

Looking Inward, Looking Outward: Citizen science in the Bras d'Or Lake Biosphere

Annamarie Hatcher, Ph.D. Unama'ki College, Cape Breton University
P.O. Box 5300, 1250 Grand Lake Road, Sydney, N.S., Canada, B1P 6L2

Email: Annamarie_hatcher@cbu.ca

ABSTRACT: The Bras d'Or Lake and watershed is a 3,566 km² region of forest, freshwater and marine ecosystems in the centre of Cape Breton Island, Nova Scotia, Canada. The estuary occupies 31% of the Bras d'Or Lake Biosphere and the watershed is thinly populated, with about 6 human residents per square kilometer (2006 census). The evolving Bras d'Or Watch program which is at the nexus of citizen science and public education seeks to strengthen the human-habitat bond among participants by:

1. *providing a forum for citizens to interact with their place*
2. *networking citizens who want to strengthen their bond with place*
3. *matching residents with scientists and historians who can share their knowledge of place*

The Bras d'Or Watch has a diversity of drivers and of anticipated outcomes. In the further development of the program, the goal is to blend ecosystem monitoring and observation based on connection to 'place' to develop an ecosystem-level synopsis (looking inward) which can be used to gauge response to aspects of global climate change (looking outward). Bras d'Or Watch is all about developing the tools to allow us to see and hear what Mother Earth is showing and telling us. This article serves to outline the early development of this program.

Keywords: public education, citizen science, topophilia, ecosystem health, ecosystem monitoring

Introduction

The basic tenets of the UNESCO Man in the Biosphere program (biodiversity conservation, sustainable development and support for education and research) are underpinned by a meaningful connection between the ecosystem and the people that are part of it. The Bras d'Or Lake Biosphere Reserve is a unique

estuarine system immersed in strong and vibrant Mi'kmaw, Gaelic and Acadian cultures. Each of these cultures is deeply connected to this place. However, the current climate of global warming is causing change at an uncomfortably rapid pace and a more frequent re-acquaintance with 'place' is a strategy to reinforce the basic tenets. To accomplish this goal, the Bras d'Or Lake Biosphere Reserve Association has launched a program called 'Bras d'Or Watch'. This program is developing partly as an outreach activity and partly as a vehicle for citizens and visitors to accurately observe change in the ecosystem using an annual 'report card' approach. This article outlines the early development of the program on a small budget with an army of committed volunteers.

The Bras d'Or Lake Biosphere

The Bras d'Or Lake and watershed is a 3,566 km² region of forest, freshwater and marine ecosystems in the centre of Cape Breton Island, Nova Scotia, Canada. The estuary occupies 1,109 km² (31 percent) of the area, with the rest of the 2,474 km² constituting the watershed (catchment area). According to the 2006 census, the Biosphere is home to 14,579 human inhabitants. Although there is no reliable record of the summer population residing along the Lake, the estimated number of summer residences is in the range of 2,000. The length of the coastline of the Lake is approximately 1,230 km. The two largest settlements in the area of the Bras d'Or Lake Biosphere Reserve are the town of Baddeck and the Mi'kmaw community of Eskasoni. Mi'kmaq were the first peoples of the Bras d'Or Lake Biosphere and the largest community is nestled on the shores of the estuary (Eskasoni). The population of the four Mi'kmaw communities within the Biosphere was 4,240 in the 2006 census, and the population is growing rapidly. The watershed includes a number of small towns, mainly along the coast of the

Lake, with populations of several hundred each. Many of these communities are quite insular and have little interaction with other communities. Cultural histories are vibrant, with Gaelic, Acadian and Mi'kmaw identities often defining geographic boundaries.

On July 1, 2011 the Bras d'Or Lake received UNESCO Biosphere designation as Canada's 16th Biosphere Reserve. The designation of the Bras d'Or Lake as a UNESCO Biosphere Reserve site is the result of a highly collaborative process that started in 2005 involving First Nations representatives, Federal and provincial agencies, academics and nearly fourteen thousand (14,000) citizens in the region. The focus of the UNESCO Mab in the Biosphere program is about balancing the needs of people with the needs of the environment. The pillars of the program are conservation, sustainable economic development and capacity building through education and research. This umbrella unites a community of practice (Bras d'Or Watch) in the Bras d'Or Lake Biosphere Reserve which is composed of people and organizations that would normally have little interaction. Organizations that have contributed volunteers and equipment for the developing Bras d'Or Watch include government (Cape Breton Regional Municipality, Richmond County), post-secondary institutions (Cape Breton University), Mi'kmaw organizations (Eskasoni Fish and Wildlife Commission, the Unama'ki Institute of Natural Resources), ACAP Cape Breton (Centre for Sustainable Communities), and other small businesses and community groups (Baddeck boatyard, Ben Eoin RV Park, Aros Na Mara, Grand Narrows Waterfront Redevelopment Society). One of the goals of the evolving Bras d'Or Watch is to forge a connection among communities under the common umbrella of learning about the ecosystem that they all share. In the process of this exercise, we hope to learn more about each other. The sites for the initial Bras d'Or Watch are positioned in the location map in **Figure 1**.

Looking inward: Connecting to 'place'

It has been recognized in many fora that there is a basic human need to connect with their natural surroundings. The association between people and their place has been called 'topophilia,' a term coined in 1947 by W.H. Auden, a poet (Mendelson, 2002). This could be viewed as human-habitat bonding. Over evolutionary time, humans have been successful amidst periods of significant environmental upheaval because of their

adaptation to place. Late Pleistocene hunter-gatherers did not depend on ecological domination to successfully colonize the globe, as has been commonly proposed. Instead, they were probably successful because of place-based cultural evolution (Sampson, 2012). The term 'endemophilia' has been coined to describe a person's immersion in the locally distinctive elements of place (Albrecht, 2012) and it is a relationship that can influence mental health. The evolving Bras d'Or Watch program seeks to strengthen the human-habitat bond among participants by:

- 1. providing a forum for citizens to interact with their place*
- 2. networking citizens who want to strengthen their bond with place*
- 3. matching residents with scientists and historians who can share their knowledge of place*

Looking outward: Ecosystem health and 'place'

Is the Bras d'Or Lake Biosphere 'healthy'? During the initial Bras d'Or Watch field days, many participants asked that question. There are two distinct paths to develop a report card on an ecosystem that enables a synoptic assessment of ecosystem health. The first is through rigorous, objective data collection by trained scientists using specialized equipment. Ideally, accurate data collected throughout this process is statistically summarized and presented in a standard format with publication in peer-reviewed international journals usually categorized by discipline. The second path is through an examination of LEK (local ecological knowledge) or TEK (traditional ecological knowledge) which involves less clearly defined methods of data collection underlain by a deep connection of humans with their natural surroundings. The summarization of data during this process is more personal, relying on the sensory inputs, cultural knowledge and memory of the observer. It is this path that we follow when we decide where and when to go fishing in the spring or to gather wild food such as fiddleheads and blueberries. It is this path that encompasses the wealth of knowledge referred to as TEK and in the Bras d'Or Lake Biosphere MEK 'Mi'kmaw Ecological Knowledge'. In the further

development of Bras d'Or Watch, the goal is to blend the two paths to develop an ecosystem-level synopsis (looking inward) which can be used to gauge response to aspects of global climate change (looking outward). This is not a simple task.

One Thousand Eyes: Nature as an architect of science learning

The initial development of Bras d'Or Watch was inspired by an early program in Nova Scotian schools called 'One Thousand Eyes'. Guiding a connection of people to place seems like a modern need, fueled by the obsessive connection between humans and electronic devices. Long before the invention of the cell phone, this need to connect with nature fueled an inspirational program launched in the early twentieth century in Nova Scotia by an educator named Alexander Howard MacKay. MacKay was born in 1848 in Plainfield, Nova Scotia. In 1891 he began a 35-year term as superintendent of education for Nova Scotia and during that time he instituted a program of phenological observation for rural schoolchildren (Guildford, 2003). This program required students to note the first appearance of botanical phenomena during the year and to provide the information to the teacher. This program, called 'One Thousand Eyes' nurtured close ties to place in thousands of schoolchildren across the province. The role of nature as the architect of science learning rather than a constructed laboratory was in direct contrast to the current ways of thinking in education at that time. The Nova Scotia Museum of Natural History holds MacKay's collection of these reports from 1898 to 1923. The database was recognized in the 1990s as a globally-significant benchmark for assessing climate change" (Fenech, 2005; Zwarenstein, 2010, Zeller, 2015). How could we develop a similar program in the Bras d'Or Lake Biosphere? The observers are not captive school children but interested people of all ages and backgrounds. The co-ordinators are not trained school teachers but a committed group of engaged local community leaders and post-secondary students. As a result, the ongoing development process is fluid and organic at the nexus of citizen science and public education.

Citizen Science

The participants in Bras d'Or Watch are citizen scientists. Citizen science is an effective approach to learn about the environment because it often includes

specific and measurable goals to focus on (Reynolds and Lowman, 2013). Citizen science can be defined as the involvement of citizens from the nonscientific community in academic research and monitoring (Trumbull et al. 2000, Lee et al. 2006). It is a field that is undergoing rapid growth worldwide. It has been determined, based on many citizen science programs that success is built upon: (1) a simple monitoring system; (2) adequate training of volunteers and participants; and (3) providing all volunteers with timely feedback on their work. These requirements underpin the Bras d'Or Watch program. Many studies have shown that an increased involvement in stewardship and conservation activities result when volunteers are engaged in a citizen-based monitoring or research program. This may be a genuine revolution in 'science' that democratizes the important social role of learning about our natural world (*Working Group Synthesis Report www.citizenscience.org/conference; Citizen Science Toolkit Conference June 20th-23rd, 2007, Ithaca, NY*)

Bras d'Or Watch: Citizen Science or Outreach?

Originally the stated goal of Bras d'Or Watch was to set up a network of engaged citizen who would monitor basic estuarine properties such as salinity and temperature in waters surrounding their own back yards. An inaugural field day was set up for July 16, 2015 and six sites were chosen with the aim of taking measurements simultaneously with broad geographic coverage. To provide opportunities for a wide range of participants, several data collection and identification sheets were prepared which ranged from counting targeted invasive species (**Figure 2**) to providing a summary of nearshore water salinity and temperatures (**Figure 3**). All data collection was to take place in shallow inshore waters or on the adjacent beach and headland areas. The sites in the Bras d'Or estuary were in East Bay, Eskasoni, St. Peter's, Whycocomagh, Grand Narrows and Baddeck, which are up to 50 km apart by road. Local communities hosted the event and scientists and students from Cape Breton University, ACAP Cape Breton (Centre for Sustainable Communities) or within the Bras d'Or Lake Biosphere Reserve Association were recruited to supervise each of the sites. The local papers and radio stations publicized the event and many people participated (**Figure 4**). Data was collected and a synopsis produced and published in the local newspaper (**Figure**

5). More importantly, neighbours shared a mutual interest in learning about their place.

The Bras d'Or Watch field day is equivalent to speed dating. Acquaintances are made and connections among people and environment strengthened. A core group returned for Bras d'Or Watch field day on July 17, 2016 but participation dropped considerably from the previous year. This led to reflection about the goals of the program. Is the main goal the collection of accurate scientific data? Are we defining a goal related to accurate monitoring or to educational outreach, or both? Connecting an army of citizen scientists across the large distances in this Biosphere required an enhancement of the outreach. Participants who were engaged in 2015 did not return in 2016 because they had 'already done that'. The current evolution of the program is guided by the passions of the volunteers and feedback from participants with an eye toward the constraints imposed by the large size of the Biosphere and the long distances between communities.

Evolution and Devolution of Bras d'Or Watch

Based on the experience during the two Bras d'Or Watch field days, stakeholders have defined the ways forward for this developing program. Bras d'Or Watch is now splitting into three related but separate components. The **Field Day (Blitz)** is aimed at public education and celebration of the ecosystem. This is a coming together of interested people who want to learn more about the ecosystem in a social setting. It provides a focus for public education and an incentive for citizen engagement. Each summer we will present a different theme (ie: bird surveys, alien species spotting etc.). The primary goal is not data collection although many observations may be used in the compilation of the report card. The second component for this Bras d'Or Watch program is **Monitoring** (scientifically-defensible data to be submitted and analyzed). These data will form the core of the report card. To achieve broader geographic and seasonal coverage, interested citizen monitors emerge around the field day. This type of engagement was noted during the first two field days. Those citizen monitors were often people who own property on or near the shore and are interested in keeping in closer touch with their immediate surroundings. They travelled to one (or more) of the six Bras d'Or Watch field sites to find about the project. In the evolving Bras d'Or Watch,

these volunteers will be armed with equipment, instruction and a portal to submit data at any time. We will enable a similar sort of engagement between school groups and their nearby shores. Equipping these citizens and school groups with equipment and information on the significance of their efforts encourages human-habitat bonding. School groups can participate with a trained teacher at the teacher's convenience. The information packages will also engage residents and visitors to watch for 'sentinels', or invasive species such as the European green crab and the Asian shore crab. The third component for the evolving Bras d'Or Watch program will be a self-contained **Package for community groups**. These will be based on scavenger hunts and other light-hearted learning experiences. With the assistance of summer students, these exercises will be incorporated into community festivals.

Citizen-based monitoring: Accurate data for robust conclusions?

Maintaining interest and enthusiasm among citizen scientists to ensure data continuity and accuracy is necessary and challenging. Rapid and meaningful feedback is essential. Many citizen science projects have failed because volunteers feel that their input is flowing into an abyss from which it will never surface. The process of data collection and compilation from volunteers needs to be planned from the outset. When data are submitted digitally, this process is easy. Reports are almost instantaneous and available to stakeholders. This will be one route of many for the evolving Bras d'Or Watch. However, the network of neighbours will continue to meet in person and indulge in a less directed communication with their environment.

There have been many studies analyzing the accuracy of citizen-collected data (Shelton, 2013). Some environmental variables require a trained scientist. Dissolved oxygen is an example of a variable which can be problematic. Many environmental factors influence the concentration of dissolved oxygen so a trained eye is required to ensure representative sampling. In the Bras d'Or Watch program, the monitoring variables have been carefully chosen with regards to this concern. Temperature, pH and salinity are the core water measurements. These can be accurately taken by citizen scientists (Shelton, 2013) and are very informative. For example, water

temperature is one of the primary criteria used by governments to define habitat requirements for fish species, guiding habitat protection measures (Shelton, 2013 ; Plumb & Blanchfield, 2009).

Where to from here?

Based on feedback from citizens and educators in the Bras d'Or Lake Biosphere, new branches of the Bras d'Or Watch tree are sprouting. New initiatives that we will develop include an extension into the watershed forests with established monitoring protocols and a Secchi disc program in partnership with local marinas. A large diversity of types of forest monitoring programs are well-established in many other areas and protocols are available and robust. The Secchi disc is a device which is widely used by citizen scientists, environmental consultants and oceanographers. It is a visible disc that is lowered over the side of a boat. The depth of disappearance is directly related to water clarity. It is an inexpensive way to develop a powerful diagnostic which has been related to events such as erosion and runoff, sewage inputs and spring algal blooms. These programs will develop in parallel to the shore-based activities and all will contribute to the deepening relationship between the Bras d'Or Lake Biosphere and its' people.

Summary and Conclusions

Bras d'Or Watch is at nexus of citizen science and public education, representative of a genuine revolution in 'science' that democratizes the important social role of learning about our natural world. One of the goals of the evolving Bras d'Or Watch is to forge a connection among communities under the common umbrella of learning about the ecosystem that they all share. The multidimensional approach to summarize input and provide feedback is the 'report card'. This approach includes two paths of knowledge: scientifically-defensible data collection and LEK/ TEK (local and traditional ecological knowledge). Scientifically-defensible data can be collected electronically with high temporal and spatial coverage. Developing the lens to filter LEK is a more difficult process, requiring an orchestrated dance among researchers, residents, students and visitors. The incorporation of TEK is also challenging as it is a living knowledge embedded in culture and tradition and not necessarily parallel to the scientifically-defensible data or LEK. The ultimate goal of Bras d'Or

Watch is to engage all of these knowledges, enable a deeper engagement with ecosystem, and to develop the tools to allow us to see and hear what Mother Earth is showing and telling us

References

- Albrecht, G., 2012. "Psychoterratic conditions in a scientific and technological world," in *Ecopsychology: Science, Totems and the Technological Species*, ed. P.H. Kahn, P.H. and P. Hasbach , Cambridge: MIT Press, pp: 241-264.
- Fenech et al (2005). Impact of climate on changes in the seasonal timing of life cycle events of eastern Canada from 1901 to 1923. Integrated Mapping Assessment, Fenech A. et al. (eds.). Environment Canada, Toronto: 55-69.
- Guildford, J. ,2003. MacKay, Alexander Howard. Dictionary of Canadian Biography 15. University of Toronto/ Université Laval, Toronto and Quebec, accessed 16 October 2013 http://www.biographi.ca/en/bio/mackay_alexander_howard_15E.html
- Lee, T., M.S. Quinn, and D. Duke. 2006. Citizen science, highways, and wildlife: using a web-based GIS to engage citizens in collecting wildlife information. *Ecology and Society* 11(1):11. <http://www.ecologyandsociety.org/vol11/iss1/art11/>
- Mendelson, E., ed., 2002. *The Complete Works of W.H. Auden: Prose: Volume II: 1939-1948*, Princeton, N.J: Princeton University Press
- Plumb, J., & Blanchfield, P. (2009). Performance of temperature and dissolved oxygen criteria to predict habitat use by lake trout (*Salvelinus namaycush*). *Canadian Journal of Fisheries and Aquatic Sciences*, 66(11), 2011-2023.
- Reynolds, J.A. & Lowman, M.D., 2013. Promoting ecoliteracy through research service-learning and citizen science. *Frontiers in Ecology and the Environment* (Wiley), Vol. 11, No. 10, pp.565- Stable URL: <http://www.jstor.org/stable/43187623>; Accessed: 28-11-2016 13:37 UTC

Sampson, S.D., 2012. "The Topophilia Hypothesis." In *Ecopsychology: Science, Totems and the Technological Species*, edited by P.H. Kahn and P. Hasbach, Cambridge: MIT Press, pp: 23-53.

Shelton, A., 2013. The Accuracy of Water Quality Monitoring Data: A Comparison Between Citizen Scientists and Professionals. M.Sc. thesis, St. Mary's University, 95 pp.

Trumbull, D. J., R. Bonney, D. Bascom, and A. Cabral, 2000. Thinking scientifically during participation in a citizen-science project. *Science Education* 84:265-275.

Zeller, S., 2015. Reflections on time and place: The Nova Scotian Institute of Science in its' first 150 years. *Proceedings of the Nova Scotian Institute of Science*. Volume 48, Part 1, pp. 5-61.

Zwarenstein, C. (2010). Biodiversity: environmental scientist of the year. *Canadian Geographic*, June 2010, 3 p.

Acknowledgements

Bras d'Or Watch is made possible because of the commitment of many volunteers from the Bras d'Or Lake Biosphere Reserve Association, ACAP Centre for Sustainable Communities, Cape Breton University, Unama'ki Institute of Natural Resources, Eskasoni Fish and Wildlife Commission, Grand Narrows Waterfront Development Association and many others. Thanks to Lynn Baechler for drafting Figure 1 and to Rod Beresford and Kathy Snow for photographs of Bras d'Or Watch participants.

Figure List

Bras d'Or Watch Sites

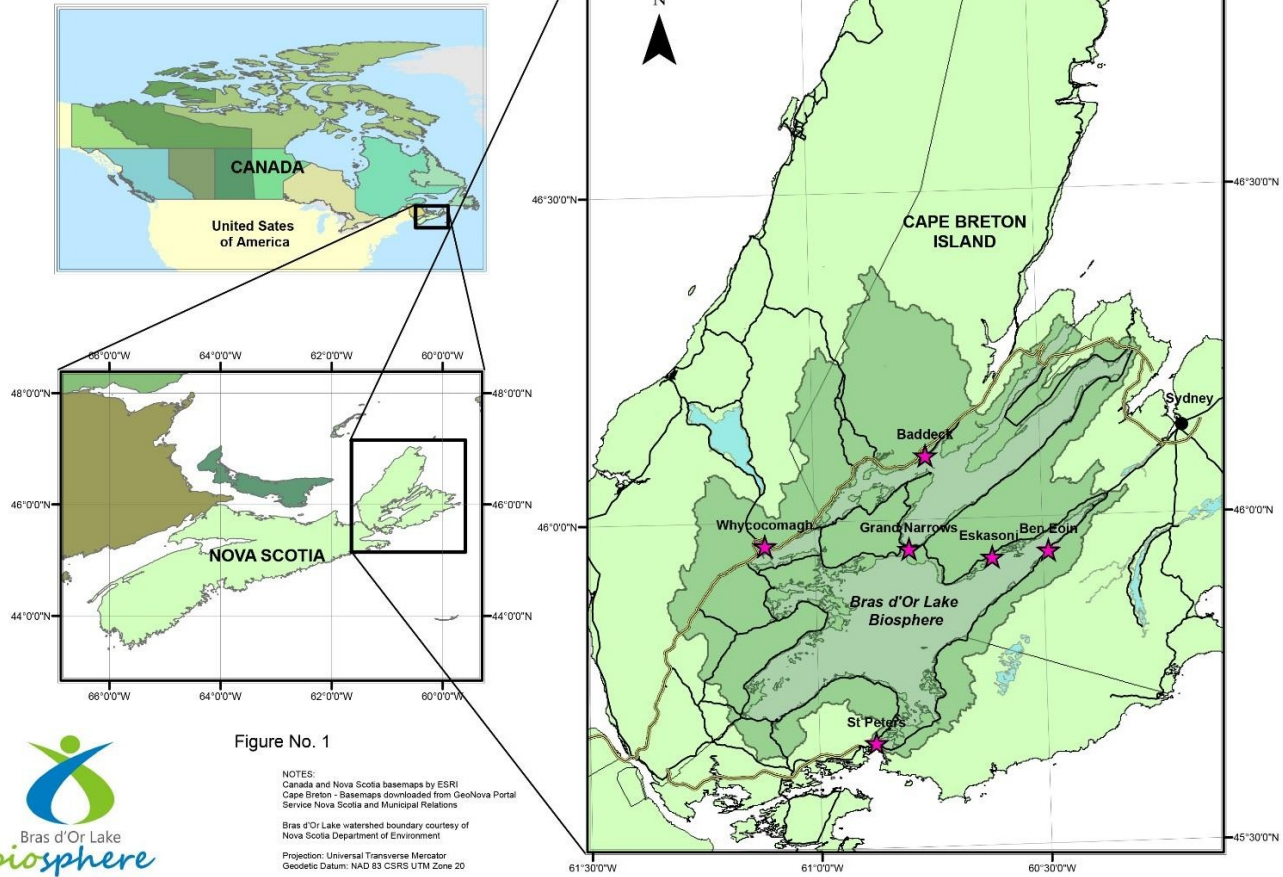


Figure No. 1

NOTES:
 Canada and Nova Scotia basemaps by ESRI
 Cape Breton - Basemaps downloaded from GeoNova Portal
 Service Nova Scotia and Municipal Relations
 Bras d'Or Lake watershed boundary courtesy of
 Nova Scotia Department of Environment
 Projection: Universal Transverse Mercator
 Geodetic Datum: NAD 83 CSRS UTM Zone 20



Figure 1: Bras d'Or Watch Sites

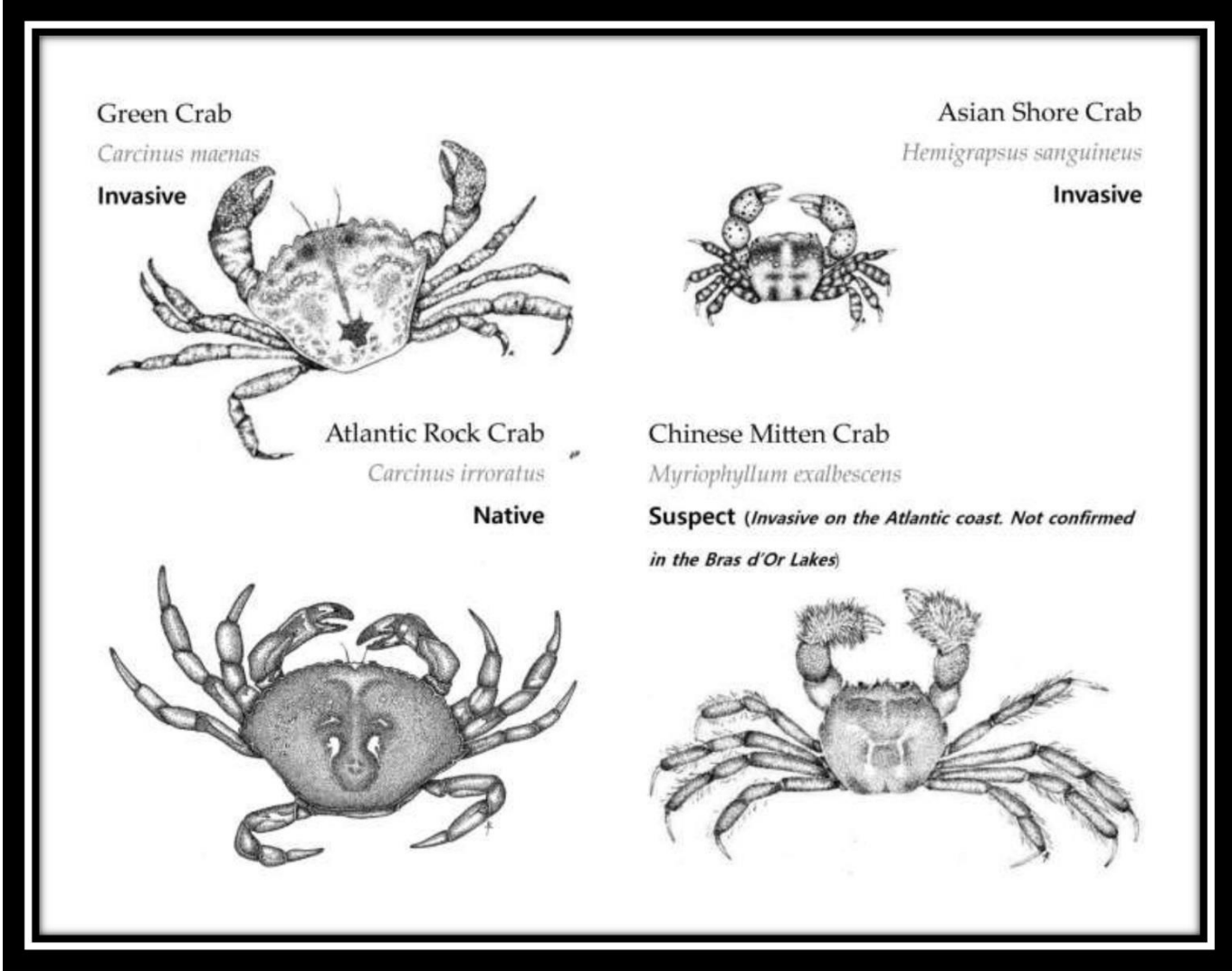


Figure 2: ID sheet for Bras d'Or Watch participants showing two species of resident crabs and two species that are of special concern. Figures drafted by Jen Cooper.



Bras d'Or Watch Field Day

Water Survey

Instructions: You should stay in an area that is not too disturbed. Make sure that you describe the area where you are sampling temperature and salinity. **THIS SURVEY TAKES AS MUCH TIME AS YOU WISH!**

1. Site (Circle one):

Baddeck BenEoin Eskasoni Grand Narrows St. Peter's Whycomomagh

2. Name and contact info (E-mail preferred): _____

3. Data Sheet Number (if you do more than one 'Water survey'): _____

4. Are you E-mailing photographs of this Water Survey? Circle Yes No

5. Describe your survey site (rocky, sandy, eelgrass etc.)

6. Choose several areas and measure temperature, salinity and pH. Make sure that you note the water depth and the distance to shore. Fill in the following table:

Sample number	Water Depth	Distance to shore (approximate)	Temperature	Salinity	pH

7. Comments:

Figure 3: Example of a data sheet that was filled out by Bras d'Or Watch Field Day participants



Figure 4: Young participants in Bras d'Or Watch Field Day 2016

CAPE BRETON POST

Cape Breton Post > News > Local

Inaugural Bras d'Or Watch field day a success

[Laura Jean Grant](#)

Published on July 20, 2015

SYDNEY — People of all ages were lakeside Saturday afternoon exploring and learning about the Bras d'Or Lake.



Kaitlyn Cann, from left, Laura Holden and Jen Cooper were three of the biologists who helped out with Bras d'Or Watch Field Day activities at Ben Eoin Beach Campground.

The inaugural Bras d'Or Watch Field Day was held Saturday afternoon at six sites on the island and drew approximately 175 participants.

"We're certainly pleased with the turnout," said Annamarie Hatcher, chair of the Bras d'Or Watch committee. "I think it was a very positive first step and the people who came, most of them were really committed to learning."

Hatcher said it was really nice to see the enthusiasm of participants as they took part in a variety of activities aimed at educating them about Bras d'Or Lake and its ecosystem

Activities at the six Bras d'Or Watch sites — Baddeck, Ben Eoin, Grand Narrows, Eskasoni, St. Peter's and Whycomomagh — varied

Saturday and included people taking part in bird watching, walks, diving, ecosystem surveying, beach seining, and wading into the water looking for crabs and fish.

Figure 5: Excerpt from 'Cape Breton Post' after the inaugural Bras d'Or Watch field day.