GNAWENJGAADENG MNIDOO-GAMII | PROTECTING THE GREAT LAKE OF THE SPIRIT

State of the Bay

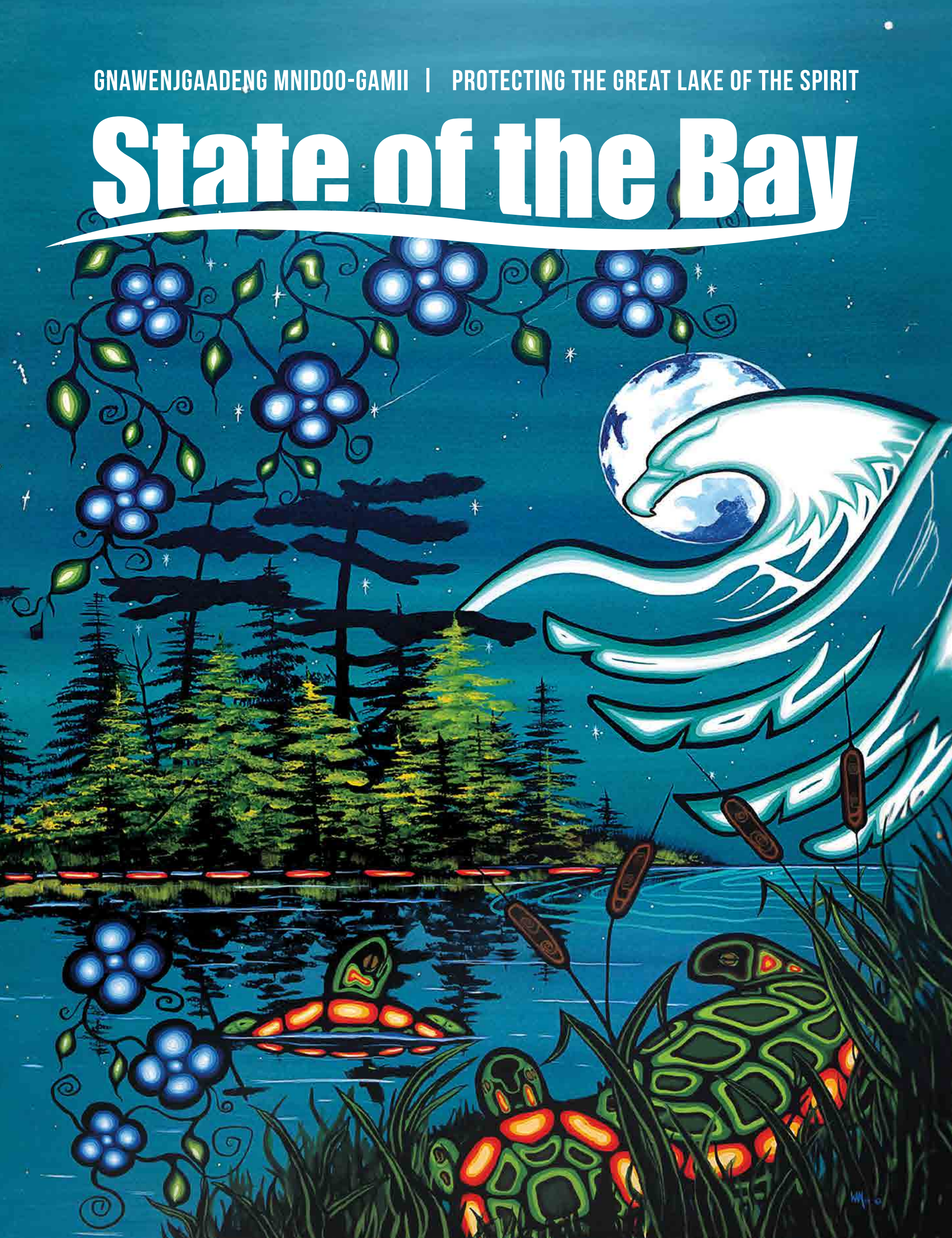

PHOTO CREDIT: WILLIAM ANTHONY MONAGUE

INTERTWINING SCIENCE, SPIRIT, & STORY

Becky Pollock and Greg Mason, Management Team
UNESCO Georgian Bay Mnidoo Gamii Biosphere

Since 2008, the State of the Bay program has been working to bring together multiple sources of information to communicate environmental changes in eastern Georgian Bay, known in the original language of the territory as *Mnidoo-gamii*, Great Lake of the Spirit.

Working with partners, the Georgian Bay Mnidoo Gamii Biosphere (GBB) gathers available research about water, wetlands, fisheries, and habitats in this unique landscape and shares this information with people who care about Georgian Bay.

For this third edition of the State of the Bay magazine, it was clear that a deeper understanding of the changes happening to the lands and waters would be created by bringing together stories from elders, knowledge holders, researchers, and scientists.

So with the help of many cultural advisors, we are taking a new approach—one that values both Indigenous knowledge and western science. Indigenous ways of knowing and storytelling are infused with ethics and teachings, worldviews and values about how to live in a good way—in a way that sustains our community and our non-human kin.

"For too long, these knowledge systems have been divided, and Indigenous knowledge suppressed through colonization and racism, while western science has been privileged and the earth has suffered."

–Elder Albert Marshall

Integrating worldviews has been called weaving, or braiding, knowledge. It has been taught as "Two-Eyed Seeing" by Elder Albert Marshall of Eskasoni First Nation, a concept he calls *Etuaptmumk* in the *Mi'kmaw* language.

In *Anishinaabemowin (or Nishnaabemwin)*, the language of *Mnidoo-gamii*, a similar concept has been shared as "Seeing Both Sides," or *Edwi-waabndamang*, by language speaker *Waabishki-mukwa*, Dr. Brian McInnes of Wasauksing First Nation.

The stories shared in these pages are about appreciating the life and spirit of this place, acknowledging the gift of land, water, sky, and all beings, and doing the work of protecting the Great Lake of the Spirit, *Gnawenjgaadeng Mnidoo-gamii*.

It is our shared love of this place that brings us together in trying to care for and protect *Mnidoo-gamii*. We are learning how science and Indigenous knowledge inform one another, creating a richer story of what is changing and how we share a profound responsibility to restore and care for this place, now and for future generations.

United Nations Educational, Scientific and Cultural Organization

GEORGIAN BAY BIOSPHERE MNIDOO GAMII

The Georgian Bay Mnidoo Gamii Biosphere is extremely grateful to the individuals who have gifted this publication with their time, language, art, and ways of knowing. We are grateful to the many organizations and individuals that contribute scientific research and monitoring to this work. It is impossible to list the names of every individual who has influenced this work over the years. If we have forgotten your name, please know that we are very grateful for your guidance.

- Aisha Chiandet
- Alanna Smolarz
- Angel Wikamakis
- Angela Vander Eyken
- Anita Chechock
- Arunas Liskauskas
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- Benjamin John
- Billie-Jo Isaac
- Brian McInnes *(Waabishki-makwa)*
- Chad Fraser
- Christine King *(Waabkanii Kwe)*
- Colette Isaac
- David Bywater
- David Sweetnam
- Dawson Bloor *(Bidwayodaam)*
- Debbie Jackson
- Deina Bomberry *(Ozawaanimkeeqwe)*
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- Gracie Crafts *(Niizhogiiziskwe)*
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- Michele Ten Eyck
- Mike Waddington
- Millie Williams
- Nadine Perron
- Oscar Crafts *(Oshkibewis)*
- Sandra Lockhart
- Sarah Koetsier
- Sherrill Judge *(Midwewekamigokwe)*
- Shilah LeFeuvre
- Taylor Judge *(Nanowaygahkekwe)*
- Tianna Burke

COVER ART

"TRANQUILITY"

"Tranquility" by William Anthony Monague (1956-2019) "*Abwaudung*" (The Visionary or Dreamer). Self-taught Beausoleil First Nation artist William Monague grew up with the People of Chimnissing. In his piece, "Tranquility" painted in 2001, the painted turtles *(mskwaadesi)* embody the symbol of healing and the reconstruction of Mother Earth. The Eagle represents the Ojibwe belief of the messenger answering our prayers; giving us the gift of strength and protection. *Miigwech* to Brenda St. Denis and for reprint permission from the Estate of William Monague.

ALL OUR RELATIONS

The Georgian Bay Mnidoo Gamii Biosphere gratefully acknowledges that we are located on *Anishinaabek* territory and that our office is currently located where the *Ziigwan* (spring) or *Gizhiijwan* (fast-flowing river) meets *Mnidoo-gamii*, Great Lake of the Spirit.

We respect and recognize the inherent rights and governance of the *Anishinaabek* pre-confederation and acknowledge the rights recognized in the Robinson-Huron Treaty of 1850 and the Williams Treaty of 1923.

There are a diversity of Indigenous cultures across Turtle Island. We honour the United Nations Declaration on the Rights of Indigenous Peoples and we strive to meet the Calls to Action set out by the Truth and Reconciliation Commission of Canada.

We are committed to our responsibility of relationship building with Indigenous peoples and respect their knowledge and ways of being.

We appreciate each of the communities in the region and thank them for sharing their knowledge and time with us.

- Wiikwemkoong Unceded Territory
- Dokis First Nation
- Henvey Inlet First Nation
- Magnetawan First Nation
- Shawanaga First Nation
- Wasauksing First Nation
- Moose Deer Point First Nation
- Chimnissing First Nation
- Wahta Mohawks
- Moon River Métis Council
- Georgian Bay Métis Council

Our organization is privileged and is working to unlearn some of what we have been taught and decolonize our ways of knowing and being. We need to hear the truth so we can reconcile with our past, create new relationships, and move forward together in a good way.

We wish to honour Indigenous resilience since time immemorial. We wish to express our gratitude to our Indigenous relations for continuously leading the way in sustainability, respect, and reciprocity.

We are grateful, Mother Earth. *Miigwetchwendam Shkakmigkwe*.

CARETAKERS OF THIS LAND

"If we are to consider ourselves as the true caretakers of this land, it is necessary that we live and understand our own culture, history, language, and traditional values. The teaching of our Elders must be sought after and honoured. Those with the intimate knowledge and ways of our people and land must be honoured and woven into the very fabric of our lives. The hope, the vitality, and the contemporary views of our youth are sought after and needed so that we can move forward in this joint effort."

–Elder Stewart *(Zhngos)* King, Migizi gii-odoodeman, Wasauksing First Nation

Sherrill Midwewekamigokwe Judge, Maawaanji'iwe Manager with GBB, releases a turtle hatchling in Shawanaga First Nation.

PHOTO CREDIT: STEVEN KELL

PHOTO CREDIT: THOM MORRISSEY

"Turtle Island, as it is known by the original inhabitants of this land, is considered sacred and remains a sanctuary and a place of affinity for all natural people. Our Creation story tells of our connection to this land, to the plant life, and to all living things. Our original instructions tell us that we must take care of all things placed here for us, and that they would provide for us during our lifetime. Our people were given a very specific language to communicate with all living things, both physically and spiritually."

–Elder Stewart *(Zhngos)* King, Migizi gii-odoodeman, Wasauksing First Nation. Excerpt from the 2011 Parks Canada publication "Working Together: Our Stories."

NISHNAABEMWIN: THE LANGUAGE OF THE BAY

Nishnaabemwin, the language of the Ojibwe, Odawa, and Potawatomi peoples, is an original language of *Mnidoo-gamii*. The *Nishnaabeg* ("the good beings") recognize their language as a sacred gift from the Spirit and know it to be representative of their original values, practices, and unique ways of thought. *Nishnaabemwin* is a highly adaptive language that matches the resilience and adaptive capacity of Indigenous nations. It is spoken throughout the Great Lakes region and beyond, in both Canada and the United States.

Despite the broad distribution and historic strength of the language, hundreds of years of colonial practice have decimated speaker numbers. We honour the efforts of Indigenous communities to revitalize and restore their language. Each of the local communities in *Mnidoo-gamii* are still blessed with fluent master language speakers whose words and wisdom are perhaps more important now than ever before.

We recognize and honour the various dialects of the *Nishnaabe* language (such as *Anishinaabemowin*, which is spoken further north and westward) and other Indigenous languages (such as Mohawk and Cree) that can be heard in the local region today. The increased diversity of languages and cultures has added special value to life in *Mnidoo-gamii*. *Nishnaabemwin*, which is resonant with the natural sounds of this place, holds unique value and positionality as the first language of the bay. It is why the sacred ceremonies and prayers of the *Nishnaabe* people continue to be made in their original language. It is the language that the land, water, and spirit of this place best understand.

Indigenous languages did not originally use an alphabetic writing system with symbol-sound correspondences. Evidence of historic Indigenous writing systems can still be found throughout *Mnidoo-gamii* in rock paintings and on birch bark scrolls. Traditional artistic expression, such as beadwork or quillwork, was occasionally representative of these historical writing systems, which more encoded stories or teachings as opposed to words. The double vowel system is the most popular way that *Nishnaabemwin* is written today. Having a semi-standardized writing system has been extremely helpful to the expansion of the language into educational, written, and technological domains. Various phonetic or syllabic orthographies have also been developed and may find expression in these pages. Any writing system works equally well, provided it is consistently and accurately used. What is most important, especially for an oral language such as *Nishnaabemwin*, is that the written guide supports the expressive use of the language.

Some basic principles of the double vowel system as it relates to the contemporary expression of *Nishnaabemwin* are shown here. This is a roman orthography, which uses many characters and sounds (such as consonants) that are already found in the English language.

PHOTO CREDIT: THOM MORRISSEY

A few unique pronunciation features of the double vowel system are highlighted below.

VOWELS

Nishnaabemwin is written with seven vowels—three short vowels and four long vowels. The following chart lists some English language words that have similar sounds.

SHORT VOWELS		LONG VOWELS	
a	"but"	aa	"saw"
i	"pit"	ii	"key" or "see"
o	"okay"	oo	"coat"
		ee	"leg" or "flag"
E.g. Mnidoo-gamii		***Say: Min-i-doh gumee***	

GLOTTAL STOP

A glottal stop is caused by a momentary pause or stoppage of breath. This is written in *Nishnaabemwin* with an apostrophe, as in *de'* ("heart") or *wen'enh* ("namesake"). This is a similar sound as found in the English expression "uh-oh."

–*Waabishki-makwa*, Dr. Brian D. McInnes, Wasauksing First Nation, University of Wisconsin

MNISINOOG: WARRIORS FOR THE BAY

Wasagaam ezhaayaan
To the other side of these waters do I travel.
Bmaashkaa bmaashkaa
The waves go along, the waves go along,
Ondaasgaam ge-giiweyaan
To this side of the lake will I return.

–Ojibwe Song

Many years ago, I was visiting with my great uncle Duncan Pegahmagabow on the Wasauksing reservation on Georgian Bay. The sun was setting over the water when the wind shifted direction and the dark blue waves were suddenly arrayed in yellow, orange, and brilliant red light. Then, as quickly as it had begun, the wind settled, and the colours of the fading day soaked into the dark, still water. A gentle peace descended upon us as my uncle acknowledged the completion of the sun's work that day.

"*Miigwech nmishoomis*—thank you grandfather," he said. His gentle Ojibwe words passed along the water before being carried off by the wind. It was a beautiful convergence of many things that my uncle summed up with one final word that evening: "*Mnidoo.*" The spirit.

I have often thought of that moment while travelling through the waters of *Mnidoo-gamii*—the Great Spirit Lake. It is a name that encapsulates the beauty, strength, and sacredness of the bay. It is also a name that no human being bestowed upon this place. It was instead *Nenabozho*, the great cultural hero of the *Nishnaabe* people, who first walked these shores and declared the forever name of this place. There were six such sister *gamiin*—the Great Lakes—but *Mnidoo-gamii* (Georgian Bay) was the Great Lake of the Spirit. It was a shared territory, of spiritual beings and humankind.

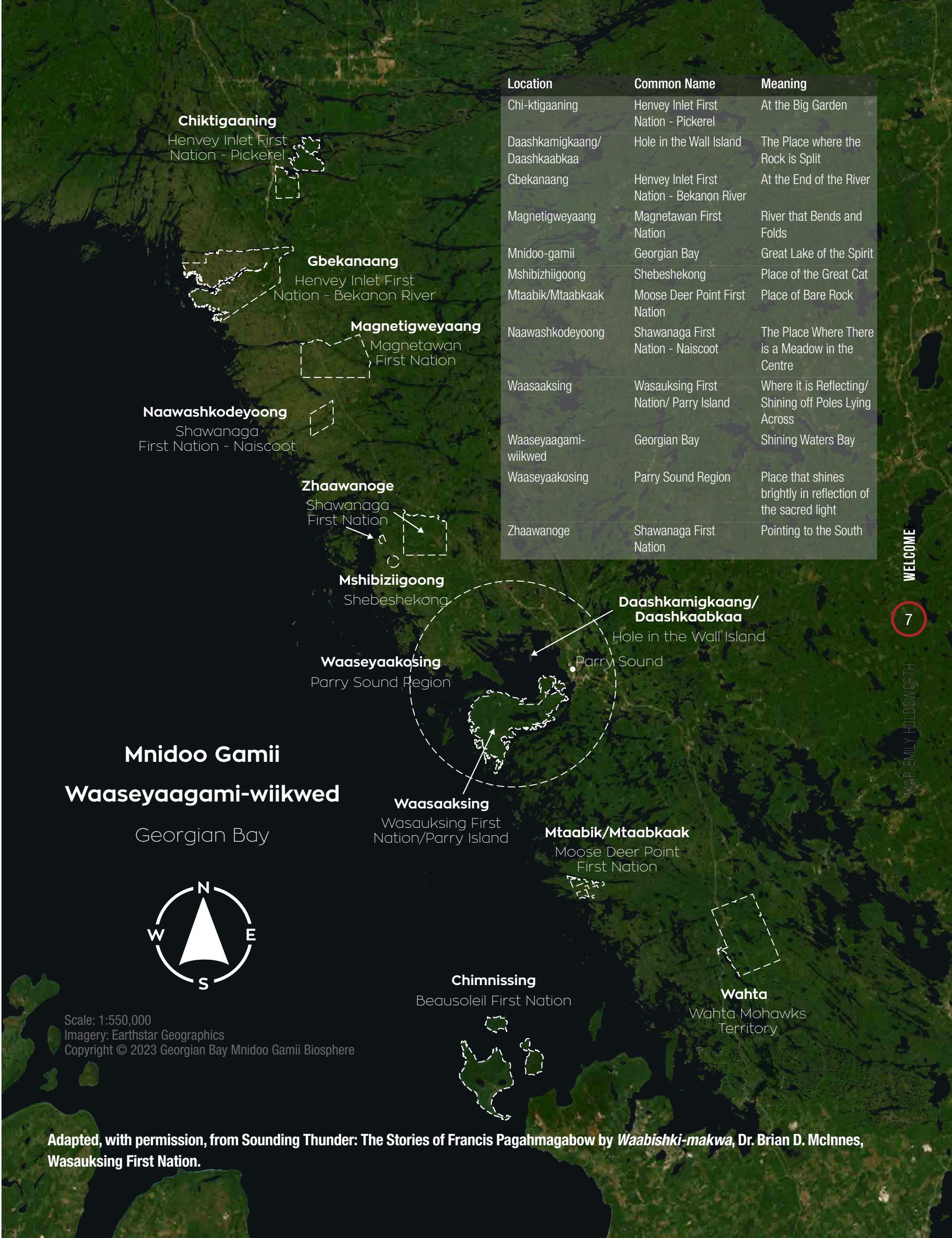
Merfolk swam in the deepest parts of the bay, seen only for an instant on the warm rocks of summer before disappearing into the depths. Giant white turtles and sturgeon—the chiefs of all the water beings—surveyed the extremities of their domains, while tribes of little people looked after the shorelines and sacred rock domains. Offerings of sacred tobacco were left for them all, and always for the great water lynx *(mshibizhii)*, whose blessing was needed for safe travel and a successful catch. The First Peoples learned to live with respect for the totality of the natural world—including both physical and spiritual domains.

In the old legends of the *Nishnaabe* people ("the good beings"), *Mnidoo-gamii* was created by the spirit guardians as a place of great richness and power. The ancient rock base of the Canadian Shield—amongst the oldest in the world—was said to contain all the wisdom and memory of the world. Shaped by the four elements, including the legendary journey of the great ice to the forever winter lands of the north, *Mnidoo-gamii* would become a sanctuary for both living and spiritual beings.

When conditions were ready for the First Peoples to be born, *Nenabozho* rose from his place on Manitoulin Island *(Mnidoo-mnising)* to make his storied walk throughout the landscape. The names and stories he gave to the world preceded human life but not human purpose—they would be, in many circumstances, the very reasons that humans came to be. The earth was filled with meaning and destiny before the first humans left their tracks in the sand—and they were gifted with a special charge for maintaining the sanctity of this place and the memory of its story.

PHOTO CREDIT: THOM MORRISSEY

Georgian Bay has one of the most diverse geographies of any Great Lake, perhaps other than Lake Superior *(Gchi-gami)*. From its towering bluffs, long, flat beaches, and seemingly endless channels that stretch far into the interior, it remains a place of both majesty and mystery. Each of the *gamiin* were distinct to the First Peoples. With their own names, stories, songs, and purpose, these lakes were connected to each other through a series of channels and even underwater passages.



Location	Common Name	Meaning
Chi-ktigaaning	Henvey Inlet First Nation - Pickerel	At the Big Garden
Daashkamigkaang/ Daashkaabkaa	Hole in the Wall Island	The Place where the Rock is Split
Gbekanaang	Henvey Inlet First Nation - Bekanon River	At the End of the River
Magnetigweyaang	Magnetawan First Nation	River that Bends and Folds
Mnidoo-gamii	Georgian Bay	Great Lake of the Spirit
Mshibizhiigoong	Shebeshekong	Place of the Great Cat
Mtaabik/Mtaabkaak	Moose Deer Point First Nation	Place of Bare Rock
Naawashkodeyoong	Shawanaga First Nation - Naiscoot	The Place Where There is a Meadow in the Centre
Waasaaksing	Wasauksing First Nation/ Parry Island	Where it is Reflecting/ Shining off Poles Lying Across
Waaseyaagami-wiikwed	Georgian Bay	Shining Waters Bay
Waaseyaakosing	Parry Sound Region	Place that shines brightly in reflection of the sacred light
Zhaawanoge	Shawanaga First Nation	Pointing to the South

Adapted, with permission, from Sounding Thunder: The Stories of Francis Pagahmagabow by *Waabishki-makwa*, Dr. Brian D. McInnes, Wasauksing First Nation.

MAP: EMILY HOLDSWORTH

Water—*nbi*—was the lifeblood of Mother Earth and essential for all existence. But so too was a comprehensive knowledge of the world. A sense of respect, and an innate curiosity for the scientific underpinnings of the world, characterized *Nishnaabe* experience in the world. The ability to receive spirit messages of healing and direction, combined with keen skills of investigation, observation, and analysis, helped ensure life would always be more than survival.

Nishnaabe people today still recall when there was no sickness that couldn't be cured through traditional medicine. The earth was a place of both revelation and introspection. Learning how to use available resources most productively and sustainably was all a part of *mno-bmaadziwin*—the good life, for the *Nishnaabeg*.

All of the stories about how the First Peoples come to *Mnidoo-gamii* are connected to the guidance of the Great Spirit—*Gchi-mnidoo*—during a time of need or change. In one compelling story still told today by *Nishnaabeg* along the eastern shore, a young boy went fasting during a great hardship. After breaking his fast early, he wandered the land while plagued by endless hunger and continuous growth until he dwarfed even the tallest trees.

After a long journey throughout the Great Lakes region, he came upon a young woman who was afflicted by worry about the fate of her people, who were searching the landscape for a new homeland. The boy agreed to help her by scooping up some sand with his giant hands and blowing it off to a distant and uninhabited place. As the grains of sand fell into the waters, they became a vast chain of islands that would provide sanctuary and protection for the young girl's people. This story of redemption ends with the boy being rewarded with an end from his ceaseless wandering and the young girl finding a new home that would never be taken away from her people. It is also within this story that the famous 30,000 islands find a place within the spiritual history of the *Nishnaabeg*.

The story of the great migration, expertly recounted by Ojibwe oral historian and ceremonialist Edward Benton in *The Mishomis Book*, details how the mainstay of the Ojibwe Nation travelled from their home on the eastern shore of Turtle Island to find a home in the interior of the continent. Guided by the words of eight spirit prophets who emerged from the Atlantic, the people set out to find a new home that would be revealed by freshwater oceans and food that grew on top of the water. They were told to watch for signs along the way—namely the appearance of a great spirit shell in the sky at seven different places.

This journey, which would take generations to complete, passed through *Mnidoo-gamii*, where the nation may have paused the longest. There was a familiarity about the land and water here—and the people developed a love for this place. The presence of *mnoomin* (wild rice)—the prophesied food that grew on the water—left many to wonder if this was the new homeland they'd been seeking. In time, however, the sacred shell emerged from the place of bright water *(waase-biishing)* and shone its light upon the eastern shore of the bay. The journey for the *Nishnaabeg* would continue—but not for all.

The bright light that shone upon the eastern shore of the bay proved an epic moment that left its mark upon the land and the hearts of the people. It was unquestionably time for the nation to continue westward and leave this place that had been home for generations. It was not entirely about the great shell that appeared in the sky and cast its light upon the land: how the land responded proved of equal consideration. The white colouration of the sand, metallic and crystalline rock, birch trees that lined the shoreline, and the bleached teepee poles along the beaches, reflected the shell's light in almost perfect luminescence: *Waaseyaakosing*—the place that shone in reflection of the sacred light. The end of summer marked the point at which it became necessary to travel onwards for the mainstay of the nation. The encampments from *Wasaagiing* (Wasaga Beach) to *Mnidoo-mnising* (Manitoulin Island) were retired and abandoned, save for some select groups that

PHOTO CREDIT: THOM MORRISSEY

elected to remain behind. In honour of the great reflection of the spirit light in this place, many vowed to remain and protect this new eastern doorway of the nation.

The *Nishnaabeg*, who shared much of the bay with the Huron Nation, maintained a peaceful and progressive co-existence. An exchange of goods and customs was a part of their relationship, but so too was a mutual respect and friendship.

Mnidoo-gamii connected multiple regions and groups in a vast pre-Columbian intercontinental trading network. The *Nishnaabeg* benefitted from participating in this exchange, which enhanced local culture and life. All such visitors were awed by the abundance of the bay and the good life it provided. The majestic old-growth forests reached to the heights of the sky and merged blue and green into a single colour in *Nishnaabemwin*—the language of the people. The waters provided an endless source of fish, and the land rewarded the people's hunting and agricultural pursuits. In time, the Ojibwe who stayed behind would join with their Odawa and Potawatomi relatives in a new age of strength and prosperity under the Three Fires Confederacy of nations. Through times of war and peace, the *Nishnaabeg* found strength in the spirit of the land and each other.

The four winds *(niiwin wendaanmak)* were prominently honoured and beseeched *Mnidoog* (Spirit Beings) whose blessings could ensure calm travel but also bend the largest pines and rock to their will. Evidence of their influence could be seen everywhere in the bay—in both the lasting changes they made to the land but also in how quickly still water could become a mighty tempest. There is not a rock, tree, or parcel of shoreline that has not been influenced by the winds and water. So powerful were the whitecaps *(waabi-dgowag)* that the *Nishnaabe* would describe them as animate beings—composed of inanimate water but with a spirit life all of their own.

This deep connection to the natural world became reflected in the thought and language of the people. Wasauksing Elder Fred Wheatley would often say that you could hear the unique sound of the land in the way the people of a region spoke. It is for this reason today that language remains one of the most important cultural aspects of *Mnidoo-gamii*—encapsulating words, ideas, and stories that frame a respectful and good way of living with the earth.

The story of how the 30,000 islands *(mnisan)* were formed in *Mnidoo-gamii* describes more than the creation of a physical home. It provided the people with an unbreakable strength and spiritual grounding in the land. It is, therefore, no surprise that the *Nishnaabemwin* term for warrior—*mnisinoo*—would also originate from this same connection with nature. The islands exist together as a seemingly endless and unbreakable collective. No two are alike, but they stand together as one—enduring some of the most extreme forces of nature with steadfast resilience. It is a construct that is also metaphorical of the distribution of Indigenous lands throughout *Mnidoo-gamii* today.

The reserve lands—aptly called *shkon'ganan* (that which is left over or saved) represent a mere fraction of the totality of lands lost by the *Nishnaabeg*. Part of our collective work today is to recognize the enduring connection that Indigenous peoples have to their complete original homelands and to respect and advocate for their enduring rights of access, stewardship, and even compensation.

A related task is to recognize what it means to live in a shared homeland in *Mnidoo-gamii*—the Great Lake of the Spirit. Protecting these sacred waters is a responsibility we all share today. We can find inspiration from the warrior tradition of the *Nishnaabeg*, whereby each individual stands as an island in defence of the land with all others. Continuing to learn from the *Nishnaabeg*, using the original place names, and helping restore the first language and stories of this place are all part of defending *Mnidoo-gamii* today. We must all stand together through the storms of the present, as allies and relatives, in defence of this new shared homeland that we must seek to protect for the next seven generations ahead.

—*Waabishki-makwa*, Dr. Brian D. McInnes, Wasauksing First Nation, University of Wisconsin

PHOTO CREDIT: THOM MORRISSEY

CLIMATE CHANGE

THE STORY OF OSHKINIGIG

In October 2019, several *Anishinaabek* youth from the territory led a *wiigwaas jiimaanke*. The focus of the build was to revitalize and celebrate the ancestral knowledge, teachings, and practice of building an *Anishinaabe wiigwaas jiimaan*.

Youth and participants were guided by the expertise of *Anishinaabek* canoe builders from throughout the Great Lakes. With community support and the dedication of more than 40 Parry Sound High School students and more than 10 Indigenous youth, the *jiimaan* was built in 19 intensive and beautiful days. Over 200 people from the community came together at a traditional gathering place to honour and launch the *jiimaan* into the waters.

The *wiigwaas jiimaan* is deeply rooted within *Anishinaabek* identity and culture. It connects people to the water, to the land, and to each other. A *jiimaanke* is a group effort, bringing together families and community members of all ages and with a wide variety of skills.

Building a *jiimaan* is one of the most complex forms of *Anishinaabek* science and technology. Over the past 150+ years, the practice of building *wiigwaas jiimaanan* has been interrupted due to policies of assimilation, such as the Indian Act and residential schools. Many *Anishinaabek* still have little to no access to their traditional lands and resources.

Kendaasowin loosely translates to “learning or knowledge.” The *jiimaanke* encompassed the use of language, cultural protocols, community and clan roles, and other elements of traditional practices.

Made of natural materials that have been harvested according to cultural protocols, every piece of the *jiimaan* is a gift that comes sustainably from the land and the forest.

- Hull: *wiigwaas* (white birch bark)
- Ribs: *giizhik* (cedar)
- Thwarts: *aagimaak/aagmaak* (white ash)
- Lashings and pitch: *gaawaandagwaatig* (white spruce tree)

The skills participants gained are specific to the cultural identity of *Anishinaabek* communities throughout the Great Lakes. These include understanding the characteristics of different trees and plants, as well as carving wood and stitching with spruce roots. The skills involved in canoe construction are easily translated into a variety of other artistic and scientific processes, such as making snowshoes or baskets, collecting maple sap, making fish spears, or building *wiigwam* and lodges.

Anishinaabe/Nishnaabe - Person
Anishinaabek/Nishnaabeg - People, Nation
Anishinaabemowin/Nishnaabemwin - Language
Anishinabe adziwin/naadziwin - Way of Being, Way of Life
Anishinaabe nendamowin/nendamwin - Way of Thinking
Jiimaan - Canoe
Jiimanke/Jiimaankewin - Canoe Building
Kendaasowin/Kendaaswin - Way of Knowing, Learning

Anishinaabek youth use their traditional knowledge and skills to take action on climate change by monitoring changes in nature, adapting harvests to those changes, and recovering Indigenous food sovereignty to build resilience. Protecting the land and water for future generations is a pillar of *Anishinaabe* philosophy and an idea that is woven into the canoe build and her caretaking protocols.

Kyla Zhowshkawabunokwe Judge paddling Oshkinigig.

During Falling Leaves Moon, on October 25, 2019, the community gathered for a ceremony with prayer, a smudge, and an offering to the sacred fire. The naming of the *jiimaan* was led by *Zahgausgai*, Elder John Rice. *Zahgausgai* is *Anishinaabe* from Wasauksing First Nation, and he is a member of the Bear Clan.

PHOTO CREDIT: KAYLA MARTIN; ART CREDIT: EMMA PETAHTEGOOSE

Founding members of Georgian Bay Anishinaabek Youth at the Oshkinigig ceremony and launch.

The canoe was then named *Oshkinigig* and taken for a paddle out on *Mnidoo-gamii*. Light as a leaf and strong as a bow, the *jiimaan* danced on the water as a loon watched from a distance.

Oshkinigig's name can be loosely translated to mean "The New Ones." *Zahgausgai* spoke about the *gig* (otter) who was calling out to the Four Directions for help, but ultimately it was the strong *Anishinaabek* youth persevering to learn their ancestral ways.

"The *jimaanke* has been instrumental in mobilizing and strengthening community dialogue surrounding relationships and responsibilities to protect our land and water for future generations. Increasing our sense of cultural identity, pride, and personal connection are important. The best part of the project was the celebration of community building as *Anishinaabek*!"

–Kyla *Zhowshkawabunokwe* Judge

"For so long, *Anishinaabek* have been told that we're not allowed to be *Anishinaabek*. We built a birch bark canoe on the traditional territory of Wasauksing First Nation, on a specific piece of land that was used as a place of physical and lateral violence against Wasauksing *Anishinaabek*. It's still challenging to have youth be part of these projects due to the systemic barriers they face, so our goal is to make these projects accessible and create a safe space for youth to build strong community and cultural connections."

–Kyla *Zhowshkawabunokwe* Judge

"The skills and knowledge that are used in building a *wiigwaas jiimaan* are no longer common today. The practice of canoe building has been interrupted over the last 150 years due to a number of issues, including loss of access to traditional land-base resources and to cultural assimilation. Due to impacts of colonization, such as residential schools and the Sixties Scoop, the knowledge and practice of canoe building has been buried."

–Taylor *Nanowaygahkekwe* Judge

"I learned patience. You have to take time to reflect on what you've done and the next steps that need to be taken."

–Dawson *Bidwayodaam* Bloor

Oshkinigig is resting at *Mukwa Nayoshing* (Bear Point, Killbear Provincial Park) unless she is travelling with the Georgian Bay Anishinaabek Youth.

Winter bark etching on Oshkinigig.

PHOTO CREDIT: DELINA RICE; ART CREDIT: EMMA PETAHTEGOOSE

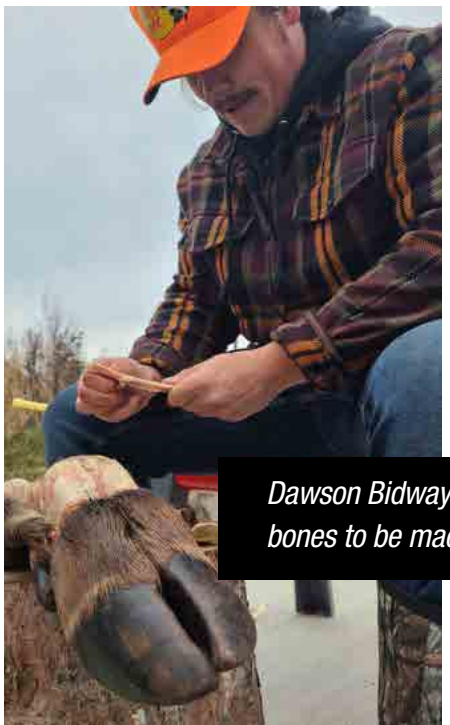
THE GIFT OF STORY

Over the years, the Georgian Bay Mnidoo Gamii Biosphere has been gifted with time, knowledge, connections, and stories from Indigenous people within the territory. These people include elders, healers, teachers, artists, grandmothers and grandfathers, and youth leaders. The Biosphere is grateful for these gifts, and in response holds a Cultural Advisory Circle open to all, four times each year for learning and sharing, intergenerational mentoring, and as a way to guide the path of the organization.

John Rice (Zahgausgai) giving Oshkinigig her name at the ceremony in October 2019.

Before *Oshkinigig*, there was a story gifted about the importance of the *wiigwaas jiimaan* shared by Elder John Rice *(Zahgausgai)* from Wasauksing First Nation. He told of the *Anishinaabek* connection to the river called the *Ziigwan* (like the season, spring) or *Gizhiijwan* (fast-flowing river) that flows through Wasauksing territory. It is currently known by settlers as the Seguin River but is reclaiming its original name. The story told of how before colonization, canoes were made and kept for anyone in the community to use.

The building of *Oshkinigig* was a vision shared by youth, elders, and adults alike to revitalize the *wiigwaas jiimaan* as part of *Anishinaabe* a*adziwin* and *ininemowin*. Elder Marilyn Capreol, *Anishinaabekwe* from Shawanaga First Nation and member of the French River Visitor Centre First Nation and Aboriginal Advisory Committee, provided a connection to federal resources for youth to build the canoe and support youth-led programming for the next seven years. *Miigwech* to those who continue to share their gifts.



Dawson Bidwayodaam Bloor preparing bones to be made into a tool called an awl.

GEORGIAN BAY ANISHINAABEK YOUTH

Georgian Bay Anishinaabek Youth (GBAY) is an Indigenous youth-led initiative in partnership with the Georgian Bay Mnidoo Gamii Biosphere. GBAY supports Indigenous youth along the rivers and eastern shore of *Mnidoo-gamii* and in Parry Sound, Ontario—within the Robinson Huron Treaty of 1850.

Anishinaabe nendamowin (thought/philosophy) is the foundation of GBAY. Their projects and programming are connected to Anishinaabe aadziwin (cultural land-based learning), and their goal is to create safe spaces for Indigenous youth to build strong community and cultural connections.

GBAY's first project was building *Oshkinigig*, the *wiigwaas jiimaan*. For GBAY, it was an act of reclamation and revitalization of *Anishinaabek* knowledge and identities. The depth of knowledge, skills, and capacity needed for harvesting, building, and caring for a *wiigwaas jiimaan* is a traditional rite of passage for *Anishinaabek* of the Great Lakes. *Oshkinigig* now travels each year through the territory as a teacher and a beautiful vessel for youth canoe trips and cultural learning.

It is a human right for Anishinaabek youth to be Anishinaabe.

By supporting each other, youth ages 12 to 29 have developed language revitalization programs, renewed their cultural practices, hosted ceremonies, and are relearning food sovereignty. GBAY has been able to reach hundreds of youth within the Georgian Bay Biosphere and across Turtle Island. While they focus on local communities, they see value in connecting Indigenous youth across *aki kwe*, Mother Earth.

The communities GBAY connects with face existing inequalities that have only been exacerbated by the pandemic. The youth GBAY are trying to reach face multiple barriers, so they create peer-to-peer programs that are as inclusive and accessible as possible—an act of decolonization they want others to follow.

The multitude of projects, programming, and partnerships of the initiative are examples of Indigenous innovation. In an era of reconciliation, it is necessary for Indigenous youth to see their realities as caretakers of the land reflected throughout *Mnidoo-gamii*.

Follow GBAY on Instagram
@GBAnishinaabekYouth

Taking the fur off a deer hide to prepare for drying and scraping during the 2022 hide tanning camp held in Magnetawan First Nation.

PHOTO CREDIT: DELINA RICE; GBB, GBAY

PHOTO CREDIT: MEG WALLACE

"But in those times, too, the winters were healthy winters in Pointe au Baril *(Gebiiyaang)*. There wasn't the drought we suffer now, and it was cold enough to freeze ice blocks that would have been four feet in depth…. And you know, I remember seeing those ice blocks when I was small, and the clarity so that we understood what the ice was, and the way the people used to mark the ice for safe travelling was they would cut a square there, pull it up and put it on the ice so that we understood that four feet over here, a foot and a half over here, no ice over there, that type of thing. And they needed to do that, the men and the families, because some of the families lived on the islands. And people had a horse and a sleigh. They were what I call the ice highways.

How has it changed? ... The abuse of a woman, the greatest one that we have, Earth Woman *(Skwagaamok)*. After listening many days on the ice in February 2023, and sitting on the shores, I understood Ice Woman's message of how weak she is becoming. You cannot stress this enough. I don't even know what 50 years from now is going to look like. The impact in that short time, that's how fast things are deteriorating. We're not looking at a four-foot block of clear ice as I did at five years old, six years old. And now I'm 74, or 962 moons. That's not a long time."

–Elder Marilyn Capreol, Shawanaga First Nation. Adapted from The Water Peoples: Stories of Growing Up on the Eastern Edge of Georgian Bay.

GLOBAL TO LOCAL

Climate change is the result of excess greenhouse gases (GHG) being emitted into the atmosphere as a result of human activity. The burning of fossil fuels, such as oil, gas, and coal, to power industry, vehicles, and buildings is the primary source of GHG emissions.

Before the Industrial Revolution (1760–1840), emissions were very low. However, with the increased use of fossil fuels to power machines, global emissions rose to 6 billion tonnes of carbon dioxide (CO2) per year by 1950. The amount had almost quadrupled by 1990, reaching a rate of over 22 billion tonnes per year. Currently, the world emits over 34 billion tonnes of CO2 each year.

Carbon dioxide and other GHG emissions are accumulating in the atmosphere and causing unprecedented rates of global warming. With an increase of over 1°C in global temperature, the world is already experiencing more frequent severe weather events, including heat waves, wildfires, and flooding. Almost everyone can point to a severe weather event that has occurred in the last few years.

The Intergovernmental Panel on Climate Change (IPCC) has underscored that global warming must be limited to **1.5°C** above pre-industrial levels. This will require drastically reducing GHG emissions and balancing remaining emissions through carbon sinks to achieve net-zero emissions by 2050.

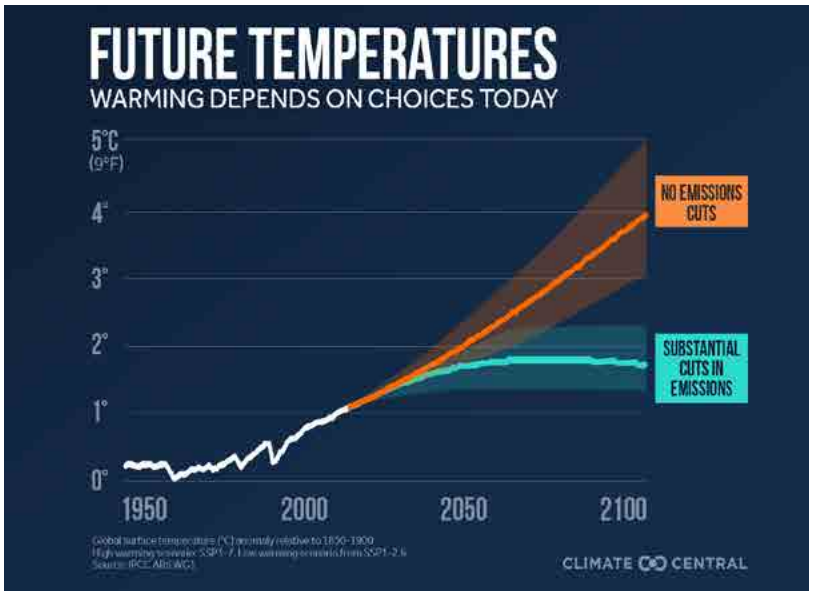


PHOTO CREDIT: CLIMATE CENTRAL

Addressing climate change is urgent. In Canada, communities are experiencing a rate of warming approximately twice the global average, due to the country's northern latitude. Communities within the Georgian Bay Mnidoo Gamii Biosphere, along with the rest of the world, must act now to avoid the worst impacts of climate change.

- Climate change is occurring right now.
- Our current human activity is causing it.
- We must act quickly to reduce the number of catastrophic events.
- Individual actions make a big difference!

"Climate change is one of the great challenges of our time. It is changing nature itself, our mental and physical health, our economy, and our livelihoods. Tackling climate change requires a shift in how we live and work and think. Working together, we can have a healthier, more prosperous and sustainable future."

–Regional Climate Action Plan for Georgian Bay Mnidoo Gamii Biosphere, 2023

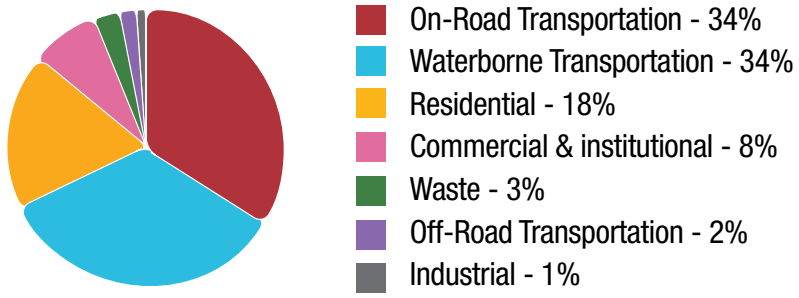
DID YOU KNOW?

GHG emissions in Canada are among the highest per person in the world, along with the United States, Australia, and China.

REGIONAL EMISSIONS

Below is a summary of the GHGs produced in the Georgian Bay Biosphere region, calculated using the Partners for Climate Protection model. Similar to other regions of Canada, the highest emissions are from transportation and residential buildings.

Total Regional Community Emissions, 2016 (5 Townships)



The calculation of emissions from waterborne transportation is not part of a standard model, so data was collected on recreational watercraft ownership, average engine size, fuel type, average annual operating hours, and average fuel consumption. This calculation does not capture transient watercraft (coming from outside the region), nor commercial barges or fleets. Until a standard model is developed or more data is available (including fuel sales), these are the best estimates possible and part of an important conversation about reducing recreational GHG emissions in eastern Georgian Bay.

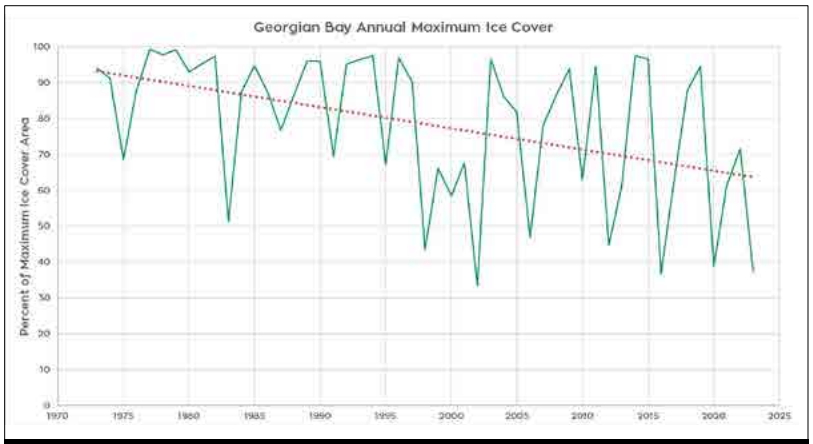
Use our carbon calculator to calculate emissions from your household or business, then set a goal to reduce them. Just by washing your laundry in cold water and hanging it to dry, you can reduce your GHGs by about 1 tonne each year! To calculate the GHG emissions of your home or business, visit: **gbbr.ca/carbon-calculator**

CLIMATE IMPACTS

ICE COVER

By looking at ice cover data for Georgian Bay, we can see a warming trend in our region. The Canadian Ice Service has been recording ice cover weekly since 1973. A variety of techniques are used to track changes in ice cover, including real-time satellite observations that record the area of ice cover, maximum and average ice thickness, and the duration of ice cover each year.

There is considerable variation in ice cover from year to year; this is common for most climate-related data. Despite colder and warmer years, the maximum annual ice cover for Georgian Bay from 1973 to 2023 shows a warming trend over the past 50 years.



Maximum annual ice coverage for Georgian Bay from 1973 to 2023. Data from the Canadian Ice Service.

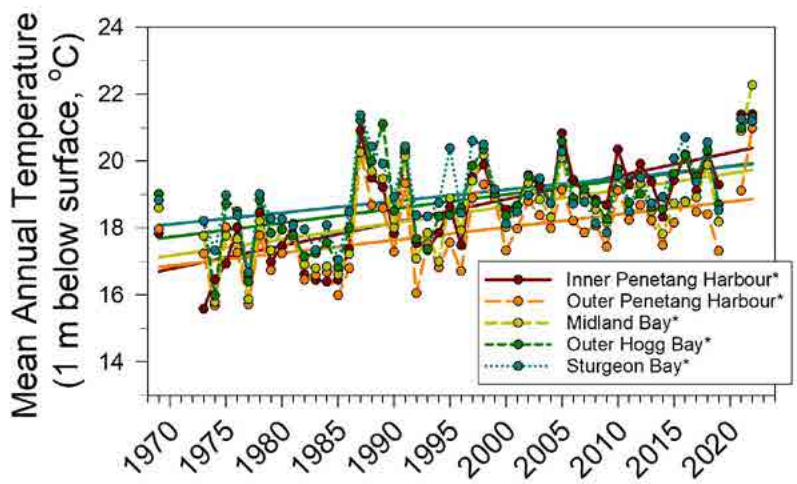
Winter 2023 saw temperatures 4°C above normal, with temperatures 6°C above normal in January 2023. Warm air temperatures in winter resulted in record low ice cover on the Great Lakes, with only 7% coverage recorded on February 13, 2023. This is 35 to 40% below the expected ice cover for this time of year, according to the National Oceanic and Atmospheric Administration, which monitors the Great Lakes.

WATER TEMPERATURE

Results from summer surface water temperature data show a similar warming trend to ice cover. From 1980 to 2022, the average summer surface water temperature in Lake Huron rose between 0.4°C and 0.8°C per decade.

In Severn Sound, the mean ice-free season (May to October) surface water temperature at five locations increased significantly from 1969 to 2021. According to the Severn Sound Environmental Association, seasonal mean surface water temperature has risen by an average of 2.3°C over the last 53 years, or 0.4°C each decade, with the temperature in early October increasing at double the rate for mean temperature.

While these changes might not seem significant, an increase in water temperatures of up to 8°C over the next century could change the aquatic ecosystem as we know it. This rate of warming may be too fast for some aquatic species to adapt.



*Mean annual summer surface water temperature for the Severn Sound area from 1969-2020. * indicates significant trends over this period.*

Like Georgian Bay, surface water temperature in inland lakes is also projected to increase. In 2021, a Ministry of Natural Resources and Forestry report showed that surface water temperatures may increase by 3.0 to 4.1°C by the 2050s. Similarly, the ice-free season is projected to lengthen by between 37 and 53 days by the 2050s. These changes will have considerable impacts on fish habitat across the province. Coldwater species, like lake trout *(nmegos)* and brook trout, will lose habitat across the province, while warm water species such as smallmouth bass *(noosa owesi)* will gain habitat.

PHOTO CREDIT: GBB, SEVERN SOUND ENVIRONMENTAL ASSOCIATION

COMMUNITY HEALTH AND WELL-BEING

Health effects of climate change are beginning to be better understood. Community vulnerability is being studied and discussed locally to find ways to protect at-risk populations and create short- and long-term adaptation strategies to help communities prepare for the future. Populations most vulnerable to the health impacts of climate change include seniors, children, those who are socially and economically disadvantaged, those with chronic diseases and compromised immune systems, Indigenous populations, and residents of northern and remote communities.

Health and well-being is directly and indirectly affected by climate-related effects, such as:

- Extreme heat, floods, wildfires, hurricanes, ice storms, droughts
- Reduced drinking water quality, availability, and access
- Increased air pollution and greater exposure to UV radiation
- Increased food contamination and spread of vectors that cause disease
- Changes to economic livelihoods
- Impacts to mental health
- Changes to Indigenous hunting, fishing, food sovereignty, and way of life
- Food shortages and resulting food insecurity

PHOTO CREDIT: OLIVIA FINES

In response to the pandemic, GBB created their GrowingTogether program in 2020 to help those facing food insecurity. The program includes managing community garden plots and distributing hundreds of food container gardens to those in-need.

Climate justice policies and initiatives address climate change and equity at the same time. They recognize that colonization and industrialization are some of the major drivers of climate change globally, and that climate actions that deepen injustice will not be fair or effective solutions for the planet and people.

"A climate emergency, increasing disparity and poverty, the housing crisis. These complex and intractable issues are challenging livability in Canadian cities. They are interrelated, and intervention strategies for one impact the others. By understanding and addressing energy poverty, policymakers can advance progress on a number of these critical priorities and ensure we 'leave no one behind' in the low-carbon transition."

–Canadian Urban Sustainability Practitioners

As of 2019, 55% of households in the Parry Sound District were found to be "energy poor," where 6% or more of after-tax household income was being spent on home energy.

The upfront costs of energy retrofits are a barrier to many. Strategies are needed for affordable retrofits to improve the energy performance and comfort of inefficient housing that can be too cold, too hot, or too damp. Part of having affordable housing for all means designing homes to be energy efficient, like the one built by Habitat for Humanity in Pointe au Baril in 2020. Communities that generate clean, renewable power locally can also help manage energy costs for residents and create grid systems that are more resilient.

"We believe that Indigenous peoples' rights and knowledge systems are critical to developing solutions to the climate crisis and achieving climate justice."

–Indigenous Climate Action

Concerns have been raised by several communities in the Anishinabek Nation over declining moose *(mooz)* populations in their traditional territories. Three communities, Biigtigong Nishnaabeg, Magnetawan First Nation, and Shawanaga First Nation, collaborated on a study with the Anishinabek/Ontario Fisheries Resource Centre, Laurentian University, and Mount Allison University to gather local knowledge and perspectives on how declines in the moose population are affecting food security, well-being, and ways of life. Community members identified factors associated with moose declines, shared how declines are impacting the community, and their perspectives on community-led moose monitoring and management.

The primary factor contributing to moose declines was overharvesting, with climate change and road mortality as other significant pressures. Shawanaga First Nation community members shared that the timing of the moose calving season, level of predation, and the persistence of moose habitat are, or will likely be, influenced by warming temperatures as a result of climate change.

High water in the Parry Sound harbour in June 2020.

FUTURE CLIMATE CHANGE SCENARIOS

By 2100, the world will have changed in ways that are difficult to imagine—as difficult as it would have been at the end of the 19th century to imagine the changes of the past hundred years. International scientists have studied the driving forces of climate change to develop scenarios of what might occur, using models that reflect different types of demographic change, economic development, and technological change.

Climate change scenarios present a range of "possible futures" depending on GHG emission levels combined with other factors. Models use different global emission levels (low, medium, or high) and factor in the cumulative predicted rise in global temperature. Since it has risen 1°C over the past century already, scientists have warned that actions must be taken to limit global temperature to 1.5°C.

Although many believe that catastrophic rises can be avoided with immediate global GHG mitigation, a variety of scenarios where GHG emissions continue to grow have been developed to help understand what future effects could be like (regional temperatures and precipitation levels, for example) and to paint a picture of future conditions.

PRECIPITATION

Recent climate change reports have suggested that Canada's climate is warming twice as fast as the global average, in turn affecting regional temperature and precipitation. Changes in temperature can affect the timing and amount of snowpack, soil freezing, snow and ice melt, and rainfall potential during colder seasons, as well as the timing, intensity, duration, amount, and type of precipitation events (rain or snow).

While precipitation is generally projected to increase in the future, summer precipitation, particularly in parts of southern Canada, is projected to decrease. Despite an increase in rainfall at certain times of year in some regions, periods of extended hot, dry weather are projected to become more common, leading to drought conditions.

"The most serious impacts of climate change are expected to be the changes in climate extremes … The changing frequency and intensity of precipitation can be expected to lead to a changing likelihood of extreme events, such as floods and droughts."

–Independent Review of the 2019 Floods in Ontario

HEAT EXTREMES

Under a low GHG emissions scenario, Ontario could experience 4.7 more "hot days" each year, where the maximum temperature is above 30°C. And under a high GHG emissions scenario, Ontario could experience 38 more hot days each year.

With drier conditions projected, the number of wildfires could potentially double by 2040. In 2018 there was a record 1,325 wildfires in Ontario, including Parry Sound 33, which burned 11,362 hectares. To visualize the size of forest fires, one hectare is about the size of a football field.

In 2021, Ontario experienced dry, hot weather, and northwestern Ontario faced drought conditions not seen in close to 50 years. Severe drought and dry weather led to 1,198 fires. In total, more than 793,000 hectares of land were burned, a span larger than the Greater Toronto Area.

Fireweed thrives in areas that have been burned by forest fires.

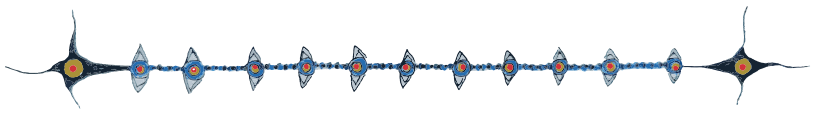
PHOTO CREDIT: THOM MORRISSEY

LAND MANAGEMENT THROUGH SHKODE

Fire *(shkode)* as a land management tool has been a practice for many Indigenous groups across the world. The *Anishinaabe* use fire as a way of influencing the land and restoring ecosystems. Blueberries *(miinan)* and other species thrive after fire burns the competing vegetation and releases nutrients, creating better growing conditions and more abundant harvests. Indigenous peoples have long managed forest habitats in ways that could promote or reduce the risk of fire, depending on their needs.

However, colonization completely disrupted the fire ecology practices of Indigenous peoples. Fire was seen as a threat and was suppressed. In turn, forests lost some resilience created by regular burning and became more vulnerable to larger fires. Because fire was viewed as a destructive force, the Fire Act was created in 1878, with jail time for people who caused or started fires. Fire Rangers were also introduced to enforce the Act; they used fire towers, like the one on Tower Hill in Parry Sound, to patrol fires on Wasauksing First Nation. Despite the laws, the *Anishinaabek* persisted in having low-burning fires to help clear the understory so that blueberry plants could thrive.

Indigenous knowledge has informed contemporary forest management practices to help avoid large-scale forest fires. Massive fires should not occur as often when "controlled burning" is used on a more regular basis. Unfortunately, forests are more vulnerable to fire than ever before as global temperatures rise with climate change and local drought conditions become more frequent.



"I had a conversation with my uncle and Elder, John Rice *(Zahgausgai)* about cultural burning practices in the Wasauksing area. He said that burnings would take place along the undercut of the forest and along shorelands to help clear the forest and prevent forest fires that would occur due to accumulated dry brush. Using fire as land management through cultural burning is a part of caring for the earth. In my understanding of cultural burning, it is a way that Indigenous people can manage land or forest by starting controlled fires in areas to help with regrowth and rejuvenation of certain species. There are some plants that need fire to reproduce. Jack pines are an example of a species that needs fire for seed cones to open so they can reproduce and grow."

–Gracie Crafts, *Niizhogiiziskwe*

FIRE KEEPING FOR THE FUTURE

Women are given the role of water keepers in *Anishinaabe* traditions. Men are given the role of fire keepers. Fire keepers traditionally monitor the age and health of forests and other ecosystems. They would observe changes in the abundance of plants, animals, and harvests, as well as changes in biodiversity, to help determine times to use fire. Burning times would happen during the fall and spring, when the ground is wet.

Wind direction also helps determine burning times and can be used to control the direction that fire moves through an area. Sacred fires are kept at specific times within community life and ceremony. However, due to the loss of knowledge, there is a disconnect of roles within communities. Use of fire within the community and at social gatherings creates shared spaces and a deeper connection to land, sky, and water.

Two Spirit people have many roles in society and can be fire keepers, water keepers, carry eagle feathers, or fulfil other roles given to them. However, many of these teachings and traditional roles have been lost and are now being relearned and reclaimed. Youth, including Two Spirit youth, have the opportunity to reclaim this knowledge, along with important land management and leadership practices. Fire keeping is one of the ways that communities can adapt to climate change.

WHY HAS TRADITIONAL KNOWLEDGE BEEN LOST?

Anishinaabek became disconnected from fire practices through loss of knowledge and oral tradition due to colonization processes that began before Confederation. Assimilation policies introduced by representatives of the British Crown and policies upheld by European settlers disrupted the transfer of Indigenous knowledge between generations when children were taken from their parents and sent to residential schools. Children no longer learned their language, ceremony, or land management practices. Many laws were put into place to make traditional practices and ceremonies illegal for Indigenous groups.

It is important to understand the history behind the loss of traditional knowledge in order to understand why these practices no longer take place and why there is sometimes still so little information available about them.

Through stories, language, the teachings of elders and other support, some traditional knowledge can be reclaimed and revitalized, but it will never make up for what has been lost and stolen from communities over generations. As elders pass on to the Spirit World, some cultural understandings are lost forever. Ongoing colonization and the dominance of the English language threatens Indigenous languages with future extinction, making the reclamation of Indigenous knowledge urgent work.

RECOVERY AFTER THE PARRY SOUND 33 FIRE

Since the Parry Sound 33 (PS33) wildfire burned more than 11,000 hectares in 2018, researchers from the McMaster University Ecohydrology Lab have studied these ecosystems' recovery. While fire has occurred historically in eastern Georgian Bay, climate change makes more frequent and intense wildfires more likely. At sites near Key Harbour and in French River Provincial Park, the McMaster group studies the resilience of landscape components to increasing fire risk, and how they continue to provide habitat for vulnerable species.

The group primarily studies the effects of fire on peatlands: wetlands with organic soil at least 40 centimetres deep. They use a variety of methods, including laboratory and field studies, to understand how peatlands respond to fire. Through controlled peat-burning experiments in the lab, researchers determined that fire could lead to leaching of carbon-based and nutrient pollution.

After the PS33 fire, measurements showed that peatland areas with an initial depth greater than 70 centimetres were least likely to be severely burned. Meanwhile, shallow soils around peatland margins and in upland forest areas burned severely. In less-severely burned peatland areas, which researchers call "fire refugia," plant regrowth is off to a strong start. Four years after burning, more than 75% of *Sphagnum moss* in some peatlands had returned. Refugia represent about 9% of the area burned in 2018 and act as safe havens for plants and displaced animals. The researchers are developing a model to identify and protect refugia, to allow burned ecosystems to bounce back more quickly.

Sphagnum moss takes large amounts of carbon dioxide out of the atmosphere as it grows, but it could be 30 years before peatlands recapture the 500,000 tonnes of carbon dioxide released by the fire.

Researchers in the McMaster Ecohydrology Lab conduct field research in a peatland several years after the PS33 wildfire.

By studying aerial images of 144 wetlands, researchers found that small peat-filled wetlands were most common in the PS33 fire area. About 30% of studied wetlands were larger and more spatially complex, with floating peat and open water patches in addition to solid peat. Wetlands covered by solid peat were more severely burned, while complex wetlands with open-water patches were more fire-resistant. Not only that, but water flow into complex wetlands was often controlled by beaver dams. This new understanding can help fire and landscape managers identify areas most vulnerable to burning, and those in the greatest need of conservation.

The Georgian Bay Mnidoo Gamii Biosphere is home to several at-risk reptile species, including turtles that nest in moss- and lichen-covered soil. While turtles require soil to be at least 8–20 centimetres deep, researchers found that burning decreased the number of soil deposits deep enough for nesting by about 72%. Now researchers are assessing whether burned habitats sufficiently incubate turtle eggs and prevent them from drying out. They are doing this by measuring the temperature, moisture, and drainage conditions of soil in burned areas and comparing the results to those of unburned nests.

In the wake of the PS33 fire, the McMaster Ecohydrology Lab continues to work on understanding the impacts of wildfire on peatlands and develop strategies for preserving resilient areas and restoring habitat as climate change progresses.

At-risk turtle species nest in lichen- and moss-covered soil deposits in depressions on Canadian Shield rock in the Biosphere.

Spatially complex wetlands, with patches of floating peat and open water, are less likely to severely burn during wildfires.

PHOTO CREDIT: DR. PAUL MOORE

PARTNER PROFILE

INTEGRATED COMMUNITY ENERGY & CLIMATE ACTION PLANS

Established in 2019, the Integrated Community Energy and Climate Action Plans (ICECAP) is a partnership between the Georgian Bay Mnidoo Gamii Biosphere and area councils for addressing climate change as a region. Communities are working together to reduce GHG emissions, adopt new technologies, and adapt to climate impacts.

To reduce GHG emissions and adapt to climate change, each participating community is developing action plans that work toward emission-reduction targets by improving energy efficiency and conservation, reducing fossil fuel consumption, adapting to new technologies, creating supporting policies, and involving community members. Each of the local plans help to achieve the targets set in the Regional Climate Action Plan, which include reducing regional emissions by 6% below 2016 levels by 2030 and striving to achieve net-zero emissions by 2050. This 2050 target aligns with Canada's current commitments.

Net zero describes a balance of GHG emission sinks and sources over a matching time scale. This means that the amount of GHG emissions released into the atmosphere is offset by restoring and protecting natural areas that sequester carbon.

Learn more at **gbbr.ca/climate-action**

SUSTAINABLE TRANSPORTATION

- Increase active transportation (cycling, walking)
- Increase use of Zero Emission Vehicles (ZEV)
- Improve electric vehicle (EV) infrastructure
- Improve transportation efficiencies

GREEN BUILDINGS

- Retrofits and energy efficient appliances
- Low-carbon building practices and policies
- Net-zero building designs
- Generate clean, renewable energy

WASTE REDUCTION

- Reduce the volume of waste produced
- Reduce the volume of waste disposed at landfills
- Improve re-use, repair, recycle
- Improve organic waste programs (composting)
- Challenge community institutions, business, and industry to reduce their waste

PARTNER PROFILE

MOOSE DEER POINT FIRST NATION

Millie Williams (left) at a climate workshop with Mat Beaulieu (right) in March 2023.

Moose Deer Point First Nation is committed to climate action. As part of their overall approach, they are using community energy planning as a tool for reducing community energy costs and emissions, while also building energy resilience.

In 2022, Community Energy Champion Millie Williams helped to evaluate and implement energy-related priorities in the community. She organized educational workshops and helped many community members measure their energy use, costs, and GHG emissions.

Using this information, Millie helped community members undertake home retrofits that reduced energy consumption and saved energy costs. Retrofits included projects like improving home appliances with energy-efficient fridges, freezers, dehumidifiers, and air conditioners. Other measures included weather sealing and switching to LED lighting, along with future proposals for high-efficiency windows and doors.

Connecting Guardians in a Changing World was a two-day workshop involving a series of facilitated sharing circles with elders, knowledge holders, youth, and environmental professionals. Participants discussed their greatest climate change concerns related to the environment, to their community and ways of life, and their climate change research priorities and needs.

"The workshop discussions further reflected the vulnerability of Indigenous cultures, health, and well-being to the impacts of climate change, in part due to strong connections with the environment through traditional ways of life."

–Connecting Guardians in a Changing World workshop report

PHOTO CREDIT: GBB

TAKE CLIMATE ACTION

1. Push for new policies. Follow solutions for climate change, share your personal actions to influence others, voice your concerns to those in power, and spread the word to family and friends. Vote.

2. Active transportation. Think before you drive. Consider walking, cycling, skiing, rolling, or carpooling to your destination if you can. Transportation accounts for 70% of emissions in our region.

3. Choose cleaner energy. Switch your energy source away from oil and gas to cleaner hydroelectricity or renewable energy, such as solar, geothermal, or wind. Retrofit your home with a heat pump.

Clean energy generation produces energy without emitting any greenhouse gases. Examples include solar-power systems, wind turbines, geothermal, and biofuels, referred to as “renewable energy” sources, which are created by natural processes that replenish at a rate equal to or faster than the rate at which they are consumed.

4. Consider zero-emission vehicles. The average Canadian vehicle burns 2,000 litres of gasoline every year and releases about 4.6 tonnes of CO2 into the atmosphere. Investing in an electric vehicle can have one of the biggest impacts on reducing GHGs.

Sales of electric vehicles are growing in Canada. An increasing number of EV charging stations can be found in the Biosphere region, with more planned to support the growing number of EVs on the road. With more charging stations, better battery technology and range per charge, EVs have been shown to save money on fuel and maintenance over time. See the map at **plugshare.com**

5. Be energy efficient. Turn down your heating and air conditioning. Use LED light bulbs. Turn off the lights and unplug! Look for Energy Star labels when buying electronics or appliances. Consider a tankless water heater, timer, or smart device to manage energy use.

6. Your food choices matter. Eat less meat, especially beef. Meat consumption contributes to deforestation, as well as the release of methane and other greenhouse gases. The UN Food and Agriculture Organization estimates that livestock production is responsible for at least 14.5% of global GHG emissions, the majority from cattle.

7. Reduce your waste. Garbage buried in landfills produces methane, a potent greenhouse gas. Compost when you can. Recycle paper, plastic, metal, and glass. Buy less, reuse, and repair. Rethink gifts.

Compost. Several local governments are working to reduce the estimated 40 to 60% of organic waste going into landfills by promoting composting. Not only does composting reduce the production of methane (a potent greenhouse gas), but it also creates nutrient-rich mulch from kitchen scraps and yard waste. Electric kitchen countertop food waste units are also available.

8. Plant trees. Trees store carbon dioxide, helping to remove it and other greenhouse gases from the air. You can also help reduce deforestation by purchasing recycled or sustainably sourced paper.

PHOTO CREDIT: OLIVIA FINES, GBB

WATER QUALITY

WALKING FOR WATER

Wasauksing First Nation members participated in the second annual Mother Earth Water Walk across Parry Island in 2012. The event includes ceremony and prayer, celebration and raising awareness to heal and protect water everywhere.

"As a school (Wasauksing Kinomaugewgamik), we like to call ourselves Water Protectors. We try to highlight water protection year-round. It is our way of life. It's part of who we are as First Nation peoples. No matter where people reside, what we do for a living, our beliefs or age, all of us must relate to water in order to live. Our community wants this kind of life for our children, to be able to openly practise our culture without fear.

In our water ceremony, we always make sure we have four generations of women represented so that these teachings can be continued and passed on. The women carry the copper vessel filled with water from Georgian Bay and sing a water song, and the men carry the Eagle Staff. We are trying to bring more awareness that water is life to us and the importance, the sacredness of water and the life it gives to us and everything in creation—the earth, the animals, the plants, the trees—everything.

Kendan niibiish, kendan bamaadiziwin
Know water, know life"

–*Ozawaanimkeeqwe*, Deina Bomberry

Students at Parry Sound High School conducted the school's first water walk in 2017.

WATER KEEPING

In *Anishinaabe* culture, protecting and caring for the water is a role given to women. During a Water Walk, *Anishinaabeg* women move in ceremony to honour water as a living entity.

Grandmother Josephine-Ba Mandamin was an Elder and Water Keeper from Wiikwemkoong Unceded Territory. She began Mother Earth Water Walks when she walked around Lake Superior in 2003. She was joined by others who continued to walk around each of the Great Lakes to pray for the water and raise awareness about the importance of healing and protecting water.

"When you walk with the water, you have to listen to what it's trying to tell you."

"Everything we do now will impact our grandchildren for seven generations. If we discontinue our negligence, we can change things around."

–Josephine-Ba Mandamin, *Biidaasige-Ba*

Grandmother Josephine-Ba walked more than 40,000 kilometres to heal the water. Autumn Peltier, Josephine-Ba's great niece, continues her legacy as part of her water advocacy work.

"The Water Walker is medicine roaming the earth, bringing love and prayers."

–Isaac Murdoch *(Bomgiizhik)*, artist

PHOTO CREDIT: CODY STORM COOPER/NORTH STAR, MELISSA BEASLEY

PHOTO CREDIT: GBB

"Fire *(shkode)* and water *(nibi)* balance each other. They need each other in order to be present. Examples of this balance can be seen in the natural world, as water can control where fire may burn, and fire can be used to shape the land. This teaching reflects the balance of roles in the *Anishinaabek* community: women are seen as caretakers of *nibi*, and men are seen as caretakers of *shkode*, with Two Spirit people able to fill both of these roles.

Water brings life into the world. Women carry babies in water until they are born. Water is what makes up everything and sustains us. We cannot survive without water. Men are firekeepers. Fire is the entrance to the spirit world and takes lives peacefully out of the world. Smoke from the fire is taken to the spirit world by birds and eagles. There are many teachings about being caretakers and keepers of *nibi* and *shkode*."

–Gracie Crafts, *Niizhogiiziskwe*

WATER QUALITY: TOTAL PHOSPHORUS

As the foundation of life in the waters of Georgian Bay, phosphorus is an important nutrient to measure when studying the health of the Bay. Phosphorus is essential for the plants and animals that make up the aquatic food web. Phytoplankton, such as microscopic algae, and aquatic plants require phosphorus to grow, so its quantity in a particular area is a good indicator of an aquatic system's productivity.

Phosphorus exists in different forms in water. It can be dissolved, bound to particles of soil and other materials, or contained within living or decaying plants and animals. Dissolved phosphorus is easily used by plants and algae and is typically found in low concentrations in unpolluted water bodies. Total phosphorus is a measure of all of these forms of phosphorus combined.

Natural Sources of Phosphorus

- Soil and organic matter
- Spring runoff
- Wildlife wastes
- Atmospheric deposition

Human Sources of Phosphorus

- Wastewater treatment plants
- Detergents and soaps
- Runoff from fertilized lawns
- Runoff from agriculture
- Failing septic systems

PHOTO CREDIT: THOM MORRISSEY, SEVERN SOUND ENVIRONMENTAL ASSOCIATION

Total phosphorus is also an indirect indicator of recreational water quality. Changes in levels of total phosphorus affect algae growth and water clarity, in turn affecting recreational pursuits, such as swimming, boating, fishing, and simply enjoying the beauty of Georgian Bay. Good water quality and healthy aquatic ecosystems are generally the most important concerns expressed by those living around the Great Lakes.

THE RIGHT BALANCE

The concentration of nutrients in a lake varies depending on how shallow it is, how warm it gets, and how many nutrients it receives from the surrounding watershed. Phosphorus is typically much higher in the spring because of snowmelt from rivers and streams, which carries nutrients into lakes. Some of the phosphorus is consumed during spring and summer, as phytoplankton use it to grow.

You may have heard the terms "nutrient-rich" and "nutrient-poor." In the context of water quality, these terms refer to the level of nutrients in the water; here we talk specifically about phosphorus. Nutrient-rich lakes are called "eutrophic," and nutrient-poor lakes are called "oligotrophic." The best examples of these are Lake Erie and Lake Superior: the former is shallow and warm, while the latter is deep and cold. Lake Erie gets high nutrient inputs from surrounding agriculture and human development; Lake Superior gets much less. There are many other factors at work, including the geology (type of rock and soils), hydrology (water flow), and the natural presence of phosphorus in sediments (internal load).

Having too much phosphorus can lead to excessive algae growth and even algal blooms. These algal blooms make water less attractive for cherished summer activities such as boating and swimming, and if you draw lake water for drinking, it will taste and smell foul. The algal blooms can also produce cyanobacteria, or blue-green algae, which can create toxins dangerous to both wildlife and humans. Oxygen levels in water decline as the algae decompose. Reduced oxygen kills fish, invertebrates, and other aquatic animals.

Not having enough phosphorus, on the other hand, limits productivity, or the amount of aquatic life that can be supported.

The Severn Sound Environmental Association monitors 14 open water locations throughout the ice-free season (May-October).

CLADOPHORA

Cladophora, a native, hair-like green algae species, has been making headlines in recent years because of its tendency to wash up in large decaying mats on shorelines in some parts of the Great Lakes, especially Lake Erie and Lake Ontario. The algae grow on hard surfaces, like rocks and shells, and when they die off, they break away from these surfaces, wash up on shorelines, and decompose. In places where *Cladophora* is prolific, these mats can become quite thick and smelly, impeding recreational activities. Fortunately, in Lake Huron, *Cladophora* biomass approaches nuisance levels only in select areas (Saginaw Bay, for example) that coincide with places where nutrients enter the lake.

"*Cladophora* is not found at visible levels in the nearshore of eastern Georgian Bay, nor has it been reported to foul shorelines in Georgian Bay, except in enclosed harbours."

–Todd Howell, Ministry of Environment, Conservation and Parks

To understand water quality in Georgian Bay, scientists look at two different regions of the Bay: the shallow nearshore waters along the coast and the deep offshore waters.

- **Nuisance algal blooms:** 15 to 20 micrograms/L of phosphorus (potential for harmful or nuisance algal blooms)
- **Georgian Bay nearshore:** 5 to 15 micrograms/L (nutrient rich, productive ecosystem)
- **Georgian Bay offshore:** 2 to 5 micrograms/L (nutrient poor and of concern to scientists)

Cladophora washed up on a beach in southeast Lake Huron.

PHOTO CREDIT: TODD HOWELL, GBB

OFFSHORE WATERS

In the deep offshore waters of Georgian Bay, phosphorus levels have naturally been low, representing an oligotrophic, or nutrient-poor, state. However, long-term trends show significant total phosphorus declines, with the most dramatic declines observed since the mid- to late-1990s. Offshore total phosphorus concentrations levelled out between 2010 and 2016 at around two micrograms per litre, well below the Great Lakes Water Quality Agreement objective of five micrograms per litre.

For the first time in recorded history, phosphorus concentrations are now as low as those of Lake Superior, and the offshore waters are being described as "ultra-oligotrophic," meaning total phosphorus levels lower than four micrograms per litre. These results represent an unprecedented low level of phosphorus. This is concerning because just like the shallow nearshore, the offshore open-water system requires enough phosphorus to support a healthy food web and stable fish community. The impacts of this falling productivity are still being studied but are already evident in changes to the lower food web and prey fish populations.

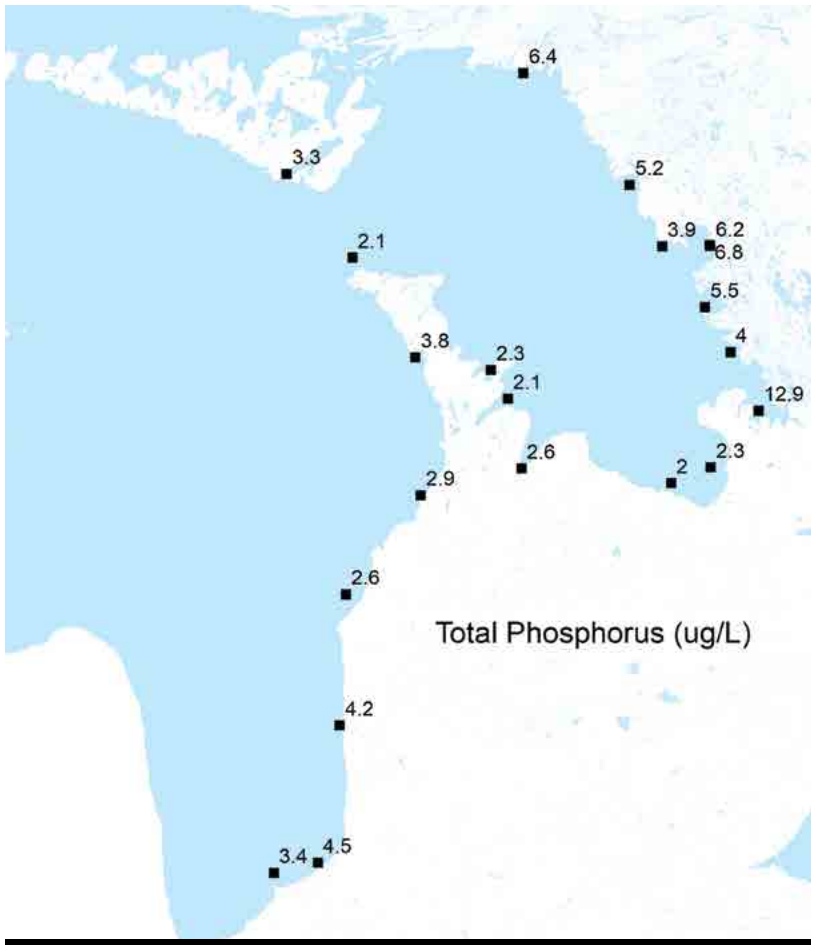
So where did the phosphorus go? The answer is not yet fully understood by scientists. Since the 1970s, efforts to reduce phosphorus pollution to surface water have been successful in reducing the occurrence of nuisance algae in the nearshore, but the invasion and rapid spread of zebra and quagga mussels likely has something to do with it, too. These mussels have an incredible ability to filter nutrients and algae out of the water. Each mussel can filter one litre of water per day, and there are trillions of them coating the lake bottom. Their feeding seems to have used up most of the nutrients in the offshore waters of Georgian Bay. However, there are likely more factors at play here, and further research is needed to better understand this phenomenon.

- **1970 to 1980s:** Aggressive reduction of phosphorus discharge into Georgian Bay
- **1990s:** Period of relatively stable total phosphorus, but arrival of invasive mussels
- **2000s:** Active filter feeding by mussels, thought to be related to lower total phosphorus levels
- **2016:** Unprecedented low total phosphorus showing fewer nutrients for ecosystem health

NEARSHORE WATERS

The nearshore waters of eastern Georgian Bay receive nutrients from the surrounding watershed. Nutrients from the landscape are transported into lakes and rivers with runoff, ultimately draining into the Bay and raising phosphorus levels, especially early in the year, after the snow melts. In shallower, protected bays, phosphorus levels can be much higher than in more open areas. This type of nutrient-rich habitat is considered very productive, supporting more species of algae and other aquatic plants, as well as a more diverse fish community.

In contrast to the offshore waters of Georgian Bay, nearshore waters along the coast of eastern Georgian Bay have not experienced the same dramatic loss of nutrients. In fact, some nearshore bays and other areas have the opposite problem: elevated nutrients contributing to nuisance algal conditions. In select nearshore areas, excess nutrient pollution can potentially lead to harmful algal blooms (HABs), and climate change could make the situation worse. Warming water temperatures may be causing faster plankton and algal growth and could lead to more bloom-forming cyanobacteria. More extreme precipitation events could also result in large inputs of nutrient-rich waters from stormwater runoff and soil erosion, potentially fuelling nearshore algal blooms. In addition, lake level changes and high wind and waves can cause erosion and disturb sediments, potentially releasing stored nutrients. The impacts of climate change on nutrient pollution are still being studied.



2022 total phosphorus levels measured at nearshore stations (2 to 5 micrograms/L = nutrient poor, 5 to 15 micrograms/L = nutrient rich)

PHOTO CREDIT: GBB, MINISTRY OF ENVIRONMENT, CONSERVATION AND PARKS

Phosphorus levels in the nearshore of eastern Georgian Bay are generally below the provincial objective of 20 micrograms per litre. However, a few locations have historically seen total phosphorus levels above 20 micrograms per litre, such as the French River and Sturgeon Bay. Unlike the relatively homogenous offshore waters, there is greater variability in nearshore conditions, which are more directly impacted by human activities on the coast and natural influences from adjacent watersheds. Exactly how much phosphorus is in the nearshore waters of eastern Georgian Bay, and therefore how productive these areas are, depends on several factors.

1. **Proximity to rivers draining water from the phosphorus-rich, forested watersheds of the Canadian Shield.** Rivers carry nutrients from their watersheds that ultimately end up in the Bay.

2. **How much mixing occurs between nearshore and offshore waters.** The amount of water exchange between the nearshore and offshore is determined by the connections between Georgian Bay's small nearshore bays and its open waters. More water exchange, or mixing, means more potential for the dilution of nutrients by the ultra-oligotrophic (nutrient-poor) offshore waters.

3. **Distance from developed areas of shoreline and intensive agriculture.** Rivers, drains, and shorelines also carry pollutants and excess nutrients that run off of city streets and farm fields.

Lake Partner Program water clarity measurements are taken every two weeks throughout the summer using a Secchi disk.

THE OFFSHORE TO NEARSHORE GRADIENT

The result of this dichotomy between the low-nutrient offshore waters and more productive nearshore waters is an offshore-to-nearshore gradient. The differences between the offshore and nearshore do not end with nutrients. Compared to the offshore waters, the nearshore waters:

- are more productive (more nutrients);
- are more coloured (higher amounts of dissolved organic carbon);
- are less clear (lower Secchi depth values);
- are less alkaline (soft water, rather than hard water); and
- have lower levels of calcium.

This gradient means that the offshore and nearshore waters can support different forms and amounts of aquatic life. For example, scientists have found that a certain amount of calcium (roughly 15 milligrams per litre or higher) is needed in the water for successful zebra and quagga mussel growth. With lower calcium levels in the nearshore waters, the growth of these invasive mussels appears to be limited. Higher calcium levels in the offshore waters allow the mussels to proliferate, with effects on water quality, namely declining phosphorus levels. The low-calcium waters entering the nearshore from the watershed have essentially protected these waters from the effects of invasive mussels.

HOW YOU CAN HELP

Reducing phosphorus pollution is still important! An increase in nutrients along the shore will not benefit the offshore deep waters but will instead accumulate, creating nuisance algal blooms—sometimes toxic ones. Here are a few ways you can control your phosphorus output:

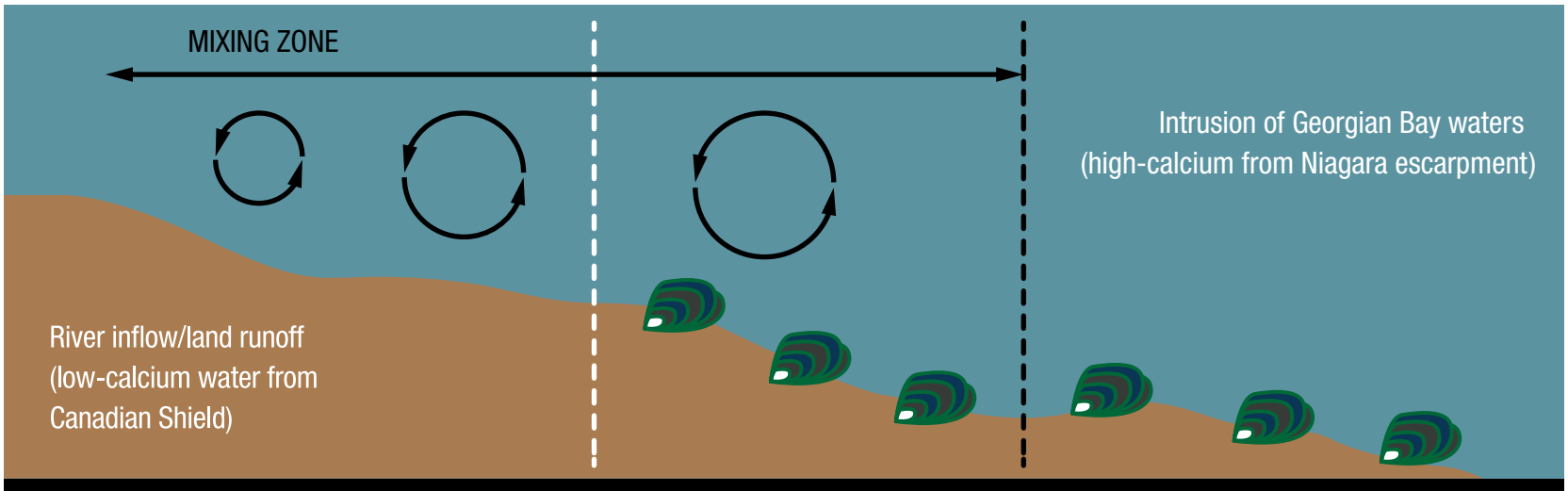
- Keep a buffer of native vegetation along shorelines, which reduces nearshore nutrients.
- Avoid the use of detergents and soaps with phosphorus.
- Maintain your septic system properly to avoid leaks and nutrient spills into water.
- Volunteer to monitor water quality near you!

As you read the rest of this report, think about the changes in phytoplankton, zooplankton, prey fish, and top predators. To what degree might these trends be related to the loss of nutrients in Georgian Bay? Researchers are working hard to find out!

GET INVOLVED

The Lake Partner Program (LPP) is an Ontario-wide, publicly funded, free program that collects data about phosphorus, water clarity, calcium, and temperature from volunteers. Total phosphorus and calcium samples are collected once per year, in the spring, and water clarity measurements are taken every two weeks throughout the summer. Find out if there is a volunteer monitoring water quality in your area by visiting ontario.ca/page/map-lake-partner.

Learn more about the LPP and how to volunteer at **foca.on.ca/lake-partner-program**



Zebra and quagga mussels require a certain amount of calcium in the water in order to thrive. The dashed white line represents the threshold calcium level for successful colonization of the invasive mussels. Figure adapted from Girihagama et al. (2022).

PHOTO CREDIT: OLIVIA FINES

PARTNER PROFILE

SEVERN SOUND ENVIRONMENTAL ASSOCIATION

Back in the 1970s, Severn Sound looked very different. High levels of nutrients, mainly phosphorus, going into the water from sources like municipal wastewater and stormwater, agricultural operations, and private septic systems, led to visibly degraded water. Low oxygen conditions led to fish kills in various parts of Severn Sound. Beach closures due to bacteria were common, and remnants from industrial operations, like logging, created degraded fish habitat and contaminated sediment.

The health of the Sound was so degraded that in 1987, the International Joint Commission, which advises on cross-border water-related issues in Canada and the U.S., formally listed Severn Sound as one of 43 Areas of Concern (AOC), or toxic hot spots, on the Great Lakes.

Hogg Creek before (left photo, 1991) and after (right photo, 2003) livestock exclusion fencing and streamside tree planting.

CLEANING UP THE SOUND

Collaboration between federal, provincial, and municipal governments, along with concerned citizens and farmers, led to the development and implementation of the Remedial Action Plan (RAP), designed to tackle the issues plaguing Severn Sound and its watershed. Major actions included:

- upgrading municipal wastewater treatment plants,
- implementing municipal stormwater management,
- restoring stream banks and shorelines,
- assessing fish habitat,
- supporting recovery of trumpeter swans by reducing lead hunting shot in the environment; and
- implementing agricultural best management practices (such as fencing livestock out of streams, planting trees, reducing tillage to minimize soil erosion, and improving manure storage).

OFF THE LIST, BUT NOT OFF THE HOOK

Working together, with significant investment and effort, Severn Sound was deemed to be restored and was officially delisted in 2003. At the time, it was only the second AOC to achieve this distinction, with Collingwood Harbour being the first. By that time, the RAP team had morphed into the Severn Sound Environmental Association (SSEA, established in 1997), and there was much celebration. Despite the improvements, several targets related to fish habitat were not fully met.

> "Our overall effort and success are excellent, and the RAP team should be commended. However … we should proceed as if we were approved and passed but forever on probation, lest we become complacent."
>
> **–Bob Whittam, former Public Advisory Committee Chair**

Twenty years have passed since the 2003 delisting of Severn Sound, and there continue to be many reasons to celebrate: levels of algae-fuelling phosphorus are much lower, and nuisance algae growth has dropped compared to the past. Many tree planting sites are thriving, and beach quality has improved. Municipal wastewater treatment continues to improve and is among the best in the province.

However, there are still stressors, including some that were not considered back in the RAP days. Issues like climate change, invasive species, shifting farming practices, and increasing urban development mean that efforts need to continue to ensure Severn Sound does not slip back to the conditions that made it a toxic hot spot in the first place.

The SSEA continues environmental monitoring and stewardship work as a Joint Municipal Service Board made up of eight municipal partners: Townships of Tiny, Tay, Springwater, Oro-Medonte, Georgian Bay, Severn, and the Towns of Midland and Penetanguishene.

For more information about the SSEA, including results from environmental monitoring programs, visit **severnsound.ca**

BEMISHKAAJIG: THE JOURNEY WE TAKE

Since time immemorial, and for the past several summers, Indigenous youth have gathered on the shores of *Mnidoo-gamii*—Georgian Bay—to paddle and to honour and celebrate their home, community, and identity.

In 2021, a canoe trip starting at Three Mile Lake continued around Wasauksing First Nation for four days. Canoes, gear, and camping equipment lined the shoreline of the lake in preparation for the first day of paddling and the first portage of the trip.

Participants in the Bemishkaajig canoe trip around Wasauksing First Nation.

"Our name, *Bemishkaajig*, was bestowed on us as a canoeing group by *Waabishki-makwa* Dr. Brian McInnes of Wasauksing. *Bemishkaajig* is a word that was used by Duncan Pegahmagabow-ban that refers to the journey we take as we paddle along the water, but it can also be applied to the way we journey through *Bemaadizi* [life]."

–*Wasanowndogizikwe*, Jordan Tabobondung

Wasauksing First Nation (WFN) invited local community groups to partner on the project. The Georgian Bay Anishinaabek Youth (GBAY), Parry Sound Friendship Centre, and Rama First Nation jumped at the opportunity to be out on the beautiful waters of *Mnidoo-gamii*. GBAY members and staff shared the responsibilities of paddling *Oshkinigig* over the course of *Bemishkaajig*.

"Paddling *Oshkinigig* was fun and challenging. We quickly learned how to care for *Oshkinigig* on the water and on the rocks. She turns well, so smooth and effortlessly. The day we paddled through Depot Harbour was very windy, with lots of huge waves crashing into the boat. It was quite challenging."

–Taylor *Nanowaygahkekwe* Judge

WFN provided a dedicated staff member to support the canoe trip by boat. Knowledge holders, elders, and guests were transported to each camping site to visit, share stories, and sing songs with the youth. Some were new to canoeing, so it was important to carry extra safety gear and equipment, in addition to a heavy load of food. Youth could be seen paddling up to the boat to replenish their water or grab a snack.

"It was so amazing to be out canoeing around my home. It was an awesome group of people to be out with, and no matter how tired some people got from the long days of paddling, you could always get a smile out of them. It was particularly special to have *Oshkinigig* out and see her on Georgian Bay."

–Dawson *Bidwayodaam* Bloor

Bemishkaajig offered a tremendous amount of learning for everyone involved. From paddling and logistics to reclaiming cultural understandings and connecting with traditional ways, the partnership enabled this story to be lived and shared.

"When we launched, one of the youth said, 'I wonder when a *wiigwaas jiimaan* [birch bark canoe] was last paddled here? I bet you my grandparents and their parents paddled a *wiigwaas jiimaan*.' The trip was exciting and emotional. For many of us, it felt like a homecoming. We had the opportunity to visit so many places and spaces in our homelands that we would not have had without canoes."

–Kyla *Zhowshkawabunokwe* Judge

PHOTO CREDIT: NIKEETA TABOBONDUNG, GBAY


Mishiikenh Kwe

ARTIST'S STATEMENT BY MISHIIKEHN KWE

This piece is called *Seasons* because it depicts the four seasons. In each season, there are plants and animals that sustain us through those seasons. The turtle represents creation, the land we live on, and the moon cycle.

The sun rises in the east, on the yellow line that represents that direction, as well as the spring season. The plants are fiddleheads and black spruce buds, which are harvested in the spring.

Below is the summer season, under the southern direction and in the direction of the red line. There are blueberries, strawberries, and roses. The sun is shining, and the days are longer.

The fall is when we harvest moose and cranberries. The fall is in the western direction, on the black line. The days start to get shorter here, so there are more stars than blue sky, as in the spring and summer months.

Finally, the winter is when my partner harvests beavers. The plants are red willow and wintergreen. The sky is mostly stars here because the days are at their shortest and the nights are long.

Altogether, the piece represents natural cycles and our connection, as well as our dependence as living beings on those natural cycles.

In my original design I had planned to name the four seasons in the language: *ziigwan* (spring), *niibin* (summer), *dagwaagin* (autumn), and *biboon* (winter). I decided not to include the words, as I do in most of my work, because I think of woodland art as a written language rather than just an art style.

Anishinaabe people have always used images to portray stories, thoughts, and teachings, traditionally as pictographs and birch bark scrolls. Now we mostly do colourful paintings and beadwork in the woodland style. I am happy to share this with you.

Miigwech.

–Mishiikenh Kwe

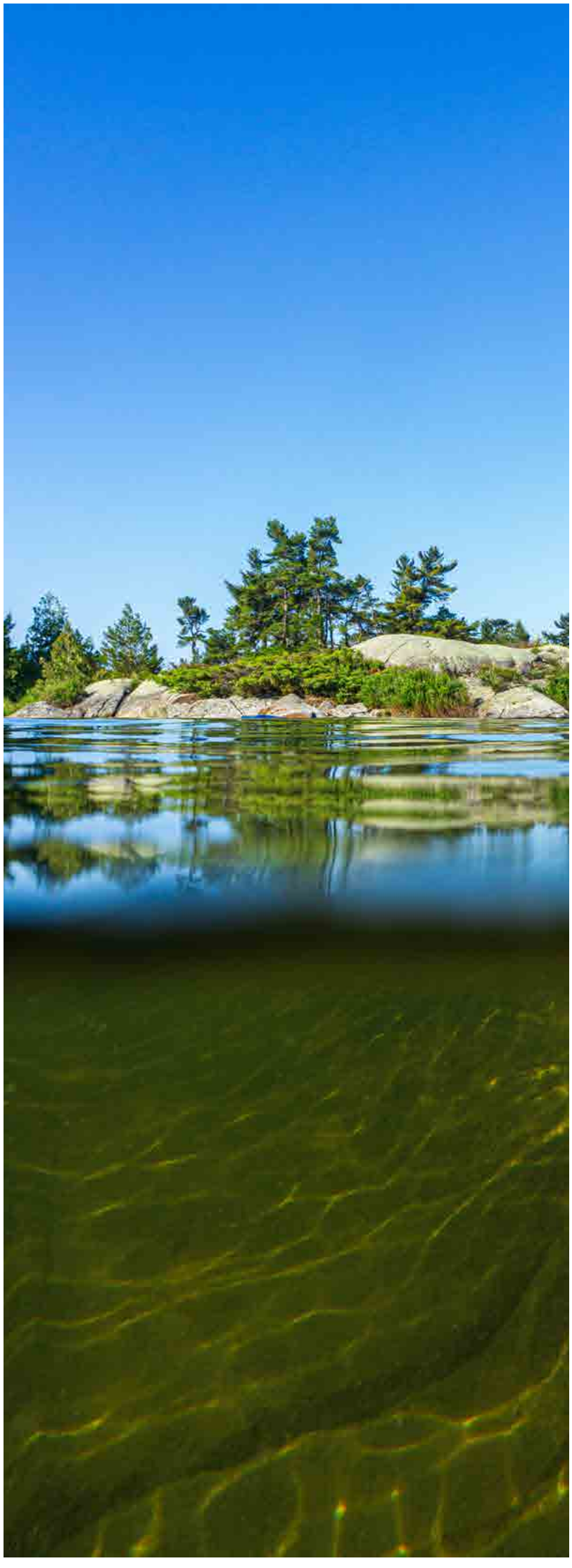


PHOTO CREDIT: THOM MORRISSEY

ODOODEMAAWIN: THE CLAN SYSTEM

Bear *(Mkwa)* Clan

Crane *(Jijaak)* Clan

Deer *(Waawaashkesh)* Clan

Eagle *(Mgizi)* Clan

Loon *(Maang)* Clan

Marten *(Waabzhesh)* Clan

Turtle *(Mshiikenh)* Clan or Fish *(Giigoonh)* Clan

Being a good relative is a hallmark of *Nishnaabe* life and society. So too is living in balance, contributing to community well-being, and honouring relationships with the natural world. *Odoodemaawin*, the clan system, is one means by which *Nishnaabe* people have maintained a positive sense of order while making sure the political, social, health, and spiritual needs of communities are fulfilled. All *Nishnaabeg* are born or adopted into a clan family that is representative of a particular animal, bird, or water being.

The clan system was bestowed upon the *Nishnaabeg* as a spiritual means of support during a time of great hardship. The oldest stories recount the presence of seven original clans who first stood up to mentor and guide the people. In time, many other clans came forward to help ensure the well-being and growth of the nation. Each clan is distinct, with its own characteristics and responsibilities. Clan membership is a source of pride, identity, and connection. In formal *Nishnaabe-style* introductions, one's clan is shared alongside one's spirit name as an indication of its relative importance.

Among the *Nishnaabeg*, clan membership is inherited from one's father. There are other First Nations people, such as the Iroquois, who inherit their clans through one's mother. Even when not related by blood, clan members regarded each other as family. To help ensure the strength of the nation's bloodline and strengthen ties between different clan families, one could not marry a member of one's own clan. Individuals seeking their clan are encouraged to research their family tree, speak to recognized elders, or consult community historians. If these prove unsuccessful, a trusted spiritual person may be consulted to help retrieve a lost clan or facilitate adoption into an existing clan.

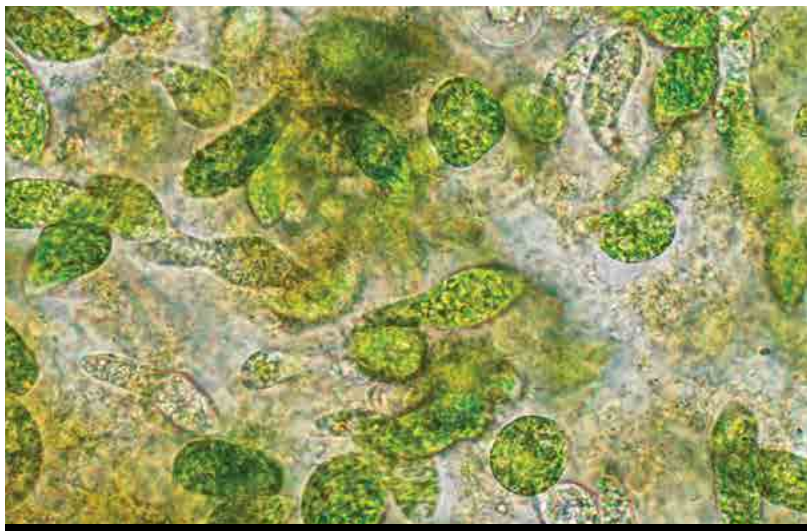
There is a revival of the role of the clan system in communities today. This includes an exploration of its role in governance, as well as any varied traditional responsibilities, such as community protection, teaching, medicine work, or strategic planning. Each clan also has its own teachings, songs, and dances. The tradition of holding clan feasts and wearing a beaded or quilled pin or pendant in celebration of one's clan identity are again increasingly commonplace.

Communities have a variety of clans represented in their membership. Some historic clans in the eastern Georgian Bay region include bear *(mkwa)*, beaver *(mik)*, caribou *(adik)*, catfish *(waasii)*, crane *(jijaak)*, eagle *(mgizi)*, hawk *(gekek)*, loon *(maang)*, marten *(waabzhesh)*, moose *(mooz)*, otter *(ngig)*, raccoon *(esiban)*, sturgeon *(nme)*, turtle (*mshiikenh)*, and wolf *(ma'iingan)*. The clan system remains an important source of resilience, strength, and connection in *Mnidoo-gamii* today.

– *Waabishki-makwa*, Dr. Brian D. McInnes, Wasauksing First Nation, University of Wisconsin

ART CREDIT: DEBBIE JACKSON

LOWER FOOD WEB



Phytoplankton are free-floating microscopic plants (such as diatoms and green algae).

Zooplankton are tiny organisms that live in the water column and are carried by currents (such as water fleas and cladocerans).

Benthic invertebrates are small aquatic animals that live on the bottom of the lake (such as leeches, clams, dragonfly and damselfly larvae).

Every fish in Georgian Bay feeds on tiny aquatic plants and animals at some point in its life. This includes phytoplankton, zooplankton, and benthic invertebrates.

Phytoplankton, just like plants on land, require nutrients, such as phosphorus and nitrogen, and sunlight to grow. Zooplankton get their energy from eating phytoplankton or other zooplankton. Finally, benthic invertebrates can eat phytoplankton, zooplankton, or other invertebrates.

This collection of life is known as the lower food web. It feeds larger aquatic species, including small baitfish, large predator fish, young turtles, loons, bald eagles, and many others. Without a healthy lower food web, the higher levels of the food web simply cannot thrive.

Studying the lower food web can provide information about overall aquatic health in a number of ways:

- Phytoplankton levels are related to nutrients that support growth, such as phosphorus, and may drop as nutrient levels decrease.
- Zooplankton levels can indicate changes in phytoplankton and other dynamics, such as contamination.
- Benthic invertebrates have different tolerances to changes in water quality. A reduction in pollution-sensitive invertebrates can indicate deteriorating water quality.

PHYTOPLANKTON TRENDS

From the late 1980s through the mid-1990s, phytoplankton in the open waters of Lake Huron underwent very little change. There were 40 common species, and all major groups were similarly abundant over this time period.

Historically, nutrient inputs into the lake from tributaries in the spring would contribute to a surge in phytoplankton growth, referred to as the spring phytoplankton bloom. This was the time of year with the greatest amount of phytoplankton available in the water column. Between 2003 and 2008, scientists noticed a significant decrease in the spring phytoplankton bloom. Since then, this major episode of primary production has remained almost entirely absent in offshore waters.

Conditions that support phytoplankton are changing and are not well understood. Possible factors contributing to shifts in abundance and community composition are:

- Low nutrient levels in offshore areas;
- Invasion of quagga mussels in deep waters; and
- Changing water temperatures due to climate change.

PHOTO CREDIT: GREAT LAKES ENVIRONMENTAL RESEARCH LABORATORY

ZOOPLANKTON TRENDS

Between 1998 and 2006, zooplankton populations in Lake Huron declined dramatically, due in large part to a 95% decline in the abundance of herbivorous crustaceans such as cladocerans. Zooplankton populations have not rebounded in more recent years, and unfortunately the zooplankton groups that experienced the largest declines (such as cladocerans) were the ones that fish consumed the most.

Researchers have not yet determined the exact reasons for the decline of zooplankton, but there are a number of factors that are thought to have played a role, including:

- Changes in nutrient availability and the related loss of phytoplankton;
- Changes in the fish community; and
- Introduction of invasive species, including the predatory spiny water flea and zebra and quagga mussels.

Climate change also poses a potential threat to zooplankton. Researchers have observed increasing water temperatures and decreasing ice cover in all of the Great Lakes. Warmer water may alter temperature-dependent growth and reproductive rates, potentially favouring species that can adapt to a new, warmer temperature regime. In addition, earlier spring warming could lead to earlier spring phytoplankton blooms, potentially creating a situation where peak food supply for herbivorous zooplankton occurs too early for them to take advantage of it. Without adequate food available at the right time, zooplankton populations could decline, ultimately affecting higher levels of the food web.

The relationships between warming temperatures and zooplankton dynamics are not well studied in the Great Lakes and represent an important area of future research.

"Everything is connected through the lands, waters, and all living things. We have roles and responsibilities to look after the lands and waters. The lands and waters sustain us and provide us with everything we need. Indigenous knowledge systems and languages are connected to the land."

–Our Relationship with the Land and Water, Anishinabek Nation

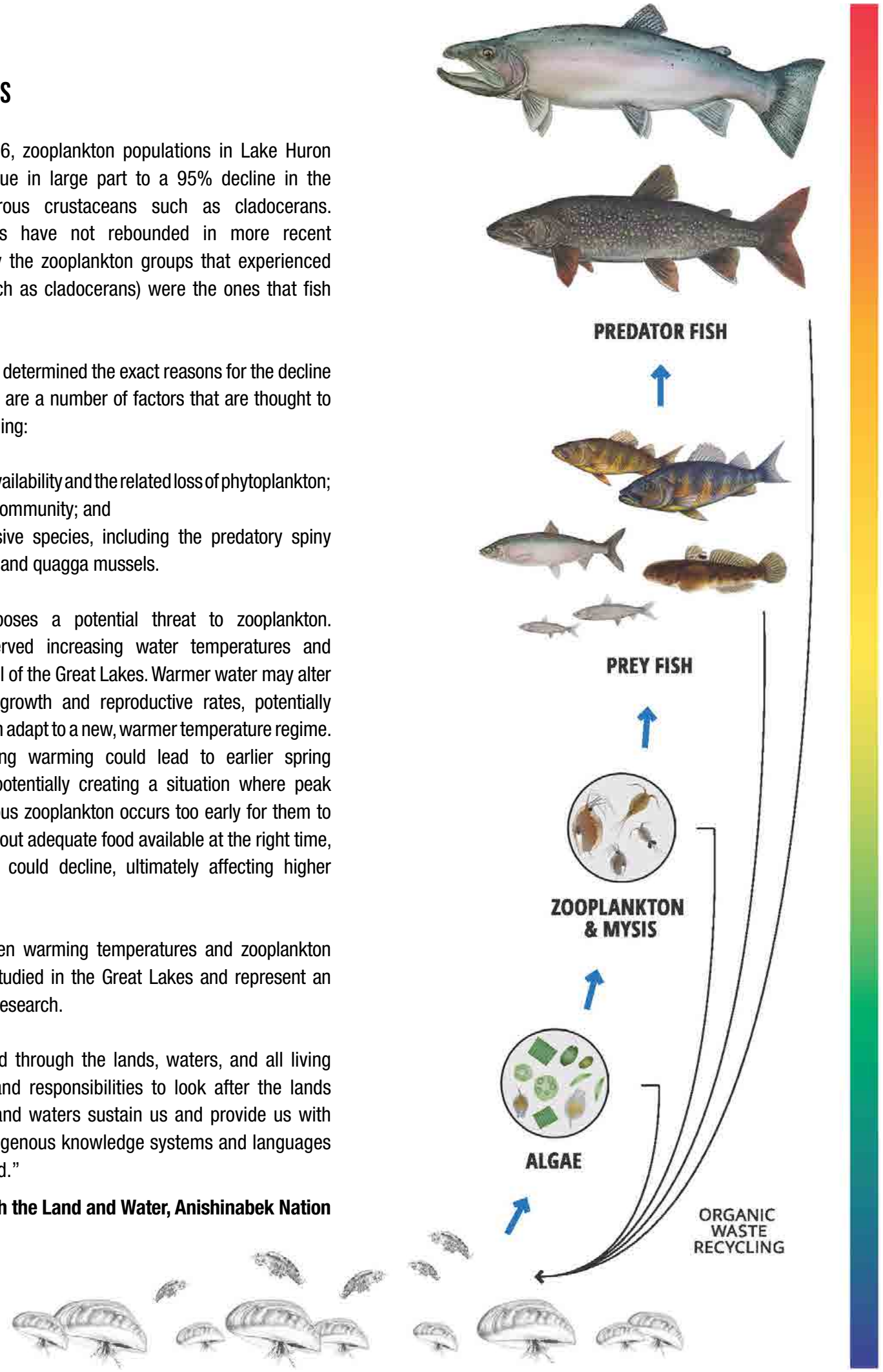


PHOTO CREDIT: GREAT LAKES FISHERY COMMISSION

BENTHIC INVERTEBRATE TRENDS

The benthic invertebrate community in Lake Huron and Georgian Bay has undergone dramatic changes in the past several decades, with the introduction of invasive zebra and quagga mussels and the almost complete loss of *Diporeia*, a shrimp-like freshwater crustacean.

Surveys in recent years have shown that in the offshore waters of Georgian Bay, 71% of total benthic density (the number of benthic organisms in a certain area) is made up of oligochaetes (aquatic worms), followed by quagga mussels and Chironomidae (non-biting midges and bloodworms) making up a combined 13%. Looking at biomass (total weight of organisms in a given area), quagga mussels accounted for 98% of total wet biomass in Georgian Bay!

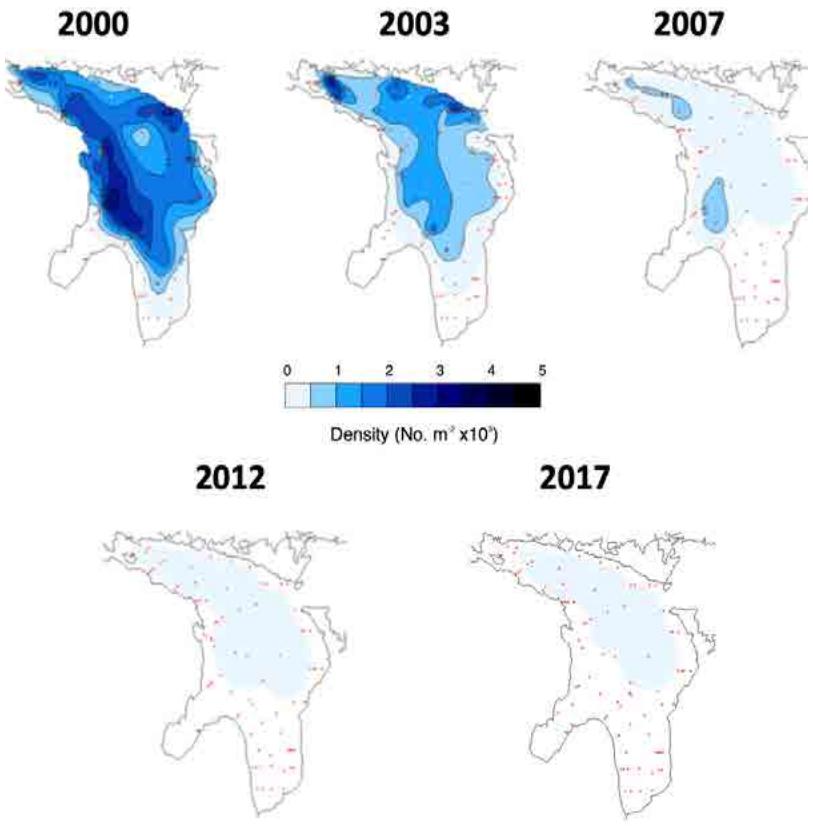
Amphipod Diporeia spp.

However, in the nearshore areas of eastern Georgian Bay (with water depths less than 20 metres), the abundance of zebra and quagga mussels was found to be relatively low, especially when compared to similar habitat in Lakes Erie and Ontario, but with a wide distribution.

In the past, *Diporeia* were the most abundant benthic organism in the cold, offshore regions of Lake Huron and Georgian Bay. *Diporeia* live on the lake bottom, in the upper few centimetres of sediment, and feed on settled plankton from the water column. Their bodies contain 30 to 40% fats and oils, making them a vital energy source for fish and crucial to the entire food web.

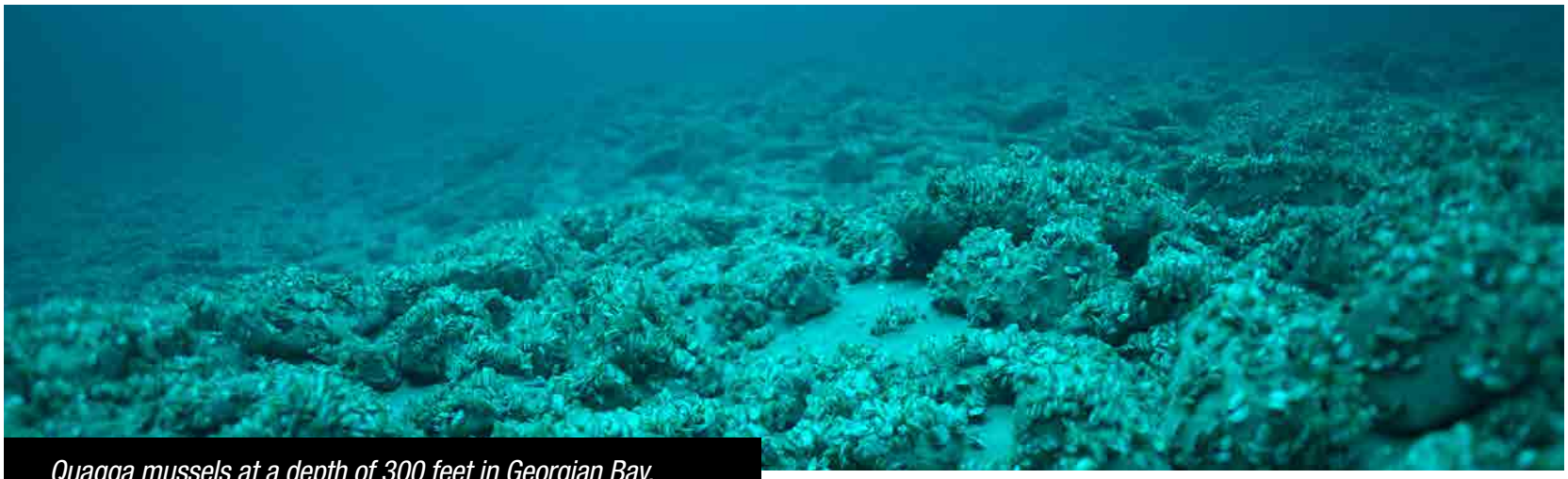
Between 2002 and 2017, *Diporeia* populations experienced serious declines. In 2002, mean *Diporeia* densities across all depth intervals ranged from 1,400 to 1,700 individuals per square metre. Fifteen years later, in 2017, the range in mean densities was two to five individuals per square metre at the shallowest and deepest depth intervals. This represents the loss of a major food source for many Lake Huron fish species. As a result, fish populations have been forced to change their diet and move to areas with more food.

The crash of *Diporeia* happened around the same time as the number of zebra and quagga mussels was rapidly increasing, but the connection is not yet well understood. Possibly, the mussels are using nutrients in the nearshore areas and on the lake bottom, reducing nutrient availability for *Diporeia*, zooplankton, and fish that live offshore. Further research is needed to understand the causes behind the *Diporeia* decline and the implications for the entire food web.



Decline of the amphipod Diporeia in Lake Huron from 2000 to 2017, density in thousands per square metre. Although this figure only shows the main basin of Lake Huron, similar declines have been experienced in Georgian Bay.

The Severn Sound Environmental Association monitors 14 open water locations throughout Severn Sound. All Severn Sound bays have shown a decrease in the total biovolume of algae since 1973. Zooplankton diversity has fluctuated, but total density of crustacean zooplankton has been declining.



Quagga mussels at a depth of 300 feet in Georgian Bay.

ZEBRA AND QUAGGA MUSSELS

Shelled organisms on the lakebed, such as freshwater clams, are part of the native Great Lakes ecosystem. Unfortunately, two non-native species of mussels have invaded Georgian Bay waters over the past three decades. Zebra mussels entered our awareness as a safety concern for swimmers due to their sharp shells. Water shoes became the norm. Zebra mussels also started attaching themselves to water intakes, causing restrictions and blockages and resulting in millions of dollars' worth of clean-up maintenance to keep the pipes flowing. Those mussels started to disappear, and many people thought the problem had disappeared with them. But that's when a worse issue arose.

Quagga mussels followed, moving from their native eastern European waters into the Great Lakes, and they began to outcompete the zebra mussels for the algae and nutrients both species needed to grow. The calcium-rich Georgian Bay offshore waters now contain trillions of bottom-dwelling quagga mussels. These mussels have, in turn, removed the food source of a major shrimp-like prey species called *Diporeia*, which themselves are a fatty and protein-rich food source for Great Lakes fish species. The result has been a collapse of *Diporeia* populations, as well as fish populations, in the offshore waters of the Bay.

These quagga mussels are particular about the algae they consume, spitting out toxic blue-green algae in favour of other algae species. Algae blooms are increasingly likely to be toxic, as over half a million residents of Toledo, Ohio experienced in 2014, when a do-not-touch-or-use order was issued for the water coming out of their faucets. Boiling water will not break down those toxins, so one needs to be extremely careful in order to stay safe.

Quagga mussels have also been implicated in the periodic bird and fish die-offs seen along Georgian Bay shorelines. Scientists suspect that quagga mussels are ingesting the botulinum toxin that causes botulism disease in birds and fish. The toxin is believed to bioaccumulate in the mussels, the invasive round goby fish eats the mussels, then other fish and diving birds consume the round gobies and die as a result of botulism poisoning.

Quagga mussels grow right on top of native species of shellfish and disrupt their basic functions, choking them out, starving them, and ultimately killing them. Further research is needed to better understand the potential effects of quagga mussels on benthic communities in Lake Huron, particularly in offshore waters.

AN UNCERTAIN FUTURE

Nutrients, including phosphorus, have declined drastically in offshore waters. Phytoplankton and zooplankton levels also dropped dramatically. *Diporeia*, once the most abundant benthic food source in Lake Huron, has been decimated.

What effects will this have on species higher in the food web? Are invasive species, combined with climate change and warmer waters, creating a biological desert on the bottom of Lake Huron and Georgian Bay? More research can help to answer questions like these.

GBB works with townships in the region to monitor benthic macroinvertebrate communities in area lakes over time.

PHOTO CREDIT: INSPIRED PLANET PRODUCTIONS, OLIVIA FINES

FISH COMMUNITIES

FISH COMMUNITIES

Fishing is a favourite pastime of many who spend time on Georgian Bay. But did you know that one of the best ways to study the health of the Bay is to look at the fish community? Fish are a useful indicator of aquatic ecosystem health because they reflect changes in nutrients, prey availability, water quality, and habitat.

Georgian Bay has undergone significant changes over the past century as a result of the overharvesting of fish, introduction of invasive species, deforestation in the watershed, and the more recent pressures of climate change. From primary producer to top predator, every part of the ecosystem has been, and continues to be, affected.

Indigenous people have observed changes in fish since time immemorial. More recently, fisheries biologists have conducted a variety of studies on the fisheries of Georgian Bay. Together, these sources of information tell us a lot about how conditions have changed over time. Below, we provide reports on six fish community indicators—prey fish, smallmouth bass *(noosa owesi)*, northern pike *(gnoozhe)*, muskellunge *(maashkinoozhe)*, walleye *(ogaa)*, and lake trout *(nmegos)*.

PREY FISH

Prey fish, also called baitfish or forage fish, are the small fish eaten by others for food. They make up the majority of fish in Georgian Bay and support key ecosystem functions by connecting the aquatic food web. Prey fish eat phytoplankton, zooplankton, and benthic (bottom-dwelling) invertebrates and, in turn, provide food for predators.

Historically, prey fish in Lake Huron were quite diverse. In offshore waters, there was a mix of native prey species such as the deepwater cisco, sculpin, lake herring, ninespine stickleback, and trout-perch. In nearshore waters, species like the gizzard shad, spottail shiner, emerald shiner, young whitefish, and yellow perch were important in the diet of predators. Native prey were in balance with native predators. However, around the 1970s, the balance shifted to favour an abundance of the introduced, non-native alewife and rainbow smelt.

After peaking in the late 1980s, prey fish biomass in Lake Huron began a steady decline in the mid-1990s and reached a historic low in 2008, following the collapse of alewife populations in the early 2000s.

Changes in the prey fish community are believed to be the result of top-down and bottom-up pressures in the food web. At the top, introduced and abundant salmon species consumed an excess of alewives and other prey. At the bottom, a major decrease in offshore phosphorus and the spread of invasive zebra and quagga mussels caused declines in the production of phytoplankton, zooplankton, and benthic invertebrates. As a result, less food is available for young fish, which threatens their growth and survival. Given this combination of pressures, prey fish are “squeezed” in the middle.

Despite periodic increases of certain species, overall offshore prey fish biomass and diversity in Lake Huron remains low, although there is a higher representation of native species. A return to historic levels of prey fish biomass is unlikely due to several factors, including reduced nutrient inputs, high predation levels by recovering predator populations, and changes in food web dynamics that potentially favour nearshore bottom-dwelling species such as the round goby. This situation creates a potential food web imbalance, where there is less food energy in the system for predators.

The complexity of the Georgian Bay shoreline makes it challenging to summarize prey fish population trends for this region. Different areas along the coast vary in terms of prey fish biomass, species diversity, and dominant species. The figure shows the catch composition in several areas of Georgian Bay in 2019 using a variety of fishing gear. The pie charts indicate the four most common families at each sampling location; all other families are grouped in the fifth “other” category.

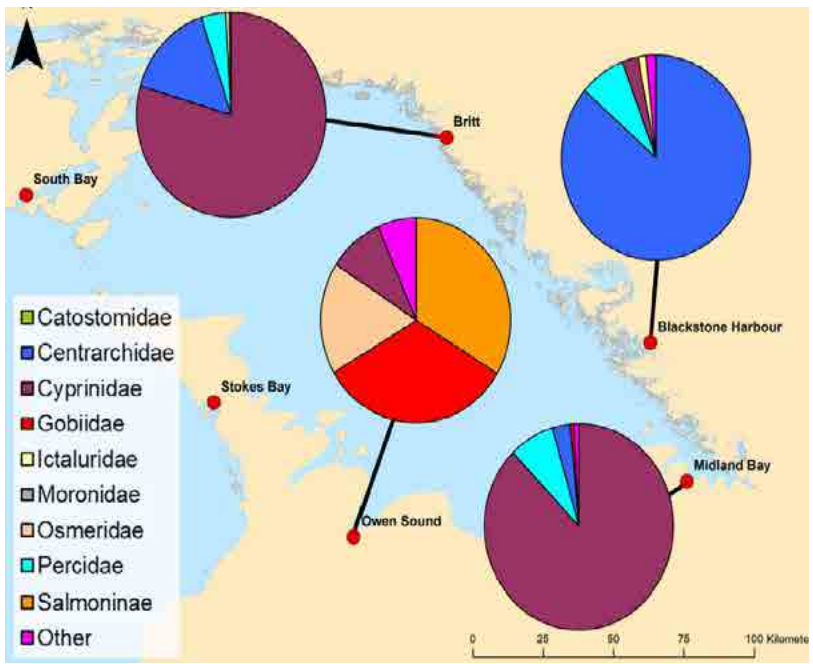


Figure reprinted from the Upper Great Lakes Management Unit Small Fish Community Assessment Program Summary Report 2019.

PHOTO CREDIT: MNRF, FISH ART: ISAAC MURDOCH

INVASIVE ROUND GOBY

The invasive round goby is believed to have become a significant prey item in Lake Huron that, until recently, has been very difficult to survey. Round gobies tend to concentrate in nearshore and rocky habitats, where they are harder to capture with traditional survey equipment. Fisheries managers are coming up with new technologies and piloting new strategies to better study round gobies and their habitat.

The United States Geological Survey Great Lakes Science Center has developed the "GobyBot," an autonomous underwater vehicle that utilizes high-resolution video and images to identify and quantify fish species found on the lake bottom. Three hundred kilometres of GobyBot transects were collected in the Canadian waters of Lake Huron in the summer of 2022 and will undergo analysis.

The Upper Great Lakes Management Unit of the Ministry of Natural Resources and Forestry is testing out an electrofishing unit used alongside a high-resolution underwater camera to count round gobies. A recent survey in Owen Sound utilizing this survey equipment estimated 118 million round gobies (144 tonnes) during day surveys and 144 million (237 tonnes) during night surveys.

Improving understanding of the status and trends in the round goby population is important for several reasons. Round gobies compete with native bottom-dwelling species, prey on eggs and fry of native fish species, consume invasive dreissenid mussels and are now also an important food source for native predator species including walleye, yellow perch, smallmouth bass, lake trout, and lake whitefish.

SMALLMOUTH BASS (SHIGAN/ NOOSA OWESI)

- **Warm-water predator**
- **Habitat:** Shoreline rocks and points, offshore shoals, deep water, associated with cover
- **Trend:** Unchanging

In eastern Georgian Bay, smallmouth bass are one of the more abundant predator species. Smallmouth bass were historically limited to the Great Lakes and have since been introduced to inland lakes. They have a broad diet and are highly sought after by anglers, making them both ecologically and recreationally valuable. The diet of young smallmouth bass begins at the bottom of the food web and expands to include almost all aquatic organisms as the fish mature. As a result, thriving smallmouth bass populations suggest productivity and good health in the lower food web.

Despite their abundance, they are affected by human activities, including harvesting, habitat disturbances, and shoreline development. Research looking specifically at smallmouth bass in eastern Georgian Bay is limited, however they are captured as part of broad fish community surveys, as well as surveys targeting other species, such as walleye. Although smallmouth bass populations in eastern Georgian Bay appear to be healthy, biologists cannot confirm a definitive trend for Georgian Bay.

There is some evidence to suggest that smallmouth bass are benefiting from increasing water temperatures as a result of climate change and the presence of the invasive round goby. Warming water temperatures may allow smallmouth bass to expand their range in the Great Lakes to areas that would have once been too cold. Smallmouth bass have also been found feeding on invasive round gobies, helping them maintain their status as one of the most abundant nearshore predators—if not the most abundant.

PHOTO CREDIT: ROBERT J EAKINS, GBB; FISH ART: ISAAC MURDOCH

PHOTO CREDIT: GBB; ART CREDIT: MISHIKENH KWE (AUTUMN SMITH)

NORTHERN PIKE (GNOOZHE)

- **Cool-water predator**
- **Habitat:** Weedy nearshore waters, secluded bays, heavily vegetated rivers
- **Trend:** Unchanging

As a top predator in nearshore waters, northern pike can provide insights about the health of the nearshore food web and coastal wetlands, which are important spawning habitat for this species. Pike are also an important sport fish and face substantial fishing pressure, although harvest rates have dropped, likely due to less fishing effort, more restrictive harvest regulation, and more anglers practising catch and release.

Although northern pike are not considered threatened anywhere in Canada, they are as vulnerable to habitat loss as any other nearshore species. Periods of sustained low water levels, along with continued shoreline development, reduce the size of important coastal wetlands upon which northern pike rely. For example, the prolonged low water period from 1999 to 2013 contributed to declines in northern pike populations in Severn Sound and potentially other areas of eastern Georgian Bay. Further monitoring is needed to determine whether or not populations have rebounded since, as water levels have risen.

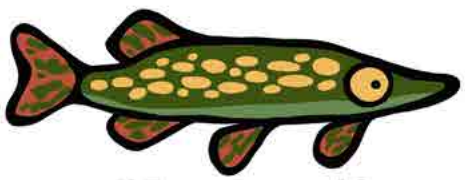
MUSKELLUNGE (MAASHKINOOZHE)

- **Cool-water predator**
- **Habitat:** Rocky and offshore shoals, edges of weedy shorelines
- **Trend:** Unchanging

Known to many as “muskie,” these impressive fish are a native predator of nearshore environments and a highly sought-after trophy fish. In Ontario, the fisheries goal for muskellunge is for populations to be self-sustaining, and to maintain Georgian Bay’s world-class fishery. Upper Great Lakes Management Unit surveys confirm the widespread distribution and presence of mature muskellunge throughout eastern Georgian Bay. Nevertheless, there is continued concern over the potential for high-quality spawning and nursery habitat to become degraded and subsequently impact the species’ natural reproduction.

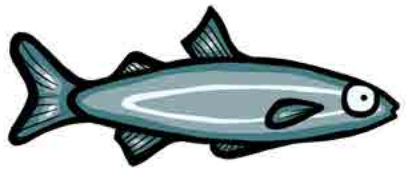
Muskellunge have a low reproductive rate, grow rather slowly, and have had their spawning and nursery habitat affected by shoreline development and, at times, sustained low water levels. Good muskellunge nursery habitat requires a diverse community of submerged aquatic vegetation, but under persistent low water levels, wetland vegetation can shift to a more uniform, less diverse community.

Research has shown that muskellunge numbers in eastern Georgian Bay appear to be unchanging, indicating a naturally reproducing, sustainable population.



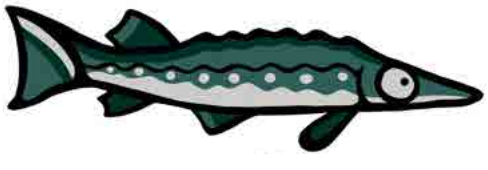
NORTHERN PIKE (GNOOZHE)

CRAPPIE (NABAGIDAASHI)

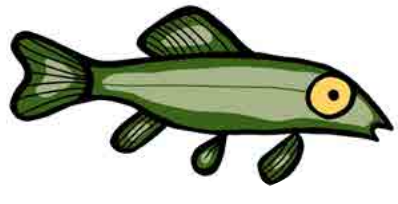


WHITEFISH (ATIKAMEG)

CATFISH (WAASSII)



STURGEON (NME)



SUCKER (NMEBIN)

LAKE TROUT (NMEGOS)

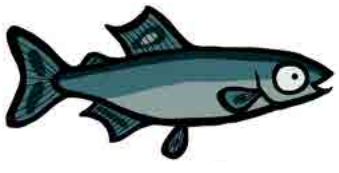
- **Cold-water predator**
- **Habitat:** Cold, deep lakes
- **Trend:** Improving

Lake trout are a useful indicator of the health of offshore waters. Assessing their populations can provide insights into food web productivity, the presence and effects of invasive species, and the availability and quality of fish habitat. In addition to their important ecological role, lake trout in Georgian Bay are caught commercially and recreationally.

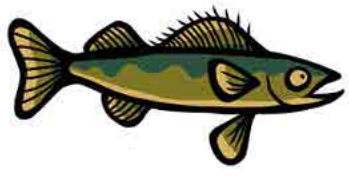
Prior to 1940, numerous populations lived in Lake Huron–Georgian Bay's deep offshore waters. An invasion of sea lamprey (an eel-like parasitic fish), overharvesting, and the decline of their major food source (the deepwater cisco) caused lake trout to collapse in all but two isolated locations: Iroquois Bay and Parry Sound.

In 1969, efforts began to rehabilitate lake trout. Sea lamprey controls were implemented across the Great Lakes. Using the same genetic strain of the Parry Sound lake trout population, fish were stocked across Lake Huron and Georgian Bay, and a fish sanctuary was established. The Parry Sound population of lake trout is one of the only populations to be considered fully rehabilitated outside of Lake Superior.

Unfortunately, lake trout populations have not re-established in most locations where they were found historically. The management goal for lake trout is to restore populations to the point where they are naturally reproducing. Recovery in Georgian Bay is slow, but indicators have recently been showing more positive trends than previously. However, the prospects for lake trout rehabilitation remain uncertain, due to reduced productivity in offshore waters and other ecosystem changes.



TROUT (NMEGOS)



WALLEYE (OGAA/GAA)

WALLEYE (OGAA/ GAA)

- **Cool-water predator**
- **Habitat:** Variety of habitats, typically in deeper or heavily vegetated waters during the day
- **Trend:** Unchanging

Walleye, also called pickerel, are highly sought after in subsistence, recreational, and commercial fisheries.

Since the early 1900s, Georgian Bay walleye stocks have declined due to a combination of overexploitation, human alteration of rivers, and the introduction of invasive species. Dams can cut off access to spawning habitat and change the flow of water. High, fast-flowing water can threaten eggs by washing them away, while low water can cause them to dry out. In the Moon River, for example, where walleye spawning runs used to number over 30,000 fish, these numbers have dropped to only several hundred.

Since the early 1980s, efforts to rehabilitate walleye populations have included habitat restoration, stocking young fish, and imposing regulations that restrict harvest. These efforts have been met with limited success. To further walleye rehabilitation efforts, the Upper Great Lakes Management Unit is in the process of drafting a walleye management plan for the Ontario waters of Lake Huron.

In 2002, Shawanaga First Nation (SFN) opened a walleye hatchery to help offset pressures on walleye. The hatchery releases millions of walleye fry each year into the Shawanaga River. Reports have shown that SFN's efforts are having a positive effect on the walleye population in this area.

"Members of Shawanaga First Nation have been stewards of the lands and waterways for time immemorial, using the seven grandfather teachings to manage the resources that were given to the people from the creator. Education about, and conservation of, the walleye population within Shawanaga's traditional territory is the main goal for the hatchery, so that all walks of life can enjoy the fishery for generations to come."

–Shawanaga First Nation Fish Hatchery Brochure

PHOTO CREDIT: GBB; ART CREDIT: MISHIKENH KWE (AUTUMN SMITH)

Recently hatched larval lake sturgeon (nme)

PHOTO CREDIT: GBB

A STORY OF LAKE STURGEON (NME)

If you have been lucky enough to see a lake sturgeon *(nme)*, you have had the privilege of laying eyes on Ontario's largest and longest-lived freshwater fish. These gentle giants can live more than 100 years and were once abundant in the Great Lakes. Today, their populations are only a fraction of what they used to be. In fact, the Great Lakes–Upper St. Lawrence populations were declared threatened in 2006 by the Committee on the Status of Endangered Species in Canada (COSEWIC).

While lake sturgeon have long been valued by many First Nations, prior to the mid 1800s, commercial fishers considered them a nuisance because they tore their nets, as the fishermen were targeting other species, like lake whitefish and lake trout.

At that time, sturgeon meat had little value on the market, so captured fish were disposed of, left to spoil, or even used as fuel for steamboats. By mid-century, however, people began discovering profitable uses for lake sturgeon meat, eggs, and swim bladders, sending demand skyrocketing. In 1880, 3.4 million kilograms of sturgeon were harvested from the Ontario waters of the Great Lakes! By the early 1900s, the lake sturgeon harvest had declined to commercially insignificant levels, owing to steep population declines.

"Sturgeon supply is in a critical state…. We think that some strong remedy should be adopted for the preservation of this fish, before it becomes entirely extinct in the waters of Georgian Bay."
–"Fisheries Commission Appointed to Enquire into the Fisheries of Georgian Bay & Adjacent Waters" for the Dominion of Canada, 1908.

Severely overfished lake sturgeon faced additional threats in the form of habitat alteration and water pollution. Dam construction cut off access to spawning habitat in rivers; activities such as farming and logging degraded habitat through sedimentation; and industrial pollution impaired reproductive success.

Adding to these stressors, the biological characteristics of lake sturgeon make them even more vulnerable. These fish are:

- **Slow growing:** They grow quickly during the first 10 years of life, then their growth slows.
- **Slow to mature:** Males first spawn at around 20 years of age, and females around 25 years.
- **Only spawn periodically:** Males spawn every two to three years and females every four to nine years.
- **Have high site fidelity:** Spawning adults typically return to the same spawning habitat each year.

Due to a combination of stressors and biological characteristics, the loss of spawning-age fish (through overfishing, for example) continues to have a big impact on the recovery of the lake sturgeon population. As evidence of this, most of the populations that were overexploited in the late 1800s and early 1900s still have not recovered. The lake sturgeon commercial fishery was closed in 2009 in the Ontario waters of Lake Huron, 100 years after its protection was first recommended.

Despite the fact that lake sturgeon have been around for millions of years, there are still many questions about the status of the population, as well as the species' habitat preferences, movements, behaviour, and more. Report the lake sturgeon you see on the iNaturalist app!

Lake sturgeon, or *nme* (also spelled *name*) are a culturally significant species for the *Anishinaabek* in the Georgian Bay region. The chief of the Fish Clan is *Nme*, Lake Sturgeon.

"The gifts of *nme* are intellect, wisdom, mediator, and spiritual teacher or guide. *Nme* are knowledgeable, and slow and deliberate in the way they move and the way they do things in life. They represent longevity and are recognized as grandmothers and grandfathers.

The *nme* life cycle can be used to teach the stages of life. *Nme* go through several life stages from egg to spawning adult, maturing at a slower rate relative to many other fish species. Young people are encouraged to go through at least three stages of life before they settle down and enter the planting or "doing" stage in which they plant their own seeds."

–Christine King *(Waabkanii Kwe)*, Lake Sturgeon Knowledge Sharing, March 2021

PARTNER PROFILE

SHAWANAGA FIRST NATION

In 2019, Shawanaga First Nation (SFN) and Georgian Bay Mnidoo Gamii Biosphere partnered on a multi-year project to study lake sturgeon *(nme)* in eastern Georgian Bay. Staff at SFN conducted interviews with elders and knowledge holders, commercial fishermen, and local residents to gain a better understanding of the species and their cultural significance. The Indigenous knowledge gained from the interviews, combined with existing science reports, helped identify potential lake sturgeon spawning sites. Several of these sites were monitored during the lake sturgeon spawning season in May and June.

SFN trains river monitors, like Tyrone Jones, to collect data on the health of walleye (ogaa).

While this project started down a path of bringing together different sources of knowledge to improve understanding, there is still much to be learned about lake sturgeon in eastern Georgian Bay. If lake sturgeon populations in this region are to recover over time, it will take a collaborative effort involving many dedicated partners on the coast.

FUN FACT:

ONE ANGLER RECAUGHT A MUSKELLUNGE 17 YEARS AFTER IT WAS ORIGINALLY TAGGED!

Muskellunge (maashkinoozhe) captured during an Upper Great Lakes Management Unit survey in the Moon River.

PARTNER PROFILE

UPPER GREAT LAKES MANAGEMENT UNIT

The nearshore waters of eastern Georgian Bay and the North Channel support the largest contiguous distribution of muskellunge *(maashkinoozhe)* populations in the Great Lakes. Nearly 380 kilometres, stretching from the south end of Severn Sound, north to the mouth of the French River, and west to Sault Ste. Marie, represent prime nearshore muskellunge habitat.

Prior to 1996, very little was known about the population characteristics of this species, yet the area was perceived by anglers as supporting a world-class fishery. Since 1996, close to 30 targeted muskellunge spawning surveys at 10 different locations in eastern Georgian Bay and the North Channel have been completed by the Upper Great Lakes Management Unit (UGLMU) of the Ministry of Natural Resources and Forestry (MNRF).

During the UGLMU's surveys, over 1,000 muskellunge have been captured, biologically sampled, and affixed with external identification tags. Subsequent recaptures of over 300 tagged fish have provided valuable insights into their movements. Some tagged muskellunge have been recaptured multiple times in both UGLMU surveys and by recreational anglers.

Fish scale samples collected during these surveys have been the source of genetic material that scientists at the Aquatic Research and Monitoring section of the MNRF have used to determine the genetic structure of muskellunge in Lake Huron. This work has revealed that muskellunge in Georgian Bay are made up of small populations with limited ranges and high site fidelity, meaning they return to the same areas to spawn year after year. These findings reinforce the importance of identifying and protecting these habitats in order to maintain self-reproducing populations of muskellunge in Georgian Bay.

Aquatic vegetation is a critical component of wetland nursery habitat for young-of-the-year muskellunge, or those born within the past year. A joint study with McMaster University and the UGLMU found that sustained low water levels and increased shoreline modifications may have contributed to the recent disappearance of young-of-the-year muskellunge at many sites in southeastern Georgian Bay.

Assessment and research efforts continue and will be necessary to address emerging challenges, including climate change, ongoing habitat loss, invasive species, and more interest among anglers in pursuing muskellunge.

PHOTO CREDIT: GBB, MNRF

COASTAL WETLANDS

DIVERSE AND DYNAMIC ECOSYSTEMS

Eastern Georgian Bay is famous for its extensive collection of islands—or freshwater archipelago—with an abundance of coastal wetland habitat along its shoreline. Coastal wetlands are incredibly productive ecosystems with high ecological, cultural, and economic value. Healthy wetlands filter water, store carbon, play a role in controlling flooding, and help mitigate more frequent extreme weather events resulting from climate change.

The great blue heron (shagi) relies on wetlands for feeding.

Wetlands support high levels of biodiversity because they are transitional environments providing habitat for both aquatic and terrestrial species, and are resilient to changes in water level. Patches of small coastal wetlands work together to provide critical habitat for spawning fish, breeding amphibians, colonies of birds, such as the great blue heron *(shagi)*, and feeding grounds for the endangered Massasauga rattlesnake *(zhiishiigweg)* and eastern foxsnake.

Indigenous peoples have an inherent right to hunt, fish, and harvest plants, berries, wild rice, and other foods. Healthy wetlands help maintain cultural and spiritual relationships with plants, animals, birds, and water creatures. The gift of food from the lands and waters of *Mnidoo-gamii*, its rivers, forests, wetlands, and islands, are part of natural law and *Anishinaabek* food sovereignty.

Human activities have resulted in the loss of many Great Lakes wetlands. Coastal wetlands have been filled in, dredged up, paved over, and converted to other land uses. Invasive species, such as *Phragmites australis* (European common reed) have been introduced and can completely replace native vegetation, destroying wetland habitat and its ecological functions.

Fortunately, Georgian Bay still contains high-quality wetlands distributed along most of its shorelines that are relatively protected from roads and human development. However, these wetlands still face the threat of human impact from shoreline modifications, increased runoff and sediment, water withdrawals, invasive species, and the increasing impacts of climate change.

MCMASTER UNIVERSITY COASTAL WETLAND RESEARCH GROUP

Since 2003, the coastal wetlands of eastern and northern Georgian Bay have been continuously studied by researchers from McMaster University's Coastal Wetland Research Group. Led by Dr. Patricia Chow-Fraser, this research group has created one of the largest and most comprehensive databases on Georgian Bay's coastal wetlands. Their work has focused on a broad range of topics, including the effect of changing water levels on coastal wetlands, how human activities are influencing nutrients in coastal bays, how species at risk reptiles use their habitats, and more recently how the proximity of boreal forest landscapes to water bodies and human features affects their recovery from wildfires.

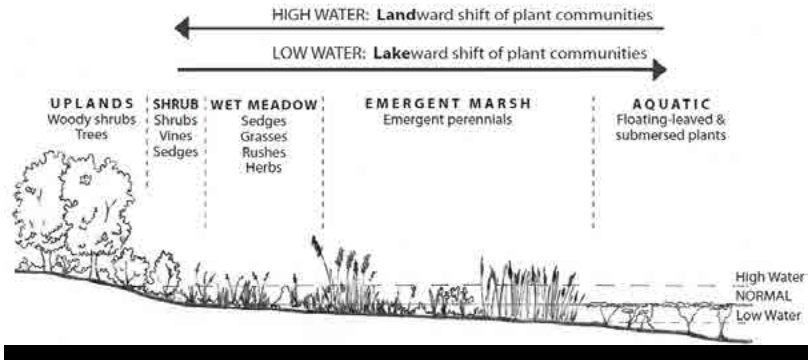
Learn more about McMaster University's Coastal Wetland Research Group at **greatlakeswetlands.ca**

WATER LEVELS & WETLANDS

Not only are coastal wetlands important habitat for a variety of fish and wildlife, but they contain some of the highest plant diversity, too. Marshes can contain floating aquatic vegetation, submerged aquatic plants, meadow plants, and shrubs—and they may look very different from one year to the next.

One reason that coastal marshes contain so many different plants is that they are subject to changes in water levels. Periodic flooding changes the plant composition, brings in new nutrients, and can expand the total area of wetland. Periods of low water levels may support more meadow species and even the arrival of shrubs and the establishment of young trees.

The scientific term for alternating high and low water levels in wetlands is "dynamic hydrological gradient," meaning that the vegetation zones in coastal wetlands go from fully submerged to dry upland areas. This gradient looks different depending on the slope of the shoreline and lake bottom.



Plant communities shift with fluctuating water levels.

PHOTO CREDIT: THOM MORRISSEY, LAKE HURON COASTAL CENTRE

It is important to recognize that lake levels naturally influence coastal wetlands, and there are species that benefit when water levels are higher and others that thrive during drier periods, when the water levels have dropped. With climate change likely to reshape water level variation into the future, researchers are trying to understand how these changes will impact wetlands in Georgian Bay and the Great Lakes more broadly.

Jenna Kentel surveying a wetland for turtles as part of her Masters research.

HIGHER HIGHS AND LOWER LOWS

The winter of 2022–2023 was one of the warmest on record. For the first time in its 52-year history, the National Capital Commission in Ottawa did not open the Rideau Canal Skateway. Lake Huron ice coverage was very low, and surface water temperature was near the highest recorded. Climate change is causing measurable impacts in the Great Lakes region related to temperature, precipitation, storms, flooding, and water levels.

Contrary to most people's intuition, there is very little evaporation from Lake Huron on a hot summer day. Most evaporation occurs in the colder months of the year, when cold air is passing over the relatively warmer open water—much like a pot of hot water steams into the colder room-temperature air. As the water in the lake cools and ice forms over the water's surface, evaporation slows, like putting a lid on the pot. This dynamic creates the starting conditions for the coming year's water levels.

From annual relative lows in the winter, water levels in Lakes Michigan and Huron rise until they reach a late-summer peak. If, over several years, there is more precipitation entering the lake than evaporation leaving it, water levels rise. If the balance shifts toward more evaporation and less precipitation, water levels decline. That balance has, over the measured historic record, produced water levels that have fluctuated from the lowest to the highest level by about 1.93 metres (6.33 feet).

Climate change is throwing this historic balance off. There is more water vapour and energy in the air when it is hotter—approximately a 6% increase in vapour-carrying capacity per degree Celsius.

This means that future hydrologic conditions are expected to be more variable than the historic record. It shifts the balance toward favouring precipitation over evaporation.

In reality, the thermodynamics involved are more complicated than a simple pot of boiling water. Beneath the surface of the lakes there is a huge volume of water acting as a heat sink during warm months and as a heat source during cold months. Taking this into account in new three-dimensional models, American researchers project that by 2040–2049, the average monthly water levels of Lakes Michigan and Huron will increase by 0.39 metres relative to the 2010–2019 period.

Newly released modelling by scientists at Environment and Climate Change Canada shows that over-lake precipitation and over-lake evaporation are expected to increase, expanding the water level range variability up to 0.5 metres above historical extremes under a scenario where emissions slowly decline and global temperatures increase by 2.4°C. This is an increasingly likely scenario given that in May 2022 the World Meteorological Organization stated that there was a 50/50 chance that one of the following five years would exceed 1.5°C above the pre-industrial average global temperature.

"If we do not take the threat of greenhouse gas emissions seriously and continue on the present track, it could catastrophically lead to a 4.5°C temperature increase, resulting in an even greater modelled water level range variability of roughly one metre above historical extremes."

–David Sweetnam, Georgian Bay Forever

Taylor Nanowaygahkekwe Judge paddling Oshkinigig through a coastal wetland.

PHOTO CREDIT: OLIVIA FINES, GBAY

Great Lakes water levels are anticipated to experience more variability as the climate changes, resulting in more extreme highs and lows. High GHG scenarios show the most extreme changes occurring, but actual changes in water levels will depend on actual GHG emissions and how the atmosphere responds.

A CHANGING GREAT LAKES BASIN

"Evidence suggests that climate change is leading towards an increase in precipitation. At the same time, climate change has also shown trends in increasing air temperatures and increasing lake temperatures across the basin, which naturally leads to higher rates of evaporation. These two processes act as competing forces on water levels. Higher precipitation and/or lower evaporation at times will lead to more water on the landscape and higher water levels, but at other times, higher evaporation and/or lower precipitation will lead to lower water levels. With these two competing dynamic forces at odds with each other, some have alluded to this as a "tug-of-war" between stronger climatic forces.

The higher water levels in the Great Lakes in 2014 was a change from record low water levels in 2012 and 2013. It was believed to be initiated by a combination of increased precipitation, but more importantly a slowdown in the rate of evaporation triggered by the very cold winter of 2014, which was caused by a polar vortex that sent cold air southward and froze the Lakes. This reduced evaporation and increased precipitation resulted in water levels that have risen in the Great Lakes to the record extremes observed in 2017 and 2019. Climate experts believe that this swing of the pendulum, going from one extreme of low water to one of high water, is in fact a consequence of climate change across the Great Lakes Basin and at continental scales."

–Independent Review of the 2019 Floods in Ontario

PARTNER PROFILE

ENVIRONMENT AND CLIMATE CHANGE CANADA

Wetlands are known to be dynamic systems that have been resilient to changing water levels, but what is less known is how resilient they will be to changes brought on by the impacts of climate change, including varying water levels, water temperatures, precipitation, exposure to wind and wave action, and invasive species.

Environment and Climate Change Canada conducted an extensive study on coastal wetlands in the Great Lakes to determine their vulnerability, sensitivity, and capacity to adapt to climate change. Of the 20 coastal wetlands in the study, three were in eastern Georgian Bay:

- Treasure Bay, on Beausoleil Island, within Georgian Bay Islands National Park
- Hog Bay, a provincially significant wetland in Severn Sound
- Frances Point, on the northeastern tip of Franklin Island, near Brooks Landing

Researchers assessed each of the wetlands in the study under a low- and high-water scenario, as well as against multiple other factors related to climate impacts to help determine their level of vulnerability. In general, the modelling showed that wetlands in eastern Georgian Bay showed greater vulnerability to the effects of climate change under higher water levels when compared to the same wetlands under more stable or lower water levels.

Learn more about the study at **trca.ca/great-lakes-coastal-wetlands**

PHOTO CREDIT: GBB

PARTNER PROFILE

GEORGIAN BAY FOREVER

Phragmites australis, or the European common reed, is an invasive plant that has colonized much of the Great Lakes region, with devastating effects. It can be seen lining highways, filling ditches, and expanding through wetlands and waterways. *Phragmites* is one of the most damaging invasive plant species in Canada, and not a problem that will go away on its own.

Since the first known North American documentation of *Phragmites* in the early 20th century, this plant has been progressively taking over the shores of natural bodies of water, including Georgian Bay. While it may look relatively harmless—a perpetrator hiding in plain sight—it constitutes an immediate and severe threat to the ecosystem.

Additionally, the mass amounts of tall grass contribute to low water levels and increase the risk of wildfires, further adding to the strain on the local ecosystem.

ADDRESSING THE PROBLEM

Georgian Bay Forever is committed to tackling the *Phragmites* invasion with non-chemical and carefully planned long-term management strategies. The most effective way to remove *Phragmites* stands without herbicides is to create an ongoing cycle of stressors to the root system, monitor the cut base for regrowth, and remove cut stalks from the water in which they may regenerate roots.

Volunteers at an invasive Phragmites community cut.

Phragmites grows aggressively and spreads quickly, dominating the areas in which it grows by releasing toxins from its root system, effectively depleting and damaging food sources for native plants.

The dense structure of a *Phragmites* stand also creates an inhospitable environment for local wildlife, with fish and turtles dying after becoming trapped in the plant's dense stalks. Over time, biodiversity suffers due to the choking out of native plant life, which usually provides a safe habitat for wetland animals. The plant's height (up to 5.5 metres tall) impedes land animals from accessing the water and can also affect people's ability to enjoy activities such as swimming and boating.

By the summer of 2022, Georgian Bay Forever had mapped 962 *Phragmites* stands, eradicated (with ongoing monitoring) 509 stands, and was in the process of cutting an additional 255 stands. Together, these remediation efforts represented approximately 80% of mapped stands under control in Georgian Bay.

"The work is laborious and demanding of both resources and commitment, but the rewards are worth it for the health and longevity of Georgian Bay" says Laura Thipphawong of Georgian Bay Forever.

Learn more about Georgian Bay Forever at **gbf.org**

PHOTO CREDIT: DAVID HAWKE

7 STEPS TO CONTROLLING INVASIVE PHRAGMITES ON SHORELINES & WETLANDS

Native Phragmites stems feel smooth and have strong red colouring on the stalks.

PHOTO CREDIT: NICOLE CARPENTER

1. IDENTIFY AND MAP

Be sure to identify whether the plant is native or invasive, and record the size and location of the site for future reference. One obvious difference is seen at the base of the stalks in mature stands. Invasive *Phragmites* feel rough and are beige, while native *Phragmites* feel smooth and have strong red colouring on the stalks.

2. CREATE A COMMUNITY GROUP

Create a working group or network of landowners that could act as a *Phragmites* resource committee for other landowners in the area. This network can also keep everyone alert to any new or existing *Phragmites* stands.

3. GATHER EQUIPMENT

This could include hand-held cutters, rubber boots, gardening gloves, eye protection, hat, PFD, natural twine, yard-waste or garbage bags, transportation for disposal (such as a sleigh or wheelbarrow and perhaps a tarp to cover the cut *Phragmites*) and anything else you may need when working outdoors.

4. TIMING

Remove the stalks between mid-July and mid-August, before seedheads emerge from late August to October. (Note that native *Phragmites* seedheads emerge earlier in the season, around mid-July).

5. CUTTING

If there are seedheads, remove them first and put them into yard-waste bags to rot out and die. Next, begin cutting on the outside of the patch and work inward. Cut each stalk underwater as close as safely possible to the sediment (not just below the water surface). Be sure to only remove the stalks and attached leaves. Do not try to disturb or remove the roots; they are extensive and uprooting them can contribute to the spread.

6. DISPOSAL

Collect all cut biomass and floating debris. Find a designated spot nearby where cut stalks can dry out and decay. You want to choose somewhere far enough away that rising water levels and wind and wave action will not pull it back in to the water. You can use twine to wrap up the material for easier transport and disposal.

7. FOLLOW-UP

The next year, check the disposal site to ensure nothing has sprouted from the piles. Also, check the cutting site for any regrowth and make plans to cut again. It can take two to seven years of repetitive removal to eradicate a stand.

Reprinted from **georgianbayforever.org/phragmites**, with permission.

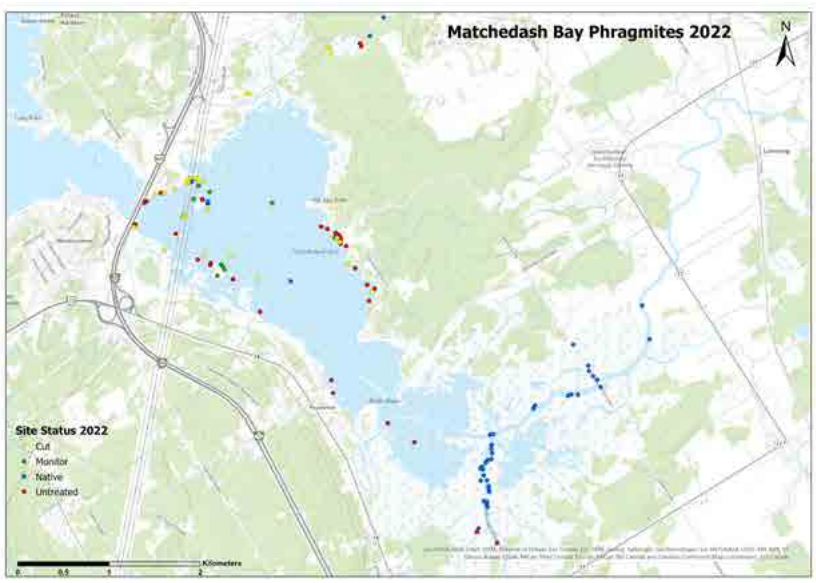
Invasive Phragmites australis stems feel rough and are beige.

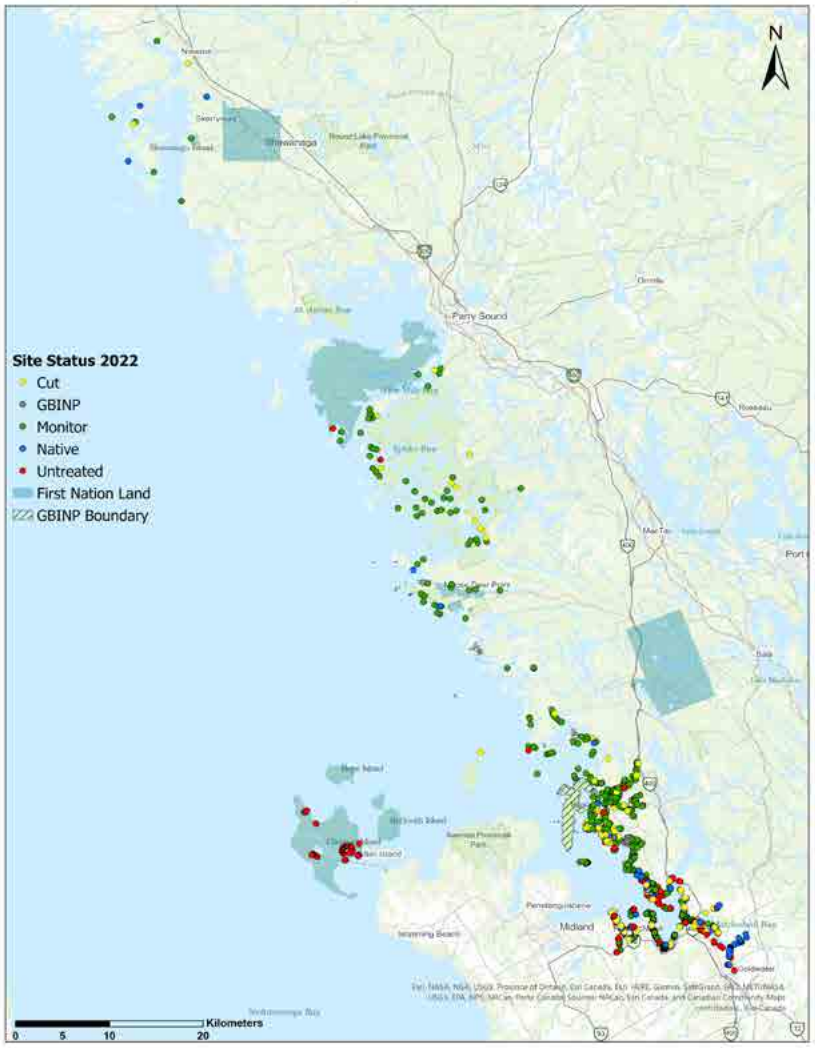
HOW YOU CAN HELP

TRACK INVASIVE SPECIES

Invasive species are spreading quickly, and you can report their location (including insects, plants, and aquatic species) using the Early Detection and Distribution Mapping System (or EDDMapS). You can submit invasive species sightings using either a smartphone or a computer. Sightings are then uploaded to EDDMapS and emailed directly to reviewers to confirm. The maps and information are freely available to scientists, resource managers, and the public. Having good data on the locations of invasive species improves our ability to manage and respond to them. Learn more at **eddmaps.org**

Invasive Phragmites stalks and seed heads.





Southeastern Georgian Bay *Phragmites* distribution and status of level of control. Maps provided by Georgian Bay Forever.

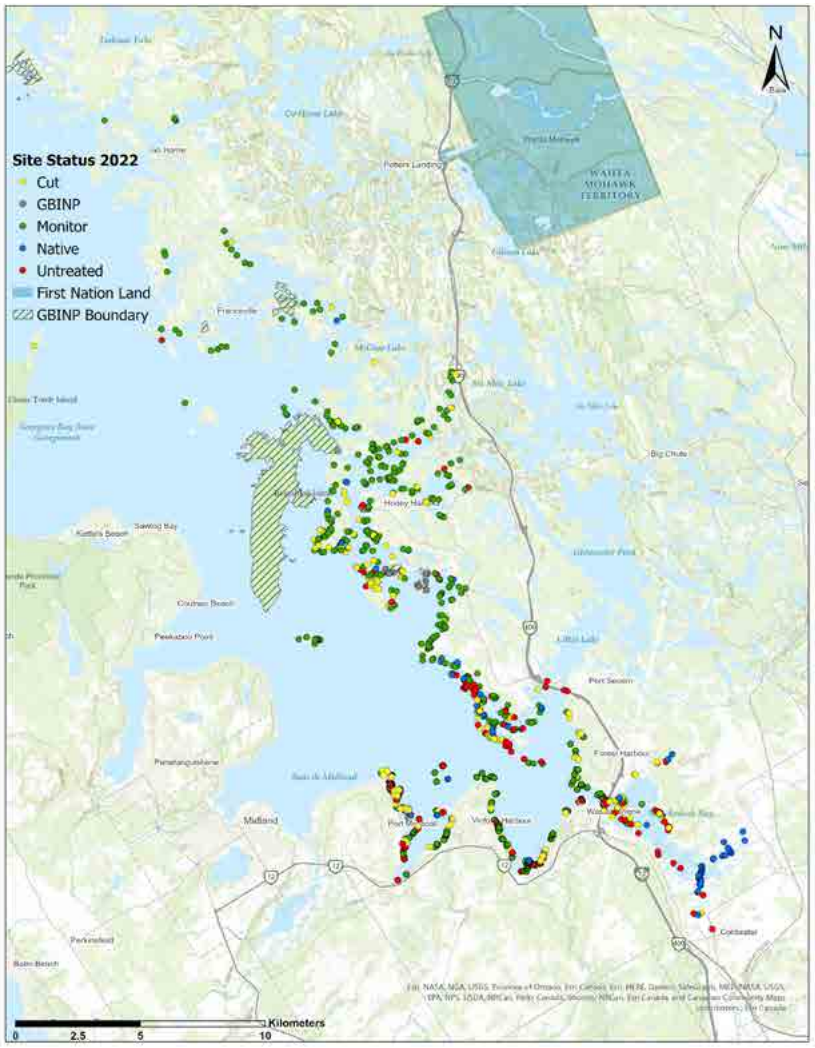


PHOTO CREDIT: LAURA THIPPHAWONG, GEORGIAN BAY FOREVER

LANDSCAPE BIODIVERSITY

CONNECTIVITY IS KEY

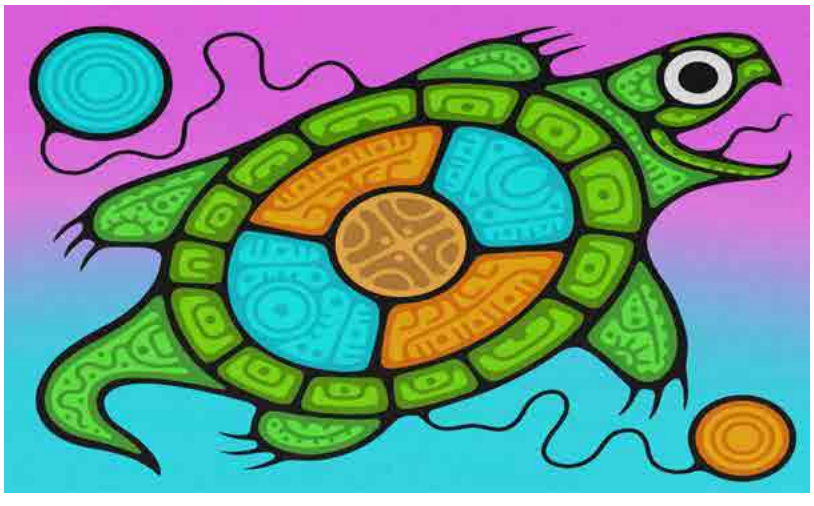
Biodiversity, or biological diversity, refers to the variety of living things on earth and can be viewed in terms of variability within species, between species, and between ecosystems. It includes species' evolutionary histories, genetic variation within and among populations of species, and the distribution of species across habitats, ecosystems, and landscapes. This variety and variation is necessary to sustain the vital services that biologically diverse ecological systems provide.

Habitat loss is the single biggest threat to plant and animal species, both globally and locally. Habitats need to be connected to allow species to breed, feed, and find shelter. When a large habitat is divided by roads, railways, power lines, or human settlements, it gets sliced into smaller patches and may no longer meet species' needs.

Well-connected habitats that support a wide range of species are important because they act like a natural buffer to the pressures of human activities, extreme weather events, climate change, and invasive species. Highly diverse landscapes can absorb these pressures better, have quicker recovery times, and help support ecosystems and their wildlife.

One of the most recognized approaches to conserving biodiversity focuses on the conservation and protection of large natural areas and the diversity of landscape types within an area. Eastern Georgian Bay is a mosaic of ecosystems ranging from forests and rock barrens to wetlands and rivers. Each of these areas provides important habitat for hundreds of species.

While protecting and conserving large natural areas is important, increased focus is being placed on the importance of bringing together multiple ways of knowing and caring for the land. All along the coast, people are working to address concerns around landscape biodiversity from different perspectives to help create a connected and resilient landscape.



MAAMWI ANJIAKIZIWIN

Along the shores of eastern Georgian Bay, *Mnidoo-gamii*, people are coming together to care for the place they call home. With a focus on species at risk and connecting people and nature, the *Maamwi Anjiakiziwin* initiative combines the words and meanings of "together," "land," "renewal," and "life."

"The first part of the word, *Maamwi* talks about working together, and *Anji* means "renewal." *Aki* talks about land but also territory because we want to be sure that we're encompassing that in all that we're doing. And the last part talks about life, which reminds us to continue living in a good way."

–Sherrill *Midwewekamigokwe* Judge, Georgian Bay Mnidoo Gamii Biosphere

Municipalities and First Nations are actively working to protect at-risk reptiles. Since 2020, biologists have removed over 8,200 eggs from turtle nests at risk from road construction activities. With appropriate permits, turtle eggs were incubated and then the hatchlings were released. Elder Lila Tabobondung (Waubenoptichikwe) from Wasauksing is pictured releasing a snapping turtle (mikinaak) hatchling at a community event.

PHOTO CREDIT: GBB; ART CREDIT: TSISTA KENNEDY

The *Maamwi Anjiakiziwin* initiative acknowledges that there is strength and value in partnership. This species at risk conservation project brings together First Nations, not-for-profits, and municipalities to share resources, values, and ideas on how to improve the well-being of species at risk across the landscape in eastern Georgian Bay.

"When everyone gets together, there are opportunities to have conversations, share observations, ask questions, create maps, and plan fieldwork programs. In the end, we share an understanding of what the priority conservation work will be, where it will occur, how it will be carried out, and how its effectiveness will be measured."

–Greg Mason, Georgian Bay Mnidoo Gamii Biosphere

One of the initiative's key objectives is to engage in cross-cultural learning and intertwine different knowledges. *Maamwi Anjiakiziwin* includes language and knowledge sharing, ceremonies for the care and release of turtle hatchlings into the wild, and *asemma* (tobacco) offerings during fieldwork.

"Honouring *Anishinaabeg* worldview and bringing that lens to what we do, braiding and weaving that into everything we do."

–Sherrill Judge, Georgian Bay Mnidoo Gamii Biosphere

"We're trying to look after the land. We're trying to look after the water. We're trying to look after the communities so that there's something for our children down the road. In order to help each other, we have to be able to get along, and work together, and have some sort of relationship."

–Michele Ten Eyck, Wasauksing First Nation

"When we improve our understanding, respect, and relationships with each other, our understanding and relationships with the land will also benefit."

–David Bywater, Georgian Bay Mnidoo Gamii Biosphere

Learn more about *Maamwi Anjiakiziwin* at **maamwigeorgianbay.ca**

Road surveys collect data that is shared among a network of partners, such as the monitoring conducted on Skerryvore Road in the Township of The Archipelago from 2020-2022.

The Maamwi Anjiakiziwin partnership is evaluating different mitigation strategies to reduce the impacts of roads on species at risk. This culvert-fence on a Carling Township road that crosses through a provincially significant wetland is a new design being tested for how well it protects reptiles, including the eastern foxsnake—a notorious climber!

ROAD ECOLOGY

As part of *Maamwi Anjiakiziwin*, many partners are engaging with multiple ways of knowing to help mitigate threats from roads to at-risk reptiles. Turtles often use roadsides as nesting habitat, increasing the chances of female turtles being hit. As a result, populations alongside roads in some areas have been found to be primarily made up of males. Ongoing mortality of turtles on roads could result in steady population declines due to their life history of delayed maturity, meaning it takes a long time before they can reproduce (up to 20 years for some species).

Snakes use roads for various reasons, including basking on them for thermoregulation. While some snakes attempt to cross roads in order to access habitat, others may avoid roads, thereby preventing their access to important habitat and reducing or altering the population genetics of the area.

Locations where numerous reptiles are found to be crossing or are found dead on roads are called hot spots. For over four years, GBB staff, volunteers, and partners have been biking roads along the coast of eastern Georgian Bay monitoring for at-risk reptiles and identifying hot spots. In this time, they have:

- monitored 12 roads/highways;
- biked over 17,000 kilometres;
- observed over 2,300 reptiles;
- rescued 214 reptiles from the road; and
- identified 42 reptile road mortality hot spots.

Working collaboratively, partners are identifying locations that could benefit from road mortality mitigation and implementing actions, such as turtle incubation programs, invasive species removal, and reptile fencing, to address the impacts roads are having on reptiles. These actions help conserve local biodiversity and restore connections between high-quality habitats.

PHOTO CREDIT: GBB

PARTNER PROFILE

MAGNETAWAN FIRST NATION

Magnetawan First Nation (MFN) is a biodiversity hot spot consisting of continuous wetlands and rock outcrops that provide ideal habitat for many species at risk. Located on the Magnetawan River in the northern region of the Georgian Bay Mnidoo Gamii Biosphere, the community recognizes the importance of environmental stewardship; a responsibility that is upheld and reflected by members of the MFN Department of Lands, Resources, and the Environment.

Sparked by community observations and concerns over reptile mortality on roads back in 2011, the MFN Department of Lands, Resources, and the Environment, with the help of Dr. Litzgus from Laurentian University, established what has since become a renowned species at risk reptile monitoring and interdisciplinary research program on the coast. The monitoring data and other information gathered across MFN has strengthened the lands department's ability to advise and guide decisions regarding the protection of the land, mitigation of development, and documenting climate change impacts.

At the heart of the monitoring program is the dedication and hard work of both community members and lands department staff who all work together to embody the Two-Eyed Seeing approach in their work. This is the guiding principle brought forward by Mi'kmaw Elder Albert Marshall of "seeing from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strength of Western knowledges and ways of knowing, and using both these eyes together for the benefit of all."

MFN's species at risk program is grounded in land-based community values and complemented by the technical practices and methodology of Western knowledge approaches. The Two-Eyed Seeing approach provides a means of collecting, monitoring, and understanding the wetlands and animal ecology within the Territory in a meaningful way that acknowledges the interconnection of all things.

"MFN's reptile species at risk program has been the gold standard in long-term, community-focused monitoring of animals of cultural importance. Their work has been consistently well-funded by federal and other grants, and was applying a Two-Eyed Seeing approach to knowledge-gathering and building community capacity before that terminology became commonplace. I have been privileged to collaborate with the lands team at MFN for the past 10 years and look forward to continuing to work with them into the future."

–Jackie Litzgus, Laurentian University

MFN's Department of Lands, Resources, and Environment celebrated 10 years of reptile species at risk monitoring in 2022.

Community involvement in the program has always been a top priority. The lands department is especially committed to supporting local youth by providing opportunities to learn land-based knowledge from elders while gaining valuable hands-on experience through summer employment and volunteer opportunities in the field.

Over time, the department's work has expanded from a focus on the reptile species at risk monitoring program to include broader stewardship of the land, the water, and all the animals that call this place home. Partnerships with several organizations, universities, and industry representatives have been an integral part of this expanded focus. Projects have included shoreline cleanups, management of invasive species, including *Phragmites australis* (or the European common reed), building community gardens, youth-led outreach and education, floodplain mapping, fish habitat assessments, and climate change research. The foundation laid by the reptile species at risk monitoring program will no doubt benefit the community and other communities across the region for the next seven generations.

Follow the MFN lands department on Facebook **@magfn_aakii** and on Instagram **@magfn.aakii**

Roads represent a significant threat to turtles in the region.

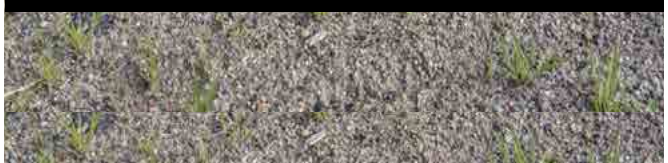


PHOTO CREDIT: ALANNA SMOLARZ

MOTUS WILDLIFE TRACKING SYSTEM

Georgian Bay is part of an international network that is helping scientists learn more about migratory species and how to protect them.

The Motus Wildlife Tracking System records the movements of birds, bats, and even certain migratory insects by using strategically placed towers to pick up signals from tiny radio transmitters attached to the animals. The data is freely accessible to scientists around the world and records everything from transcontinental migratory journeys to localized behaviour patterns. The particular advantage of Motus technology is that once an animal is outfitted with a transmitter, researchers can follow its movements without ever having to recapture or resight it.

Motus tower on the coast of eastern Georgian Bay.

Despite its important bird habitat, Georgian Bay was a blank space on the Motus map until 2017. That changed when the Georgian Bay Land Trust collaborated with Birds Canada to install the first five Motus towers in southeastern Georgian Bay, using Land Trust properties as sites for several of them. In the years since, the network has grown up the coast and inland watershed, now comprising more than 15 towers hosted by several different partner organizations, including the Georgian Bay Mnidoo Gamii Biosphere, Shawanaga First Nation, and Ontario Parks.

These towers now contribute data to dozens of local and international research projects, on species as diverse as the barn swallow, red knot, and eastern red bat. They are also bringing researchers from institutions such as the University of Guelph and Western University to the Georgian Bay area, for studies on eastern whippoorwills, common nighthawks, song sparrows, ovenbirds, and white-throated sparrows.

Installation of the Mallett Motus tower.

In an era of dramatically declining bird populations, this kind of scientific understanding is crucial to identifying causes of mortality and prioritizing conservation actions. Studies done through the Motus system are helping researchers learn more about migratory routes and the connectivity between breeding, migratory, and wintering habitats, understand bird ecology and how environmental factors influence migratory success, and much more. This will help determine which habitats and resources migratory species depend on for every part of their life cycle.

The Motus system relies on a network of receiving stations that are installed and maintained by partner organizations around the world. These stations can pick up signals from any animal travelling within 15 kilometres of the tower. Currently, there are over 1,500 towers spanning 31 countries and tracking nearly 300 different species.

Ovenbirds are one of many species being studied using Motus towers in eastern Georgian Bay.

The more we can understand about how migratory species move, in what habitats they rest, eat, and breed successfully, and how conditions in one location can affect their entire life cycle, the better equipped we will be to support successful conservation efforts. By working collaboratively with Motus, scientists on Georgian Bay and all over the world can advance this knowledge and bring us closer to protecting these species for years to come.

Learn more about Motus at **motus.org**

PHOTO CREDIT: SARAH KOETSIER, JESSICA DEAKIN

PARTNER PROFILE

MCMASTER UNIVERSITY ECOHYDROLOGY LAB

Within the unique patchwork landscape of the UNESCO Georgian Bay Mnidoo Gamii Biosphere, researchers from the McMaster University Ecohydrology Lab use innovative methods to tackle questions about the impacts of climate change. The Ecohydrology Lab operates NOBEL, the only water observatory in Ontario focusing on water, habitat for at-risk reptiles, and carbon sequestration. The acronym NOBEL stands for *Nibi* Observatory for Boreal Ecohydrological Landscapes, where *nibi* is the *Anishinaabemowin* word for water. NOBEL was established in 2010 and is run in partnership with Magnetawan and Shawanaga First Nations.

The NOBEL observatory consists of more than 10 hydrometeorological towers, as well as over 75 wetlands and small watersheds equipped with various instruments. Here, researchers study factors affecting wetland habitats and their ability to exchange carbon, water, and energy with the atmosphere. The Georgian Bay Mnidoo Gamii Biosphere is within the region of Ontario with the greatest biodiversity of reptiles; unfortunately, this area is also undergoing substantial changes due to drought, fire, and development.

Here, mossy wetlands known as peatlands are critical habitat for at-risk reptiles, including Ontario's only venomous snake: the threatened Massasauga rattlesnake. These snakes spend about half of their lives overwintering in peatlands and return to the same site each year. They overwinter in mounds of moss called hummocks, above the water table in an area that remains above 0 degrees Celsius, which the researchers call the "resilience zone."

Unfortunately, climate change makes winters more dangerous for snakes by increasing rainfall, which reduces snow depth and causes flooding. Without a thick insulating snow blanket, hummocks may become too cold. Taller hummocks may provide a larger resilience zone and maintain snake habitat despite climate changes. Since taller hummocks are more likely to burn during a wildfire, researchers hope to understand if there is an ideal hummock height to keep snakes safe during the winter. They are developing methods to predict overwintering habitat locations based on peatland characteristics, like their size or position within the watershed. Peatland areas with trees often have taller hummocks, which may help identify and protect good overwintering sites.

Peatlands help to counteract climate change by taking carbon out of the atmosphere and storing it for long periods of time, because waterlogged moss decomposes very slowly. However, drying peatlands are more vulnerable to fire and more likely to release carbon. NOBEL research has begun to tease out factors that make peatlands more susceptible to climate change impacts. For example, peat depth and microtopography (hummocks and hollows, for example) control water retention of peatland vegetation and affect vulnerability to burning and decomposition.

Part of a network of sites within the NOBEL water observatory, this solar-powered hydrometeorological tower collects information on weather conditions, moisture, and temperature properties of the moss below, and the release of water and carbon from the peatland.

NOBEL is a collaborative effort between McMaster researchers, First Nations, environmental consultants, and conservation organizations to develop a holistic understanding of wetlands in the Georgian Bay Mnidoo Gamii Biosphere. This network of sites builds capacity for partners to share knowledge crucial to local communities, which are reliant on healthy ecosystems for food, water, and medicines, and to identify and protect vulnerable habitat.

Learn more about the McMaster Ecohydrology Lab at **ecohydrology.mcmaster.ca**

An insulating blanket of snow over moss hummocks in a peatland can keep overwintering rattlesnakes safe in the resilience zone.

PHOTO CREDIT: DR. PAUL MOORE

WEAVING WAYS OF KNOWING FOR MA'IINGAN (WOLF) CONSERVATION

Human activities in the biosphere region threaten many species, including the eastern wolf *(ma'iingan)*, a species at risk. Major threats to wolves include habitat loss, hunting, trapping, road mortality, and hybridization with coyotes. Together, Shawanaga First Nation, Magnetawan First Nation, Wiikwemkoong Unceded Territory, the Ministry of Natural Resources and Forestry, the University of Guelph, and a graduate student from Trent University are trying to understand how wolves are dealing with these threats.

The framework of this Indigenous-led, collaborative project follows a "Two-Eyed Seeing" approach, utilizing and braiding together the strengths of both Indigenous knowledge and western science to better understand eastern wolf populations.

Trent University graduate student Shilah LeFeuvre fixes a GPS radio collar to a captured wolf.

To address the questions and concerns raised by community members from Shawanaga First Nation, Magnetawan First Nation, and Wiikwemkoong Unceded Territory regarding the populations of wolves within each of their respective traditional territories, the research team deployed radio collars to track wolf movements. Through the knowledge shared from each community, a total of 14 wolves were collared, with each collar deployed for up to one and a half years, sending GPS data locations every 90 minutes. Collaring allows the research team to understand home range sizes, pack size, diet, genetics, level of hybridization (with coyotes) in the packs, and how the wolves are responding to human-caused changes.

This project supports Indigenous-led, continuous wolf population monitoring to ensure their longevity. It is fully guided and interpreted by each of the First Nation communities as a way to carry on traditional ecological knowledge surrounding wolves for future generations.

EXPLORING SPACES FOR BIODIVERSITY CONSERVATION

The Exploring Spaces for Biodiversity Conservation initiative provides an opportunity to extend biodiversity conservation work within the Georgian Bay Mnidoo Gamii Biosphere by assessing how spaces in the region are contributing to the conservation of biodiversity and how they might be expanded in size, or enhanced or restored to support high biodiversity values, such as species diversity or connected habitats.

A protected area (PA) is a clearly defined geographical space that is recognized, dedicated, and managed through legal or other effective means to achieve the long-term conservation of nature with associated ecosystem services and cultural values. An example of this may be a provincial park or some land trust properties.

Other effective area-based conservation measures (OECMs) are lands that may not have the conservation of biodiversity as their primary goal but are managed in a way that results in the effective and enduring conservation of biodiversity. An example of this would be special management zones in county forests, such as Northumberland County Forest.

Adding to the total amount of protected and conserved areas in Canada supports the federal government's commitment to conserving 25% of land and 25% of inland waters by 2025, and 30% by 2030. Georgian Bay Biosphere staff will be working with partners to:

- evaluate and grow community knowledge of biodiversity;
- build community support for biodiversity conservation through outreach and engagement activities, such as species reporting; and
- assess and improve management actions through stewardship and/or restoration of priority areas with key partners.

Learn more at **gbbr.ca/events**

Protecting biodiversity ensures that pollinators like the frigid bumble bee can continue to thrive. Learn more at bumblebeewatch.org

PHOTO CREDIT: STEVEN KELL, STACEY EVANS

PARTNER PROFILE

GEORGIAN BAY LAND TRUST

Thirty years ago, concerns were growing among residents that Georgian Bay's extraordinary environment was at risk of permanent damage. Increasing road development and recreational property expansion, coupled with a lack of regional conservation planning, left little protection for the majority of Georgian Bay's natural areas outside of a few established parks. Communities needed a way to protect the lands they cared about. Inspired by North America's growing land trust movement, a dedicated group of volunteers along the eastern Georgian Bay coast came together to form the Georgian Bay Land Trust.

A land trust is a charitable organization whose purpose is to hold and conserve land for public benefit. Through donation, purchase, or conservation easement, land trusts protect and steward significant places for present and future generations of people and wildlife.

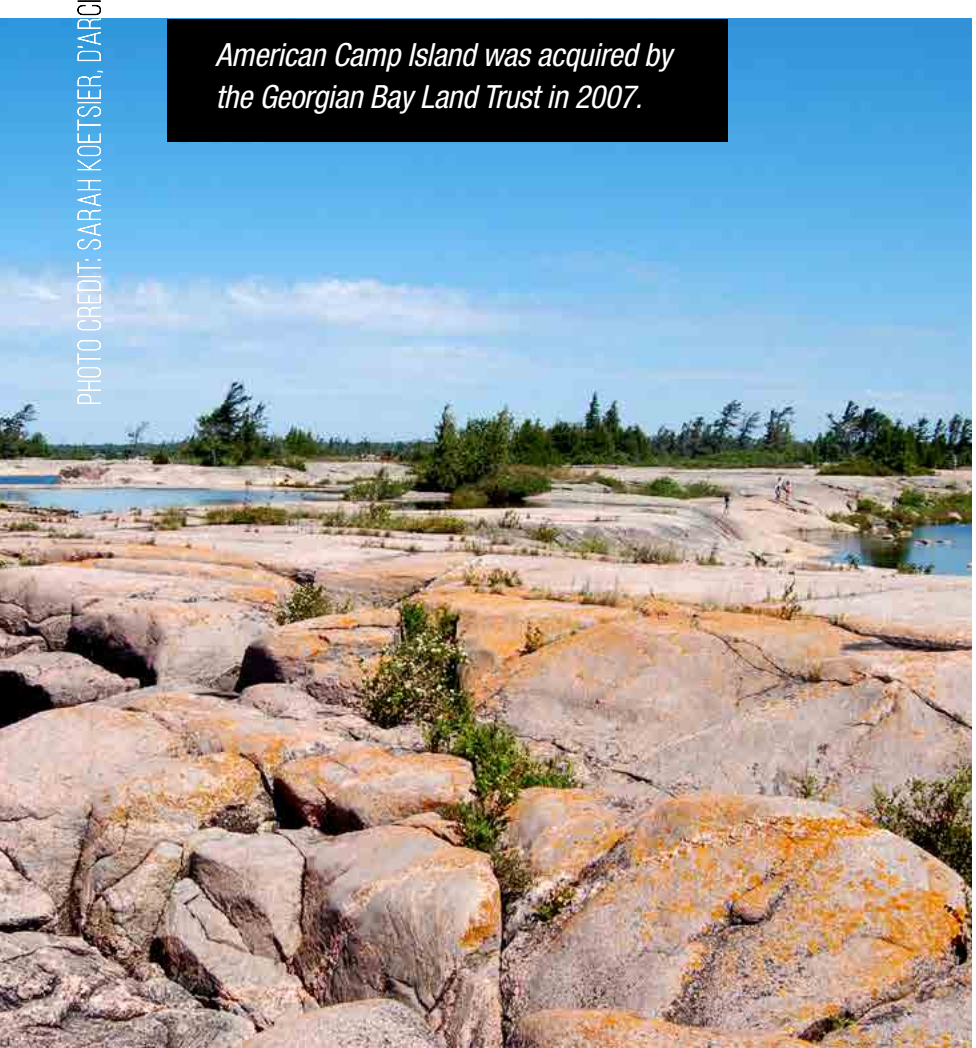
As of 2023, the Georgian Bay Land Trust protects 72 properties, totalling 3,116 hectares, stretching from Port Severn to the North Channel. Each of these places represents something unique in the ecology of Georgian Bay. They include old-growth forest and provincially significant wetlands, wave-blasted islands and calm vernal pools. Some welcome birdwatchers and picnickers, while others provide overwintering habitat for turtles, gestation sites for Massasauga rattlesnakes, and stopover locations for migrating monarchs. Together they form a network that strengthens our entire ecosystem by maintaining travel corridors and connections for species large and small.

The Land Trust is committed to using the land it stewards well, to give back to the community and advance conservation science. Land Trust properties have welcomed researchers from a number of universities and environmental organizations studying everything from turtle habitat to bat populations. They also host nine Motus wildlife tracking stations, which record signals from radio-tagged birds and contribute data to scientific studies around the world.

The Georgian Bay Land Trust's vision is of "an eastern Georgian Bay and North Channel whose islands, shores, and inland watersheds are connected and strengthened by a network of protected natural lands and habitats, where native species thrive and people interact with the natural world."

Thanks to over 1,500 volunteers, donors, partners, and staff who support the work of the Land Trust, this vision is alive and well. Eastern Georgian Bay remains a sanctuary for many animal species whose populations are severely threatened elsewhere, and the network of natural areas is stronger than in many parts of the province and the world. By continuing to prioritize conservation over the next 30 years and beyond, we can ensure that it stays that way.

Learn more about the Georgian Bay Land Trust at **gblt.org**



American Camp Island was acquired by the Georgian Bay Land Trust in 2007.

PHOTO CREDIT: SARAH KOETSIER, D'ARCI MCFADDEN

PARTNER PROFILE

FRIENDS OF THE MUSKOKA WATERSHED

Calcium is an essential element for all living things. Unfortunately, it has been depleted over decades of acid rain. This is especially true in areas situated on the Canadian Shield, like Parry Sound and Muskoka, where the soil is shallow.

The Friends of the Muskoka Watershed (FOTMW) organization has spent the last few years studying the addition of wood ash to replenish lost calcium in forests, and initial results are positive. They decided that the first step to repairing the forest—and the watershed—was to add calcium-rich wood ash to the forest floor in order to grow healthier trees. Eighty-five percent of the watershed is covered in trees, according to Dr. Norman Yan, a Director with FOTMW.

Citizen scientists volunteering with the AshMuskoka project are provided with all of the supplies needed to participate.

FOTMW launched the ASHMuskoka project to study the scientific impact of wood ash on forests and to get the community involved. They asked Muskoka's year-round and seasonal residents to save their household wood ash and deliver it to a central location once per month. Approximately 1,500 people have donated over 27,600 kilograms of ash to the project since June 2019. Volunteers filtered the wood ash and put it into containers for future distribution in forests. Ash samples were also sent to a laboratory for analysis, with results indicating that Muskoka ash is 25 to 30% calcium and contains other key plant nutrients, including potassium, magnesium, and phosphorus.

A volunteer spreads wood ash over an area with maple saplings.

The next step was to spread the ash at test sites across Muskoka. Three maple woodlot owners who operate sugar bushes participated, and an extensive project was done with test sites in the forest at Camp Big Canoe. Graduate students from Trent University ran experiments to measure the impact of the ash.

Dr. Yan explains that they believe they have determined the right amount of ash to "wake up" the forests: "Calcium has been seen in saplings, and we have hints of increased growth within the first year," he says. "It took years to deplete the calcium in the soil, but early research suggests that one application of ash is all that is needed."

Early results are showing healthier, more storm-resistant trees. And more studies are underway. Over 10,000 kilograms of ash has been spread since the project started. While research has focused on four main locations and on hardwood trees, there is an interest in understanding the benefits of residential wood ash in different locations and to different tree species. Climate change studies are also being explored. And recently, 80 kits were distributed to participants who wish to experiment with spreading ash on their own trees.

"The citizen science program aims to enrich the understanding of the benefits of wood ash for soil quality, tree health, and tree growth on Muskoka and Parry Sound properties," says Katie Paroschy, Citizen Science Coordinator for FOTMW. Dr. Yan is pleased that the ASHMuskoka program is getting a positive response from residents. "People can do their part," he says. "They can do something good."

Learn more about Friends of the Muskoka Watershed at **fotmw.org**

PHOTO CREDIT: FRIENDS OF THE MUSKOKA WATERSHED

Species at risk conservation, research, and best management practices are an important part of GBB's work. Gracie Crafts, Niizhogiziskwe, holds two Blanding's turtles found during a survey.

PEOPLE & NATURE IN BALANCE

Georgian Bay Mnidoo Gamii Biosphere (GBB) is recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a World Biosphere Reserve—an important freshwater archipelago region that promotes solutions for conservation and sustainability. It is managed by GBB, a non-profit Canadian charity that works with partners to protect biodiversity and create healthy communities.

Like other UNESCO sites worldwide, the GBB strives to be a model of people and nature in balance. Our charity:

- Takes climate action,
- Connects people of all ages to nature,
- Honours Indigenous people and cultures, and
- Builds strategies for biodiversity and species protection.

Currently, we are facilitating partnerships for:

- Collaborative strategies to protect species at risk,
- Expanded nature education and land-based learning, and
- Clean energy, sustainable transport, and climate adaptation.

Together, we are shaping a more sustainable future for the communities we care about. **Learn more and join us at gbbr.ca**

GET INVOLVED

Use the free iNaturalist app to upload your photos of flora and fauna to the "Georgian Bay Biosphere Project" so that all observations in our region can be used for science. With many specialists and amateur naturalists helping to identify species, you will be sure to learn about the incredible biodiversity we have in the Biosphere!

Get started at gbbr.ca/citizen-science and join over 4,000 volunteer observers who have identified over 5,000 species!

PHOTO CREDIT: GBB

GBB partners with First Nations to build backyard gardens to help increase access to fresh food.

THANK YOU! MIIGWECH!

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