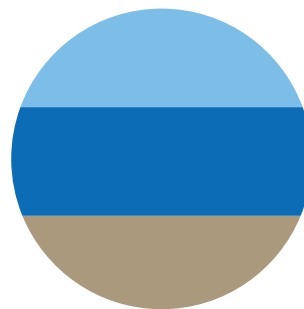


GEORGIAN BAY **FOREVER**



WINTER 2017
VOL 8, ISSUE 1

Protecting your water.

WATER LEVELS, WATER QUALITY AND ECOSYSTEMS

THE IMPORTANCE OF BIODIVERSITY

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IMPORTANT AND ONGOING PROJECTS

Preserving and protecting Georgian Bay is at the heart of what Georgian Bay Forever does to maintain the health, safety and security of its waters for generations to come. A quick snapshot of our projects follows. Please give today at www.gbf.org — your generous support enables this work.

Ecosystems

Fighting invasive species

GBF mobilizes communities across the Bay to eliminate **Phragmites**, an invasive reed that threatens its coastal wetlands. Review progress on this project at:

<http://gbf.org/invasive-phragmites/>

Identifying hot spots in need of protection

GBF is working with the University of Guelph (UofG) to build an aquatic biodiversity library using DNA barcoding. This allows us to monitor the health of ecosystem diversity, under threat from human impacts, and pinpoint areas in need of protection. Read more in this issue, or visit:

<http://gbf.org/dna-barcoding/>

Researching cage aquaculture impacts to ecosystems

Expansion of net-pen (or cage), aquaculture operations in the Great Lakes is advancing. Ontario is unique in Great Lakes jurisdictions allowing net-pen aquaculture in public water. GBF is compiling freshwater research and examining data with the UofG to determine if high density net-pen aquaculture poses a threat to the safety of the ecosystem. More information at:

<http://gbf.org/net-pen-aquaculture/>

Evaluating habitat for declining fish species to help prioritize sites for remedial action

With Walleye, Lake Sturgeon and Sucker species on the decline in areas of Eastern Georgian Bay, GBF is partnering with the Eastern Georgian Bay Stewardship Council on their 32-month project to survey eight tributaries within the Parry Sound District. More information at:

<http://gbf.org/2016/03/21/fish-tributaries-help/>

Water Quality

Standardizing a water quality protocol

GBF continues its 2-year partnership with the Georgian Bay Biosphere Reserve and other key partners to harmonize water testing protocols. Currently, there are 15 different water-testing protocols across the Bay. Tracking water quality data more consistently will better inform water quality research and government decision making and allow for scientific comparisons between regions. More information at:

<http://gbf.org/standard-water-quality/>

Water Levels

Creating climate resilience. Providing structural solutions for adaptive management in the Great Lakes

GBF retained the services of AECOM, a highly respected global engineering firm, to assess and recommend contemporary climate resilient structural options to mitigate plausible future extreme water levels of Lake Michigan-Huron and Georgian Bay. More information at:

<http://gbf.org/water-levels/creating-climate-resilience/>

Education

Driving awareness of the threats to Georgian Bay's ecosystems

Educating the public and governments regarding environmental protection, conservation, the safety and preservation of the water and the natural features of Georgian Bay enhances public appreciation for the environment. For recent topics such as *Keeping Georgian Bay Beaches Healthy*, *Microplastics* and more, visit: gbf.org. Join our email list and follow us on Facebook, Twitter, and Instagram.

Georgian Bay Forever is a community response to the growing need for major research and education to sustain the Georgian Bay aquatic ecosystem and the quality of life its communities and visitors enjoy.

We help monitor the Bay's well being, throughout the seasons, year after year.

We fund the research needed to protect the environmental health of Georgian Bay and the surrounding bodies of water. Using our research findings, we inform and educate the general public and governments about threats to environmental health and propose possible solutions.

Through workshops and seminars we are educating the Georgian Bay community. By teaming up with reputable institutions, we enhance the credibility of our research and we strengthen our ability to protect what's at stake.

Georgian Bay Forever, formerly the GBA Foundation, is a registered Canadian charity (#89531 1066 RR0001). We work with the Great Lakes Basin Conservancy in the United States, as well as other stakeholder groups all around the Great Lakes.

Deeply rooted and broadly drawn, Georgian Bay Forever is steered by lifelong devotees of the Bay. We are committed advocates, educators, environmentalists, realists, idealists, and of course, residents.

DIRECTORS

Derek Bowen	Neil Hutchinson
Janet Burt	Rod Jones
Adam Chamberlain	Anne Randell
Terry Clark	Peter Singer, Chair
Jennifer Ferguson	Erwin Stuart

Executive Director

David Sweetnam

OUR CONTACT DETAILS

Georgian Bay Forever
PO Box 163, Caledon, ON
L7E 5T2
tel: 905-880-4945

You can reach David Sweetnam, our Executive Director, at ed@gbf.org or at 905-880-4945, ext 1.

Canadian citizens may send their donations to the Caledon address above.

U.S. citizens wishing to make a donation to support our work can do so by giving to:
Great Lakes Basin Conservancy
PO Box 504, Gates Mills, OH
44040-0504, USA

This newsletter is just a snapshot of our work. For the most up-to-date information on our projects, longer versions of newsletter articles and breaking news about Georgian Bay, please become a regular visitor to our website and Facebook page.

GBF.ORG

Design by Key Gordon (keygordon.com)

Editor: Helen Bryce

Content curator: Heather Sargeant

Follow us on   



CHAIR'S EDITORIAL

By Peter Singer

What am I doing as Chair of Georgian Bay Forever? For that matter, why was I out cutting Phragmites last summer? I have a very busy life with a wonderful family and an active business career. I enjoy many other activities, but I dedicate time to the work of Georgian Bay Forever. I do it because I care and I am concerned. On December 31st, I read that the temperature at the North Pole was 1 degree Celsius which is about 25 degrees Celsius above any normal high at the pole and the pole was in 100% darkness. Early in January, I read that Larsen "C", an iceberg the size of the state of Delaware, is about to break away from Antarctica. Researchers have estimated that if the land-based ice that is held back by Larsen "C" were to be released

subsequent to the breakaway, this would cause global sea levels to rise 10 cm. I find events such as these alarming and they seem to be happening much more frequently.

However, I know what you may be thinking. These two examples do not prove climate change and they are purely anecdotal. Nonetheless, the earth is getting warmer at an unprecedented rate and that will have an impact on the Great Lakes that needs to be understood. I encourage you to read this issue of our newsletter. You will learn about our studies concerning biodiversity and the work to create a DNA database library. This type of research will provide the base line to allow for scientific comparisons with future data and thereby conclusively indicate trends.

With this we can see what is actually happening to our precious "Bay" and move away from anecdotal evidence such as "fishing used to be better when I was a child". We can then look for the causes, develop action plans to take remedial action and be better able to convince people and governments that the concerns are real and need to be addressed.

GBF is a science-based organization. It works to monitor the waters of Georgian Bay and to protect their nature. A complete catalog of the current conditions is absolutely necessary and one of the many reasons I am prepared to volunteer and get back to cutting Phragmites again next summer!

WHAT IS BIODIVERSITY?

"Biodiversity is much more than just a number of species. It involves their interconnections and interrelationships. All living beings from the smallest to the largest—every single one of us is part of biological diversity... Each individual, with its unique characteristics as well as its inheritance and genetic legacy, is part of the great natural universal diversity. Living beings and their environments make up a fragile machinery—ecosystems. Time also plays a vital role. Today's biodiversity is a result of millions of years of evolution."¹

"All living beings depend on each other. Life on our planet depends on the systems formed by genes, species, ecosystems. In a single word, biodiversity."²

—Conference on the Convention on Biological Diversity

The benefits of biodiversity to humanity

- ✓ Goods and services (e.g., rivers and lakes provide water; oceans, forests and jungles provide oxygen)
- ✓ Foods
- ✓ Medicines
- ✓ Adaptability, recovery, aiding stability; healthy ecosystems mitigate negative impacts of climate change, floods and hurricanes
- ✓ Well-being that comes from enjoyment of the natural world

We are losing biodiversity to

- x Ecosystem and habitat degradation, fragmentation and direct loss
- x Over-exploitation and over-consumption
- x Pollution
- x Climate change
- x Invasive species

Where can we collectively focus our energies?

We can contribute to the following main objectives of the Convention of Biological Diversity, ratified by all United Nations member states (except the United States):



1. Protect and conserve biodiversity
2. Use the components of biodiversity in a sustainable way
3. Share in a fair and equitable way, the benefits arising from the utilization of genetic resources

What's Georgian Bay Forever doing?

In addition to helping communities remove invasive Phragmites from coastal wetland ecosystems, read about new scientific methods to catalogue The Bay's aquatic diversity.

¹ COP13 of Biodiversity (2016, December) from the 13th Annual Conference on the Convention on Biological Diversity. [Video file]. Retrieved from youtube at <https://youtu.be/OiX00aQoCFk>

² Ibid

DNA BARCODING: IDENTIFYING AND PROTECTING GEORGIAN BAY'S BIODIVERSITY AND ULTIMATELY, THE WORLD'S

Dr. Kevin McCann and his research group study the structure and function of food webs using a combination of field research and mathematical modelling. Dr. McCann applied a degree in mathematics from Dartmouth to graduate studies in ecology. He trained with several of the most influential ecologists and earned an M.Sc. and a Ph.D. from the University of Guelph (UofG). Dr. McCann is currently a Professor in UofG's Department of Integrative Biology. Learn more <http://www.mccannlab.org/>.

We want to thank Dr. McCann and his graduate student team, Carling Bieg, Laura Johnson, Timothy Bartley and Nicholas Edmunds, for their significant work on uncovering food webs.



How did the process of DNA barcoding come about?

In 2003, Dr. Paul Hebert of the University of Guelph proposed a particular segment of DNA that has properties which allow it to be used as a tool for differentiating species. Akin to the barcodes found on food in a grocery store, DNA barcodes allow us to use this segment of an organism's DNA to determine the species to which it belongs. Wonderfully, this technique works on even relatively degraded tissues such as skin cells that are naturally shed into the environment and so it is easy to sample many organisms.

Tell me a little bit about your team's work with DNA barcoding at the University of Guelph.

We study how ecosystems are connected (food web) and look at how energy—an ecosystem's life blood—flows through organisms to maintain diversity and ecosystem services, e.g., commercial fish for food. We also look at how this life blood (an ecosystem's structure and the flows of energy) are altered by human impacts. We are specifically looking for efficient and low cost ways to "biomonitor" aquatic ecosystems under threat of human impacts. This will allow us to develop early warning signals of the loss of critical ecosystem services.

Why is it important to have a record/database of species—whether it is for Georgian Bay or the World?

In the long run, DNA barcoding databases provide Georgian Bay, and indeed any ecosystem globally, with the biological infrastructure that can be harnessed for biomonitoring both now and, more importantly, going into the future. The advent of these simple and efficient DNA methods of monitoring biodiversity allow us to rapidly

assess human impacts on aquatic ecosystems. Plus, DNA technologies are still rapidly growing. As an example, environmental DNA or 'eDNA' (DNA that is shed into the environment by an organism) is a developing technique that allows us to take a water sample and amazingly begin to predict the species in that local aquatic community. Effectively, organisms shed cells and these cells float around in the water waiting to be found.

While this technology needs to be refined, there have already been many success stories. For example, DNA barcoding is being used to detect the invasion of Asian Carp into the Great Lakes. Here, the development of eDNA techniques may allow us to rapidly assay water, looking for potentially threatening invasions by detrimental species such as Asian Carp and other invasives.

How has the DNA database helped inform deliberation around increasing cage aquaculture in Georgian Bay?

DNA barcoding could aid the identification of feed in the stomachs of fish. This is another neat application of DNA barcodes whereby we can use forensic DNA barcode approaches to reveal the fate of organisms in the food web. The fate of the feed allows us to understand if the feed is being assimilated into the food web or whether it is simply adding excessive and unwanted nutrients into the water, leading to overabundant plant growth and depletion of oxygen for sustaining animal life.

Update us on the progress being made to map all aquatic organisms in the Bay.

The fish community DNA barcoding is now almost fully sampled (some rare species have yet to be sampled). The benthic invertebrate

(see below) is the poorest sampled and so represents the real gap in the Georgian Bay barcoding database—but we are making ground. We are in the process of generating what scientists call "rarefaction curves" that predict whether you are close, or not, to sampling the full community. Benthic invertebrates are an important group of species as run-off and toxicants often sediment out of the water column and alter benthic invertebrate communities in predictable ways. As such, they represent a really important aspect of biomonitoring human impacts on biodiversity. Additionally, they are notoriously difficult to identify without expertise and so barcoding methods open up an easy and effective way to biomonitor these benthic communities.

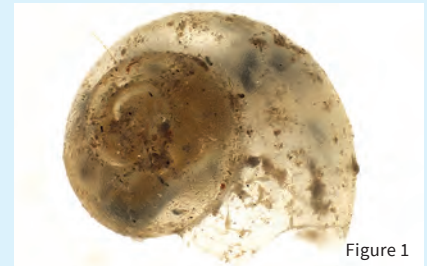


Figure 1

Benthic invertebrates are organisms with no backbone (like mollusks) that live in or on the bottom of sediments of rivers, streams and lakes. The type of benthic species and quantity are excellent measures of aquatic conditions because they rely heavily on their surroundings—from the makeup of the sediment to water quality and hydrology. They are often difficult to sample though because they can live so deep in the sediment. http://gbf.org/2016/10/03/amnicola_limosa/



By Heather Sargeant

TWO SPECIES BARCODED IN GEORGIAN BAY

Baiaeschna Janata, Springtime Darner Dragonfly

Baiaeschna janata, or the Springtime Darner, is a dragonfly that comes by its common name because of its early flight time, generally starting towards the end of April and the beginning of May. This is earlier than other "blue" darners of the *Aeshna* genus. Hence, the springtime darner is the only species in the genus *Baiaeschna*.

The springtime darner is common in the forested areas of the United States and Southeast Canada frequenting gently flowing rivers and streams and sometimes clear ponds and lakes. It feeds on bugs over water where it does its mating and egg-laying.

What's the dragonfly's connection to water?

Dragonflies can live a long time. Much of their life, however, is spent in the nymph stage occurring largely underwater where they look nothing



Figure 2

like a dragonfly. Here are some interesting facts about the life cycle of dragonflies:

- Dragonflies mate while flying over water. The female will either lay her eggs on a water plant or drop them in the water.
- The larvae from hatched eggs are called nymphs. Nymphs look like underwater flies without wings. They live in the water developing for two to four years like the springtime darner nymph pictured and found in Georgian Bay. They eat



Figure 3

- other insects and larvae, other nymphs, worms and small crustaceans. They are preyed upon by fish, frogs, birds, beetles and other dragonflies.
- Once a nymph is fully developed, and the weather is suitable, the nymph will crawl from the water and shed its skin, or exuvia, emerging as a dragonfly.
- Adult dragonflies only live for a short time, about two months.

Esox Lucius, The Northern Pike

A lurking predator – AMBUSH!

Esox lucius or the northern pike is an aggressive feeder that likes to lie in wait staying very still for a long period of time and then...striking with short bursts of rapid acceleration. This pike is quite different from some other predatory fish and is unlike the perch which chase down their prey.

The swimming character of the northern pike has been prized by fisherman for its determination and bursts of high energy. The fish move in an S-shape to accelerate and in a C-shape to slow down quickly.

These fast start movements, which other fish usually use to escape, are used by the northern pike to catch lots of small fish—primarily Yellow Perch, sunfishes, minnows and suckers.

However, these large jawed fish will also consume frogs, crayfish, waterfowl, rodents and other small mammals. The northern pike is also a cannibal and is known to eat its young. Some theorize that this could explain why females lay so many eggs.

The pike eggs and new hatchlings have a high infant mortality rate falling prey to larger pike, perch, minnows, waterfowl, water mammals and even some insects. If the northern pike makes it to adulthood, its biggest worries in the Great Lakes are the invasive sea lamprey and humans. Spawning adults, in shallows, can be vulnerable to bears, dogs and other large carnivores.

How did the Esox lucius become commonly known as a northern pike?

The northern pike resembles a weapon, or long pole, from the Middle Ages known as the Pike.



Figure 4

Want to meet more species?

Go to <http://gbf.org/species-georgian-bay/>

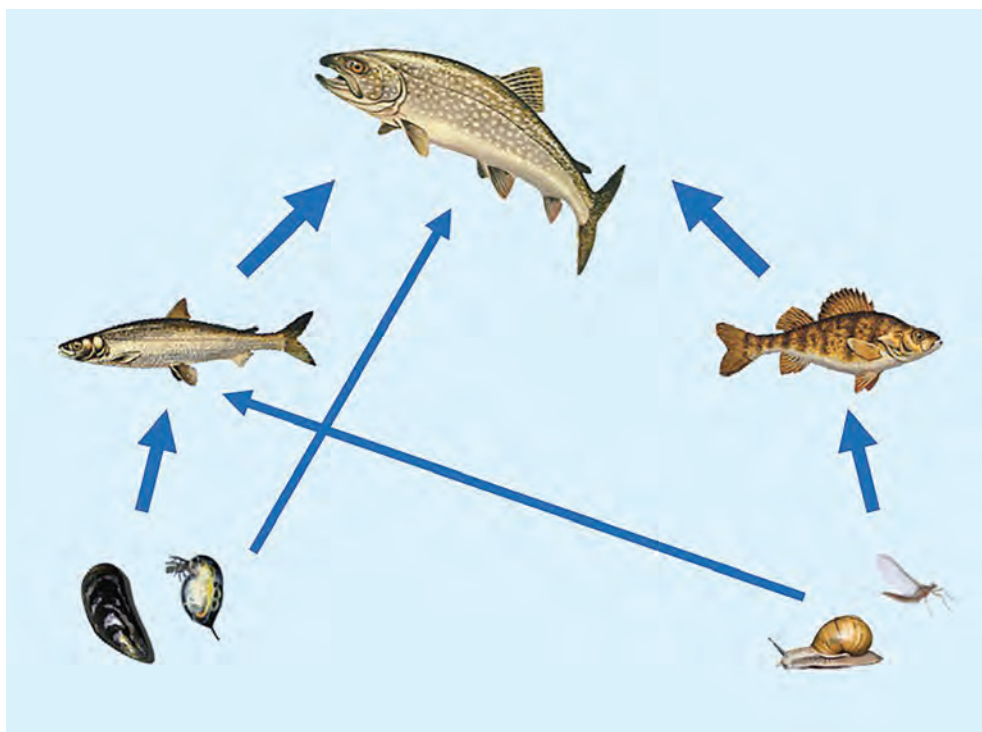
Sources for *Baiaeschna janata* (figure 2): <http://ibol.org/about-us/what-is-ibol/>, <https://en.wikipedia.org/wiki/Baiaeschna>, <http://wiatri.net/inventory/odonata/speciesaccounts/SpeciesDetail.cfm?TaxalD=13>, <http://bugguide.net/node/view/8137>, <http://www.pbase.com/rbrady/janata>, <http://www.marylandbiodiversity.com/viewSpecies.php?species=676>, <http://www.americaninsects.net/d/baiaeschna-janata.html>, <http://www.dragonfly-site.com/dragonfly-life-cycle.html>, <http://steonline.org/circles/lessons/energy/PDFs/water-pixies17.pdf>

Figure 3: License: Creative Commons Attribution NonCommercial ShareAlike (2012) License Holder: CBG Photography Group, Centre for Biodiversity Genomics

Sources for *Esox Lucius* (figure 4): <http://ibol.org/about-us/what-is-ibol/>, https://en.wikipedia.org/wiki/Northern_pike, <http://www.fishbase.org/summary/258>, http://www.michigan.gov/dnr/0,4570,7-153-10364_18958-45685--,00.html, <http://www.arkive.org/pike/esox-lucius/>

USING BIO-TRACERS TO CONSERVE BIODIVERSITY IN GEORGIAN BAY

Using various naturally occurring bio-tracers, we can build a comprehensive view of the food web in a particular ecosystem.



This food web example shows who eats whom in an ecosystem. The arrows point from the prey to the predator and show how energy and nutrients flow throughout an ecosystem.

Georgian Bay is renowned for its unique and beautiful biodiversity, but the ecosystem is threatened by human-induced changes such as climate change, species invasions, habitat loss and pollution. To preserve Georgian Bay, we need to understand how humans impact the biodiversity of this important ecosystem. However, understanding the biodiversity of Georgian Bay goes beyond simply counting species; it also involves the many relationships between species. So how do we study all aspects of biodiversity in an ecosystem like Georgian Bay?

One way to study biodiversity is to use a set of naturally occurring chemicals that are present throughout the ecosystem, which we call *bio-tracers*. Using multiple bio-tracers gives a holistic picture of the Georgian Bay ecosystem by revealing what species are present, how those species interact with one another and how the ecosystem as a whole is changing. In the McCann Lab, we use bio-tracers to monitor how humans impact biodiversity by changing the food web—that is, who eats whom—in Georgian Bay. On page 7, we will discuss three examples of bio-tracers we commonly use.

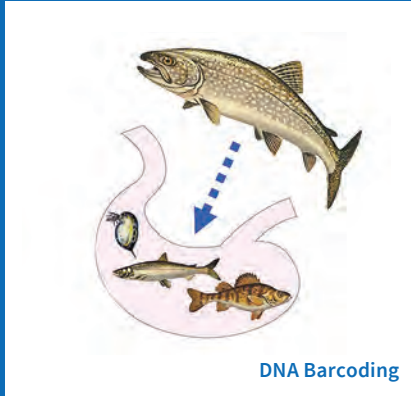


Carling Bieg finished her Master's degree in September and works as a research assistant for Dr. McCann at the University of Guelph. With expertise in Ecology and Marine Biology, she currently investigates the effects of human-induced change (including fisheries as well as other anthropogenic stressors and climate change) on aquatic food webs. You can read more about her past Master's work at <http://www.mccannlab.org/carling-bieg>.

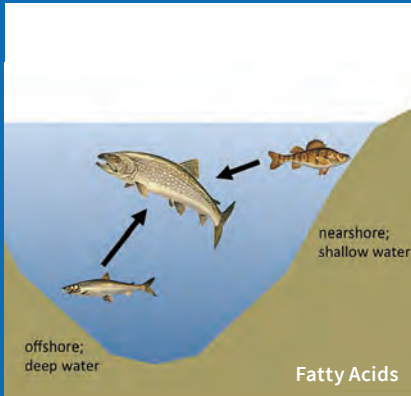


Timothy Bartley is a Ph.D. Candidate who studies ecology in the Department of Integrative Biology at the University of Guelph. His research involves the use of DNA barcodes for diet analysis in order to determine who eats whom in lake food webs. He also loves to fish and hike throughout Ontario. Find his published research at https://www.researchgate.net/profile/Timothy_Bartley.

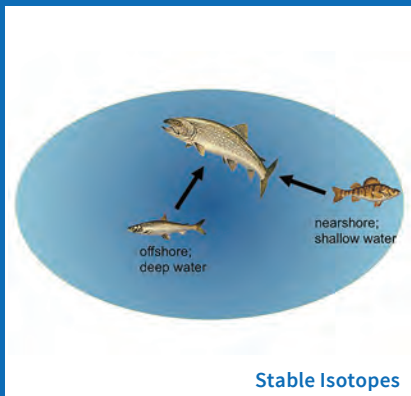
Georgian Bay Forever is deeply grateful for their articles and graphs that enhance our understanding of scientific tools for food web research.



DNA barcoding allows us to determine what species are in an ecosystem and what an organism has eaten recently based on its stomach contents.



Fatty acid analysis allows us to build food chains based on the accumulation over time of certain fatty acid indicators.



Stable isotope analysis can show where a species has been feeding over the last few months.

DNA Barcoding

DNA is present in all living organisms, making it a logical bio-tracer for identifying organisms and studying ecosystems. Once we have a catalogue of all fish and invertebrate species in the ecosystem, this catalogue can be used in many ways. For example, we can use DNA barcoding to assess changes in biodiversity in different areas of the Bay or to identify fish stomach contents and reveal what fish have eaten recently.

Fatty Acids

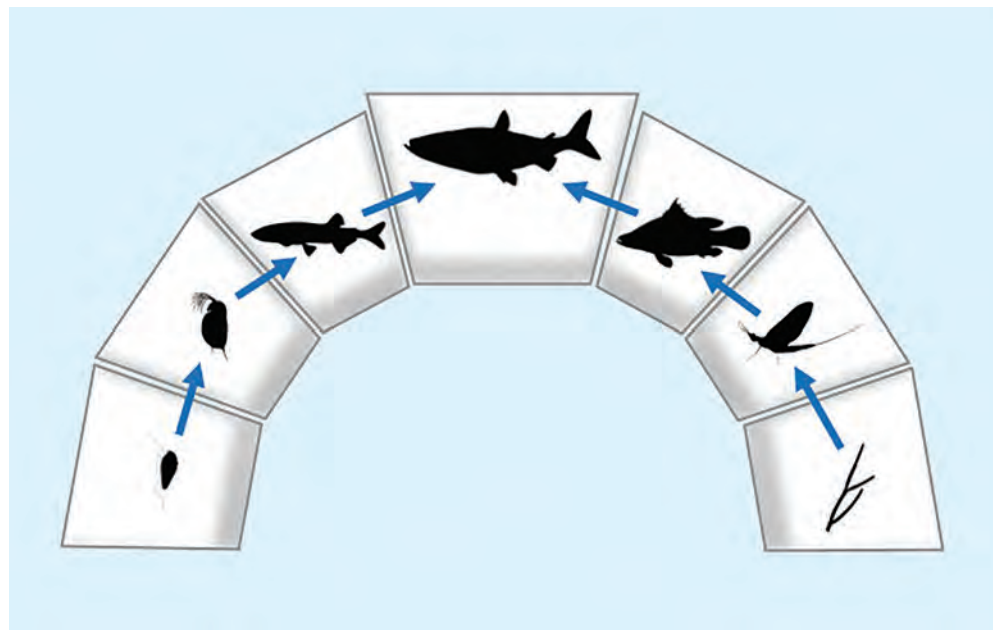
You may have heard of fatty acids because they are an important part of a healthy diet. Fatty acids are another bio-tracer that give researchers a different glimpse of what fish have been eating. While some fatty acids can be produced by an organism's body, others cannot and must come from the diet. These fatty acids accumulate as they are eaten (recalling the old saying, "you are what you eat"). Based on the fatty acids present in different species, we can infer what fish have been eating and get a glimpse of the whole food chain, from invertebrates up to top predator fish.

Stable Isotopes

Stable isotopes are naturally occurring elements that accumulate in fish based on their diets. For example, stable carbon isotopes can determine where a fish has been feeding (either near shore or in deep water), and stable nitrogen isotopes can determine whether a fish has been feeding more on invertebrates or other fish. This tells us about how fish feed in different habitats and how these habitats are connected. It also can tell us how nutrients move throughout the Georgian Bay ecosystem.

Bio-tracers have already revealed some of the ways Georgian Bay is responding to human impact. For example, we have used bio-tracers to show how excess feed from aquaculture cages is incorporated into the local food web. Our research team continues to use bio-tracers to catalogue the species present in Georgian Bay and to better understand the food web that these species form. We hope to illustrate how biodiversity and the Georgian Bay food web will respond to human activities and climate change and ultimately determine how to best protect this unique ecosystem.

Biodiversity & the Analogy of a Stone Arch



The analogy of a stone arch demonstrates the importance of biodiversity to food webs; the stones/species work together to make a stable arch, and removing stones increases the risk of an unbalanced structure that is susceptible to collapse.

DNA Barcoding determines which stones are in the arch

Stable Isotope Analysis determines whether stones are on the right/left side of the arch and how close to the top they are

Fatty Acid Analysis determines the placement of the stones relative to each other

THE MANY WAYS DNA BARCODING, AN AQUATIC LIBRARY, AND BIO-TRACERS HELP GEORGIAN BAY.

Recent molecular developments have dramatically enhanced our ability to efficiently and rapidly audit biodiversity.

DEVELOPING THE DNA LIBRARY

DNA barcoding allows us to rapidly identify an individual at the species level. Despite this scientific advancement, many of the Great Lake's iconic ecosystems, including Georgian Bay, have yet to develop the DNA barcode library that permits the use of this tool to monitor environmental impacts at the species level.

GBF's work with the University of Guelph (UofG) seeks to implement this fundamental biological infrastructure for Georgian Bay as a next step toward increasing the applicability and project range of these techniques. The existence of this database will allow a rapid and cost-efficient method to assess human impacts as well as a means to measure the success of restoration efforts.

WHAT WILL THE DNA LIBRARY DO?

- Once in place, this DNA library will support environmental tools for the Great Lakes for the foreseeable future.
- It will also almost certainly identify DNA sequences from aquatic freshwater species never before seen.
- A related goal will be to further develop innovative technologies that can assess changes and identify threats at the ecosystem level.

THE INTEGRATIVE METHODOLOGY

These goals will be realized through a novel integrative methodology utilizing a suite of scientific tools that assess human impacts at both short-term (e.g., individuals) and long-term (e.g., ecosystem) time scales.

The creation of this methodology will provide managers with the necessary tools to respond and adapt to both short-term and long-term environmental stressors. **The base-line data will provide centuries of useful scientific information to guide policy and regulations.**

In summary, we are developing a data-rich methodology for scientifically assessing the influence of various stressors on the structure and function of critical aquatic habitats throughout the Great Lakes starting in Georgian Bay. (Article continues on page 9.)



(Continued from page 8.) By taking this multi-level approach to assessing human impacts, this research program will greatly improve our ability to quantify the impacts of human effects on Georgian Bay while establishing **global leadership** in integrative environmental management.

The state-of-the-art technologies used in this project will be transferrable as an innovation in the measuring and monitoring of biodiversity related to stressors—like climate change—and development impacts in both Canada and the United States, across multiple jurisdictions.

What's Been Accomplished?

As of September 2016, 399 specimens have been collected for the Georgian Bay Forever project.

There is so much more of The Bay to go.

Of those collected to date, 236 have been identified to the species level, with all but 41 having some taxonomy level of identification. The samples have been collected from Big Sound, Shawanaga Bay, Sturgeon Bay and some from Wiarton and Owen Sound. (More information at <http://georgianbayforever.orgdnabarcoding/#Specifics>)

GBF is also teaming with UofG to use DNA barcoding and bio-tracer methodologies to look specifically at the **impacts of cage aquaculture** or net-pen aquaculture “feed” on the local food

web in Big Sound. The results of this research, as well as a compilation of all research on the impacts of freshwater cage aquaculture on the surrounding ecosystems, will be released in the late Spring of 2017.

Building a database of Georgian Bay's aquatic ecosystem is so crucial that GBF and Dr. Robert Hanner, the Associate Director for the Canadian Barcode of Life Network, are discussing how to fund and speed up the process of collection.

Georgian Bay's library is vital for scientists due to the relatively pristine state of its ecosystems versus many of the other impacted areas of the Great Lakes. Scientists need a control or baseline to advise other jurisdictions on their own aquatic situations to help preservation and remediation, as well as being able to protect Georgian Bay in the future.



We Can't Stop Now

Although we are making progress, we must continue this critical work.

“Biodiversity is the greatest treasure we have... Its diminishment is to be prevented at all cost.”

—Thomas Eisner

Read about this famous entomologist and ecologist at www.gbf.org/eisner.

Protecting and preserving our aquatic ecosystems will get harder and more expensive the longer we wait. Your donation to Georgian Bay Forever will allow projects like these to continue.

JUST BELOW THE SURFACE...



By David Sweetnam

Georgian Bay is our treasure and protecting it is our responsibility and passion. In order to ensure that our work will contribute to the long-term protection of our beloved Bay, we often need to look at things from unconventional perspectives. One of those perspectives is from under the water.

Most of the time, it is the sparkling magic of a sunrise or sunset over the water or a refreshing dip in the cool clean water that boaters and cottagers experience. But under that shimmering surface, populations of lake trout are struggling to survive due to sea lamprey, historic overfishing and recreational fish stocking of Coho salmon creating competition for scarce nutrition. Finishing off the food web destruction are

invasive competitors like zebra and quagga mussels that strain out the nutritious phytoplankton and zooplankton and alewives—that look tasty—but leave the trout malnourished from thiamine deficiency.

Outside of Lake Superior, there are only two self-reproducing lake trout populations—one in Georgian Bay and one in Lake Ontario. Lake trout and other native Georgian Bay species are turning to invasive round Goby as a food source. This is a time of radical transition in the ecosystem.

What the fish eat indicates what is in the water. DNA analysis of the stomach contents shows us many creatures that we don't catch in nets nor are they apparent in the random samples collected by biologists in the field.

DNA barcoding, used in the global Biology of Life project to identify every species on earth, is a tool that GBF has been working with since 2012 when we pioneered the field sampling technique with the University of Guelph to catalogue biodiversity on Georgian Bay. Researchers can also follow isotopes, stress hormones and other indicators to follow energy flowing through the food web.

Our high tech research tools even include NASA's Earth Observing satellites to monitor the impacts of changing water levels on coastal wetlands. GBF is looking to the future and employing today's best technologies to protect our Bay for future generations.

DEREK AND NANCY BOWEN

By Colette Thomson

“Raw beauty, pristine waters and rugged landscapes create beautiful memories we share with family and friends. That is how we portray Georgian Bay.”

– Derek and Nancy Bowen

Derek and Nancy Bowen are second generation cottagers on Georgian Bay and first generation cottagers in Sans Souci. Having both experienced cottage life at a young age, they knew the moment they met on Wymbolwood Beach that they would one day own their own summer home. Many years later their dream came true and they settled in Sans Souci. Both Derek and Nancy are experienced sailors with much of their experience on Georgian Bay. Derek began sailing in the mid-seventies and Nancy in the mid-eighties.

Some of their best memories on the Bay revolve around family and friends and the many unique adventures they have experienced. Highlights for Derek and Nancy include sailing the circumference of Georgian Bay, short overnight trips, many family picnics and even rescuing the odd lost boaters who have gotten in over their heads.

Today both of their children, now in their mid-twenties, love coming to Georgian Bay. Derek and Nancy hope they have nurtured in their children the same passion and commitment they, themselves, have always felt for the Bay.

Like so many cottagers who close up their properties for the off-season, Derek has wondered what happens on the Bay during the winter. Taking advantage of the new technology available

now, Derek installed a webcam, providing live images of their expansive Georgian Bay view. In sharp contrast to what people are used to seeing during the summer months, these images are strikingly solitary and unique and serve to unravel some of the mysteries of winter weather on the Bay. They have accumulated over 780,000 images over the past few years and have had almost 300,000 site visits receiving ongoing positive feedback on their website from cottagers, mariners and snowmobilers.



The Bowens both are strong supporters of Georgian Bay Forever. Derek is a volunteer Board Member and Chair of GBF's Science Committee. As an Engineer, he has an interest in all things science and, with his love of Georgian Bay, GBF seemed like a good fit to 'give something back'. Nancy has a long history and years of experience with not-for-profit fundraising organizations and is a keen new member of GBF's Fund Development team.

Derek and Nancy feel that because Georgian Bay Forever is a science-based organization, it is well positioned to address the challenges facing the Bay, from unpredictable water levels, to invasive species and issues affecting the ecosystem. It is important that we understand the

long-term risks and address them now before it's too late and, potentially, too costly. GBF is the only organization that focuses solely on protecting the water, the most at-risk aspect of the Bay.

Protecting the future of Georgian Bay

“It is so important that everyone recognizes the role that Georgian Bay plays, not just in our recreational enjoyment, but as part of our larger world.”

– Derek and Nancy Bowen

Derek and Nancy have a hope for the future of Georgian Bay—to see government policy put in place that recognizes the vital role the Bay plays in our ecosystems and to know that it will always be protected for generations to come. The vitality of the Bay reaches far beyond our shores. Georgian Bay is part of the mid-Great Lakes system, serving as a proxy for the overall health of the Great Lakes. It must be protected and preserved.

Thank you

Georgian Bay Forever is extremely grateful to Derek and Nancy Bowen and our many other donors for continuing to support Georgian Bay Forever, enabling important projects and research that help preserve and protect the waters of Georgian Bay. Please visit our website at www.gbf.org to learn more about how you can continue to help make a difference. **To visit Derek and Nancy's live webcam photos, please visit their website at www.thebowens.name.**

Please join us in our mission to ensure that future generations can drink, swim and fish in our unique Georgian Bay—forever!

Preserving and protecting the waters of Georgian Bay is at the heart of what we do at Georgian Bay Forever. Every philanthropic donation is essential and allows Georgian Bay Forever to continue important scientific work underway now and in the future. There are many ways to support Georgian Bay Forever and every gift makes a difference. Please consider one of the following options:

✓ Make a single gift donation

Donate today to help protect the waters of Georgian Bay and our ecologically significant ecosystems and species at risk.

✓ Make a multi-year pledge

Your ongoing support through a multi-year gift will enable us to plan and allocate resources efficiently to achieve the highest long-range impact. Georgian Bay Forever will ensure that your gift has tremendous and long-lasting effects on the health and well-being of Georgian Bay.

✓ Leave a legacy

Legacy Giving or, as it is often called, Planned Giving, is a form of charitable giving that allows you to commit today to making a gift of any size to Georgian Bay Forever in the future.

✓ Stocks and bonds

There have been important changes to the taxation of charitable gifts and securities. It is now even more tax-advantageous for you to make a gift of stock rather than cash and provides another way for you to invest in Georgian Bay Forever. You will receive a tax receipt for the fully appreciated value of the donation and will no longer pay any capital gains tax.

✓ Monthly giving

Monthly giving is one of the easiest and most efficient ways to support Georgian Bay Forever. Monthly giving allows us to plan effectively and put more of your donated dollars towards core project funding while reducing fundraising costs.

✓ In honour and memoriam

Give a gift in honour of someone, celebrate a milestone in your life or make an in memoriam gift to honour the life of a loved one, friend or an acquaintance who is no longer with you. Help preserve and protect the Bay for other "GBayers" in the name of your special someone.

✓ Host an event

Consider hosting a fundraising event and collect donations for Georgian Bay Forever.

For more information on how to give, please call 905-880-4945 extension 3 or visit:

<http://gbf.org/how-to-help/make-a-donation/>

In our winter 2016 newsletter, on page 5 in the water levels chart, it should have been noted that the Georgian Bay Association commissioned the W.F. Baird & Associates report in 2005 and that it was funded through the GBA Foundation, which later became Georgian Bay Forever. We regret this error.



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"THE BAYKEEPER" INDICATES THAT GEORGIAN BAY FOREVER IS A MEMBER OF THE WATERKEEPER ALLIANCE, A GLOBAL MOVEMENT OF ON-THE-WATER ADVOCATES WHO PATROL AND PROTECT OVER 100,000 MILES OF RIVERS, STREAMS AND COASTLINES IN NORTH AND SOUTH AMERICA, EUROPE, AUSTRALIA, ASIA AND AFRICA. FOR MORE INFORMATION GO TO WATERKEEPER.ORG

GBF is pleased to recognize the members of the Georgian Bay Forever Circle

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The CSL Group Inc.
Doug and Ruth Grant

Husky Injection Molding Systems Ltd.
Jackman Foundation

The McLean Foundation
The Schad Foundation

GUARDIAN | \$50,000-\$99,999

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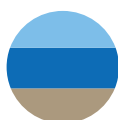
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Would you prefer to stay in touch via email? Send an email to ed@gbf.org