness

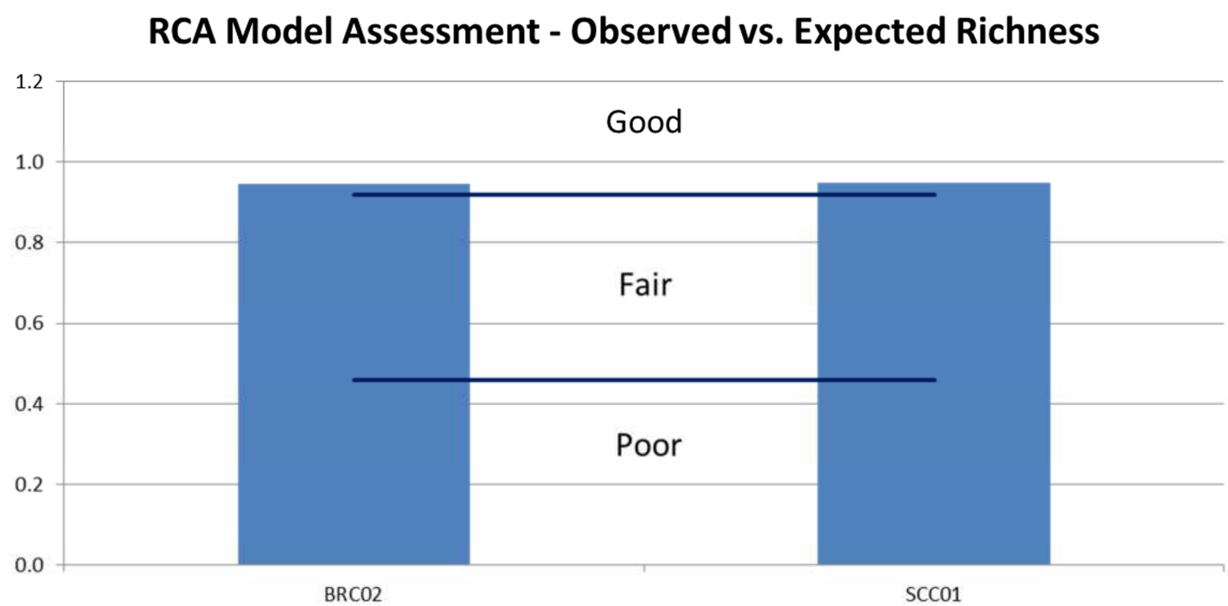


Table 3.5: Morell River Management Co-op Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Simpson	O/E Pielou	O/E Shannon
BRC02	0.95	1.42	1.24	1.19	1.27
SCC01	0.95	1.46	1.23	1.18	1.20

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.18), and also show other RCA outputs for Northeast Avalon ACAP (Table 3.6).

Figure 3.18: Northeast Avalon ACAP RCA Results O/E Richness

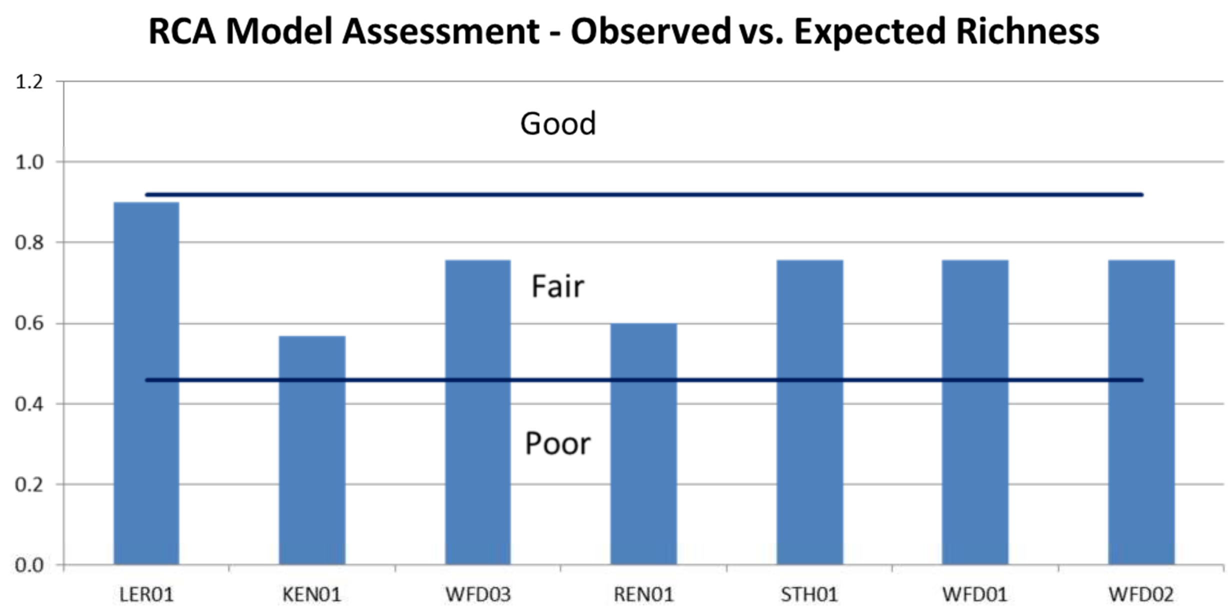


Table 3.6: Northeast Avalon ACAP Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Shannon	O/E Pielou	O/E Simpson
LER01	0.90	1.52	1.19	1.28	1.23
KEN01	0.57	1.08	0.82	0.96	0.99
WFD03	0.76	0.78	0.81	0.89	0.87
REN01	0.60	0.79	0.78	0.95	0.87
STH01	0.76	1.56	1.27	1.39	1.27
WFD01	0.76	1.33	1.19	1.24	1.21
WFD02	0.76	1.47	1.22	1.25	1.24

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.19), and also show other RCA outputs for Shediac Bay Watershed Association (Table 3.7).

Figure 3.19: Shediac Bay Watershed Association RCA Results O/E Richness

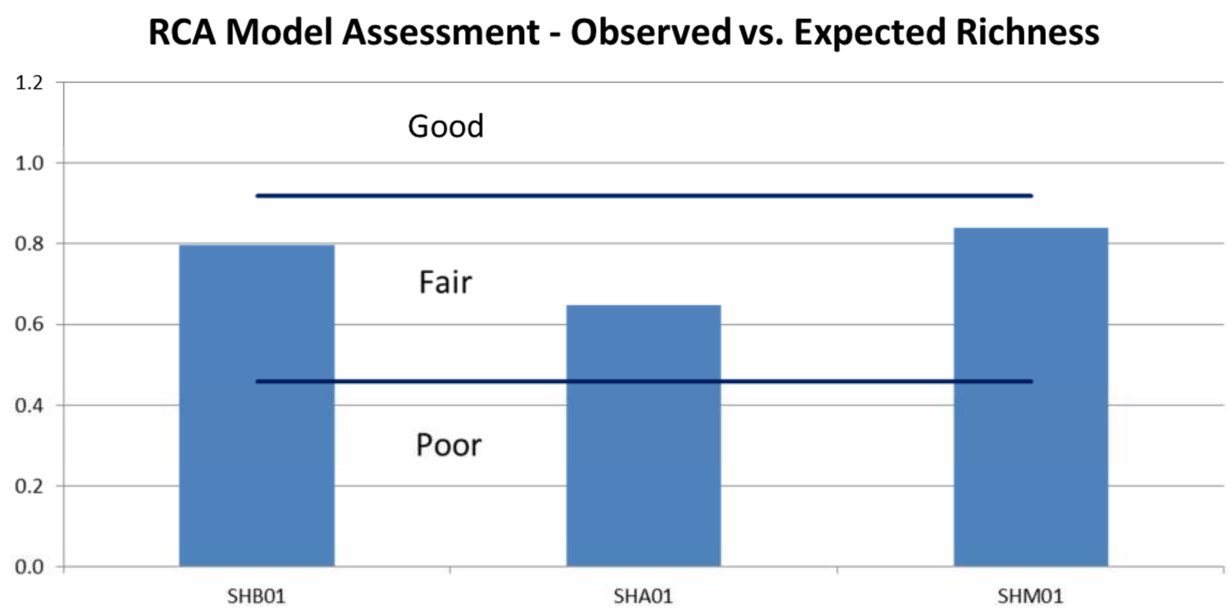


Table 3.7: Shediac Bay Watershed Association Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Simpson	O/E Pielou	O/E Shannon
SHB01	0.80	1.52	1.26	1.31	1.30
SHA01	0.65	1.36	1.16	1.13	1.10
SHM01	0.84	1.33	1.17	1.11	1.13

The following Reference Condition Approach (RCA) assessment results illustrate the findings for Observed vs. Expected Richness (Figure 3.20), and also show other RCA outputs for Southeast Environmental Association (Table 3.8).

Figure 3.20: Southeast Environmental Association RCA Results O/E Richness

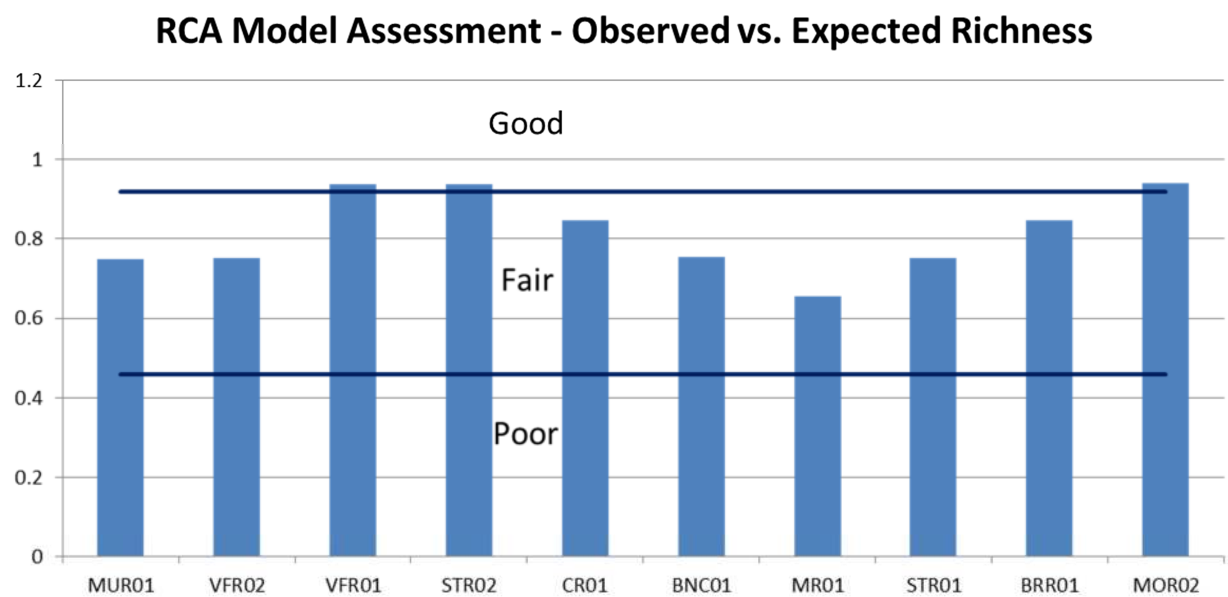
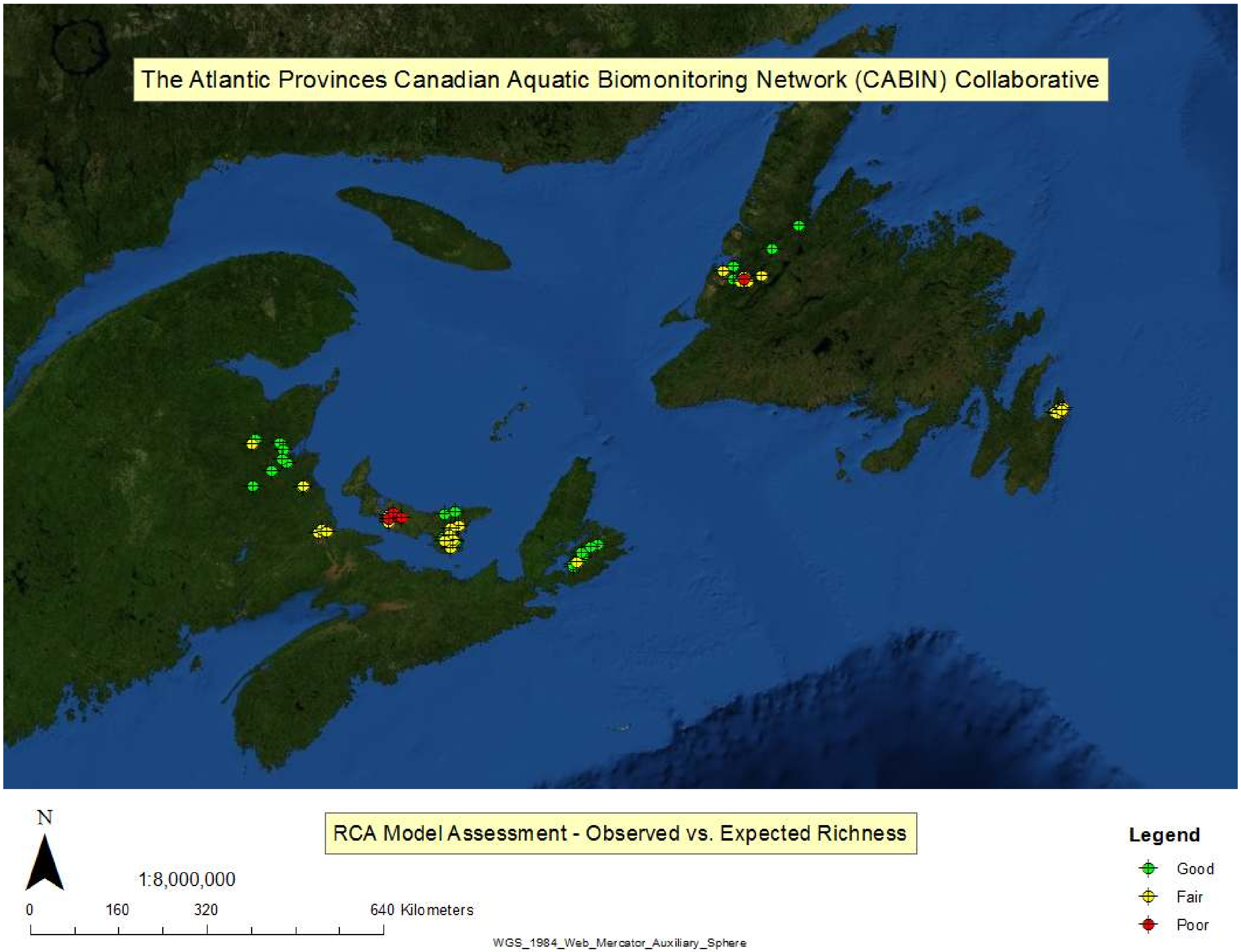


Table 3.8: Southeast Environmental Association Other RCA Outputs

Site_Ids	O/E Richness	O/E Berger_Parker	O/E Simpson	O/E Pielou	O/E Shannon
MUR01	0.75	1.47	1.21	1.16	1.18
VFR02	0.75	1.58	1.28	1.29	1.31
VFR01	0.94	1.49	1.22	1.20	1.19
STR02	0.94	1.49	1.28	1.33	1.39
CR01	0.85	1.06	1.03	0.97	0.96
BNC01	0.75	1.29	1.16	1.13	1.07
MR01	0.66	1.34	1.12	1.00	1.01
STR01	0.75	1.36	1.15	1.08	1.00
BRR01	0.85	1.02	1.03	0.92	0.95
MOR02	0.94	1.03	1.04	0.98	0.98

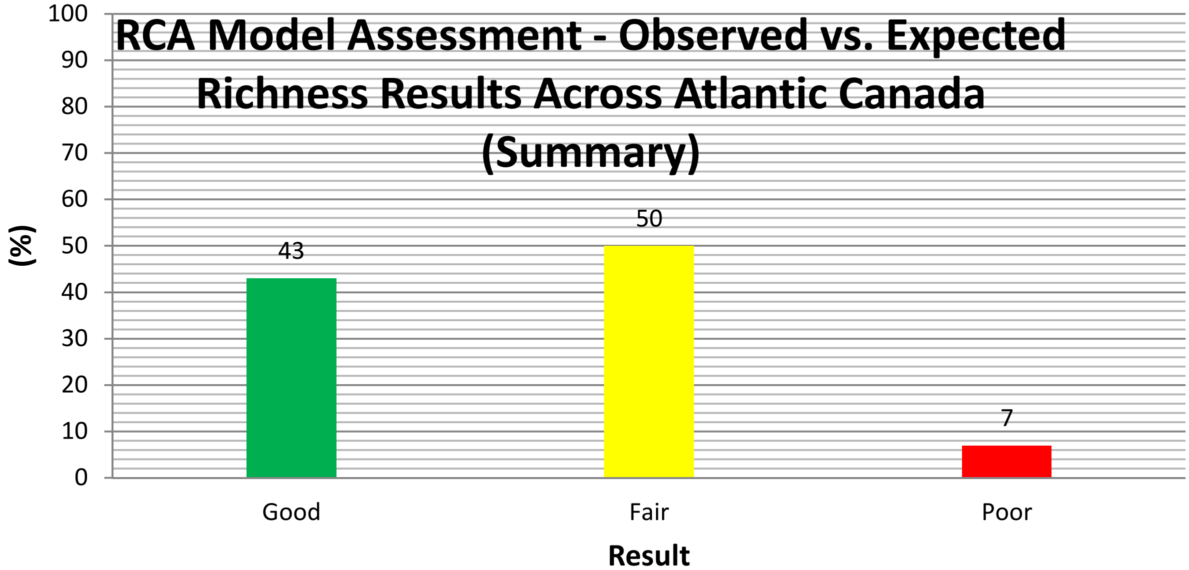
The following figure illustrates the RCA Model Assessment – Observed vs. Expected Richness results for the 56 sites across Atlantic Canada (Figure 3.21).

Figure 3.21: RCA Model Assessment – Observed vs. Expected Richness Results Across Atlantic Canada



The following figure is a summary of results for the RCA Model Assessment – Observed vs. Expected Richness for the 56 sites across Atlantic Canada (Figure 3.22).

Figure 3.22: RCA Model Assessment – Observed vs. Expected Richness Results Across Atlantic Canada (Summary)



4.0 Discussion

The RCA Model Assessment – Observed vs. Expected Richness results indicate that six of the eight MREAC sites were considered "Good", GRB-DS bordered "Good" and "Fair", and NWM-430 was considered to be "Fair". None of the sites were considered to be in the "Poor" range (Figure 3.1).

MREAC richness results corroborates with the RCA model assessment using ARM by indicating that GRB-DS and NWM-430 are indeed below the normal range and considered to be of lower taxa richness (Figure 3.2).

For total abundance, BLK-DS, LBR-DS, and TMGP-US were below the normal range and had lower taxa abundance. This could be the result of low productivity in the river. The remaining MREAC sites were within or slightly above the normal range and considered to be productive rivers. Based on the data, none of the rivers were found to be in overabundance in macroinvertebrate biomass (Figure 3.3).

The Barnaby River (BAR-DS) benthic macroinvertebrate taxa appear to be in proportion and not favouring any one particular taxon. The higher EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa (Figure 3.4).

The Black River (BLK-DS) benthic macroinvertebrate taxa appear somewhat in proportion, but slightly favouring the Ephemeroptera taxon. The higher EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa (Figure 3.5).

The Bartholomew River (BTM-DS) taxa community appears to be skewed favouring the Ephemeroptera community while having a very low tolerant to pollution community. However, the very high EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa (Figure 3.6).

Based on a number of reference sites, it is believed that the Miramichi watershed Ephemeroptera population is naturally more abundant.

The Green Brook (GRB-DS) taxa community appears to be in proportion and not favouring any one particular taxon. The very high EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa (Figure 3.7).

The Little Bartibog River (LBR-DS) taxa community appears to be somewhat in proportion and not favouring any one particular taxon. The higher EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa (Figure 3.8).

Although the percentage of Diptera taxa appears to be slightly elevated, it is worth noting that this site has a large population of very sensitive to pollution taxa, the Plecoptera taxon.

The Napan River (NAP-DS) taxa community appears to be out of proportion and favouring the Diptera taxon. The lower EPT percentage and the very high Diptera percentage seem to indicate a poor aquatic environment favouring the tolerant to pollution taxa (Figure 3.9).

The Northwest Miramichi River (NWM-430) taxa community appears to be out of proportion and favouring the Trichoptera taxon. Although the site has a very high EPT percentage, there seems to be an imbalance in the community and further investigation is therefore recommended (Figure 3.10).

The Tomogonops River (TMGP-US) taxa community appears to be somewhat in proportion. Although the Diptera taxon is just slightly elevated, the high EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa (Figure 3.11).

Based on the summary of results for the RCA Model Assessment – Observed vs. Expected Richness for the 56 sites across Atlantic Canada, 43% of the sites were considered "Good", 50% of the sites were considered "Fair", and 7% of the sites were considered "Poor" (Figure 3.22).

It should be noted that a comprehensive interpretation of the results is beyond the scope of this synopsis, and each MREAC ENGO partner is encouraged to analyse and interpret the results further in order to get a better understanding of the quality of their sites sampled. This synopsis primarily focuses on MREAC CABIN sites and data.

5.0 Conclusion

From all the available results for MREAC it can be concluded that of the eight sites sampled NAP-DS on the Napan River seems to show a disproportionate balance in the taxonomic community greatly favouring the tolerant to pollution taxa. Although slowly minimizing, nutrient loading with high total coliform and *E.coli* counts is a known issue at this site. Annual water quality sampling and monitoring continues on the Napan River and its tributary Whites Brook.

NWM-430 on the Northwest Miramichi River is of concern as well. The taxa community appears to be out of proportion and favouring the Trichoptera taxon. Although the site has a very high EPT percentage, there seems to be an imbalance in the community. Further investigation is recommended as this CABIN site is located near an illegal camping area. Although not apparent from the current analytical water chemistry results, seasonal nutrient loading could be suspect.

Based on the RCA Model Assessment – Observed vs. Expected Richness results throughout Atlantic Canada for all of the 56 sites it can be concluded that more than half of the CABIN sites (57%) were not considered Good and were in the Fair to Poor range, while 43% of the sites were in the Good range.

It is strongly recommended that a more thorough investigation is performed by each ENGO partner, and they are highly encouraged to look closely at their sites taxonomic composition and EPT vs. Diptera counts for a more in-depth analysis of their CABIN sites.