SW Nova Biosphere Region

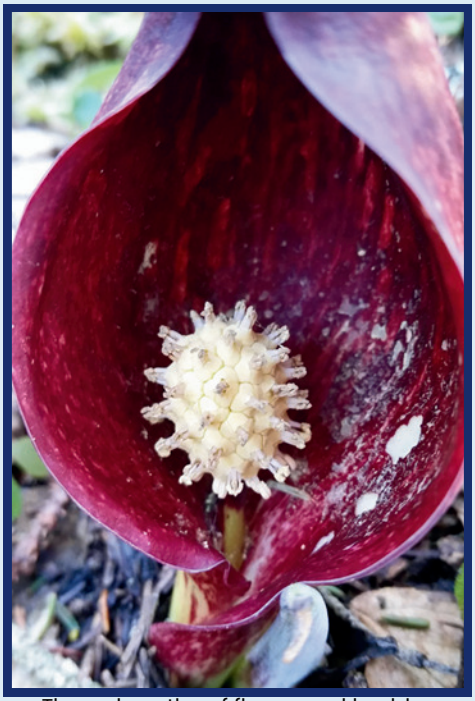
SPRING/SUMMER NEWSLETTER

September 2023

Wetlands Edition

During our last issue, the wetlands were iced over and frogs were frozen in the mud but then Spring warmed and skunk cabbage heated the snow packs sending dinner's ready odors across the swamp to pollinating flies and ravenous bears. The male red-wings showed up flashing their red wings in the cattail marshes. The yellow-spotted salamanders began to slither from their pools in the swamps over the roads to other swamps— making us think about a salamander safety program for next year— but this year they never got the perfect wet nights warm enough for their liking. The spring peepers were deafening and for a short while, green frogs made banjo twangs to join with the peepers. Snipes were free falling hundreds of feet and letting the wind use their feathers for their "winnowing" courtship call. Fishing licenses were filled out in general stores and with the hope for better luck and more time on the rivers.

Early Spring with Skunk Cabbage at East Ferry, Digby County.



The red spathe of flower and knobby (stigmas) spadix of same, a week later.

But we all know what happened. In the Spring, the Southern Uplands were ablaze with fires around Timberlea and the mammoth fire at Barrington and up the Clyde River. These fires, regardless of their causes, were more intense than usual. 2023 began as a wet year in January, but each of the next four months were significantly drier than normal (Figure 1) and the Barrington fire burning 23,525 ha was the worst in Nova Scotian history, the previous record being 13,000 ha in 1976 (Cecco, May 31, 2023, Guardian).

2023 showed the extremes of conditions climate change can bring. The dry spring was followed by excessive rainfall events leading to the washed-out roads, bridges and homes and the deaths of four people. The episodes left pain and trauma for lost loved ones, homes and livelihoods and there is also a sense of lost trust and security as climate change continues to deliver erratic weather patterns and unpredictable storms.

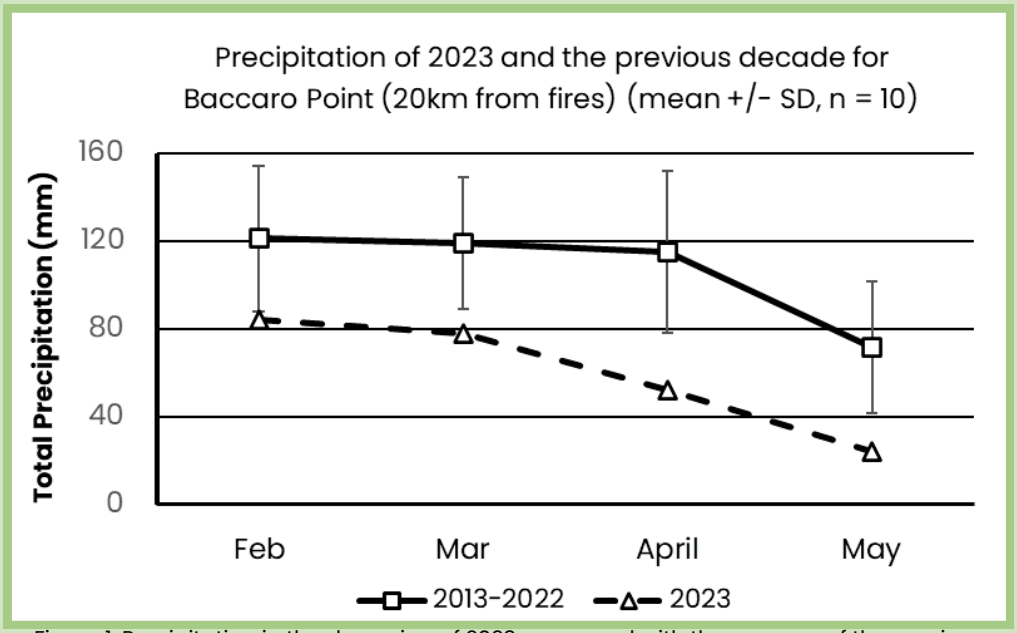


Figure 1: Precipitation in the dry spring of 2023 compared with the average of the previous decade (prepared from Environment Climate Change Canada data).

Our hearts are with the Nova Scotians who went through the fires and floods and we pay respect to all those involved in tackling the disasters and providing for the displaced people, the emergency workers and in the efforts to rebuild. We want also to reach out to the family, friends and colleagues of Steve Mockford. Whenever we met in groups by the Mersey and Medway Rivers, we felt him near.

Table of Contents

Wetlands and Climate Change

With low rainfall times and intense flood periods, wetlands will be needed more than ever to help provide base flow and well water in droughts and to provide storage in times of floods. Alex Cadel is part of "CLIMAtlantic", a non-profit that is a "hub for climate services in Atlantic Canada, providing information and support for people to consider climate change impacts in their decisions. We provide free, publicly accessible support to governments, communities, organizations, and individuals across Atlantic Canada. Services include guidance for accessing and understanding climate change data, connecting people working on adaptation, developing tools, delivering training, and other activities aimed at building adaptive capacity and community resilience."

Headwater stream of Annapolis, Rockland Brook, Rockland

Wetlands are important for habitat health of lakes and rivers, for coastal fisheries, for biodiversity and for on-going carbon sequestration and for carbon storage. We look after this land for the generations to come. Saving wetlands saves the kidneys of the landscape and a climate cooling system.

Wetlands and Climate Change in Southwest Nova Scotia

Alex Cadel, Climate Services Specialist, CLIMAtlantic

Wetlands are incredible ecosystems for many reasons, and increasingly they have been acknowledged for their climate change mitigation and adaptation benefits, such as storing carbon and increasing community resilience. Yet, we also know wetland health and function are threatened by changes in temperature, precipitation, and extreme events. To make sense of the connections between wetlands and climate change, this article discusses how the climate is changing in Southwest Nova Scotia, what impacts climate change might have on wetlands in the region, and why wetlands are important for adapting to climate change.

Nova Scotia's Changing Climate

While climate change is complex and multifaceted, the main expected changes for Nova Scotia can be summarized in five high-level trends:

- Rising temperatures
- Changing precipitation patterns
- More frequent and intense storms
- Rising sea levels
- Changing oceans

Each of these trends has some relevance to wetlands, and so will be discussed in turn in the following paragraphs. The values referenced are the latest climate projections (CMIP6) for the

geographic region of the Mersey River watershed, intended to be representative of the typical climate in Southwest Nova Scotia. Projections are for the period 2021-2050, relative to the historical average between 1971-2000.

Over the next several decades temperatures may be 2.2oC higher, on average. This means hotter summers with a greater risk of heat waves, as well as conditions more likely to cause droughts or wildfires. Milder winter temperatures are becoming more common, impacting snow and ice cover; in Southwest Nova Scotia, the average winter temperature is anticipated to increase from -3.1oC historically to -0.6oC by mid-century. Warmer temperatures will extend the growing season by up to 30 days, which could be an opportunity for many plants, but also introduces new risks from pests, diseases, or invasive species that might be better adapted to these conditions than native plants.

More precipitation is expected – about 7% more per year, on average, with most falling in winter and spring. However higher temperatures cause higher evapotranspiration rates, meaning more rain falling doesn't necessarily result in more available moisture. Warmer temperatures also cause more precipitation will fall as rain rather than snow, and a trend towards more intense rainfall events.

Intense tropical storms and hurricanes are anticipated to be more frequent, driven by warming oceans which enable these systems to maintain strength for much longer on their track north. These stronger storms will likely bring more powerful wind gusts and more extreme storm surges to Nova Scotia's coasts.

Concerns of coastal flooding are exacerbated by rising sea levels – approximately 75-80 cm of sea level rise is the median projection for Southwest Nova Scotia by 2100, under a high emissions scenario. These rising seas may also drive saltwater intrusion into coastal freshwater systems, and cause issues for sensitive coastal ecosystems such as salt marshes and dunes which may not be able to migrate quickly enough to keep pace. Ocean changes include increased temperatures, both at the surface and in deeper water, with marine heatwaves becoming longer and more frequent. Marine waters are becoming more acidic, causing challenges for aquatic life and increasing the likelihood of algal blooms. There is also a decreasing trend in marine oxygen levels, which can limit the growth and distribution of aquatic species.

Climate change risks to wetlands

A few climate trends are specifically concerning for wetland health and function. Changing temperature and precipitation patterns could alter the hydrology of wetlands, with greater risks of both flooding and drought. The distribution of many species is also constrained by climate patterns, which are shifting; species towards the southern edge of their range are likely to face challenges in hotter summers, milder winters, and competition from species

better adapted to more temperate climates. Rising seas may pose a threat to coastal wetlands, which may experience coastal squeeze and shrink over time if they don't have space to move inland, limiting their benefits. More intense storms may cause erosion and damage to vegetation, which could be more difficult to recover from if large storms also occur more frequently.

In the recent provincial climate change risk assessment, *Weathering What's Ahead: Climate Change Risk and Nova Scotia's Well-being*, wetland ecosystems were identified as a special area of concern. Wetlands are vital to our well-being now and in the future, but are at risk from multiple climate threats such as heat stress, shifting ecoregions, and invasive species. The provincial assessment identified that work is needed to better understand the specific vulnerabilities and opportunities of wetland ecosystems in Nova Scotia so as to ensure they are resilient to climate change.

Of course, non-climate pressures such as development or pollution also pose risks to wetlands. Even in cases where climate change may not be the primary concern, climatic changes can often make it more challenging for these ecosystems to be resilient to the other pressures they face.

Sweet gale (*Myrica gale*)

Labrador tea (Rhododendron groenlandicum)

Peat moss (*Sphagnum spp.)*

The importance of wetlands for adaptation

All these concerns about risks to wetlands are underscored by the fact that abundant, healthy wetlands provide substantial benefits for adapting to the changing climate. Wetlands are effective natural sponges that slow, filter, and absorb stormwater to alleviate flooding, and by storing that water also ease the impacts of drought. Wetlands are very effective buffers against strong waves and storm surge, reducing erosion and protecting communities. A recent study in Nova Scotia found over 60% of incoming wave energy is dissipated within the first 10 metres of salt marsh for water depths less than one metre (Ngulube, 2021), which quantifies the shoreline protection healthy coastal wetlands provide. Wetlands are biodiversity hotspots that provide shelter and resources for abundant flora and fauna; they are incredibly effective carbon sinks, and store more carbon than any other ecosystem on Earth. Wetlands are sources of livelihoods, providing essential resources and services to support human wellbeing, including food, medicines, recreation, and cultural connections.

Climate change is a growing threat to wetland ecosystems, and working to understand and address these potential impacts is a crucial step towards protecting and restoring these vital natural systems. The links between healthy wetlands and resilient communities are abundant, and deserving of greater recognition.

For Peat's Sake!

Nick Hill, Southwest Nova Biosphere Region

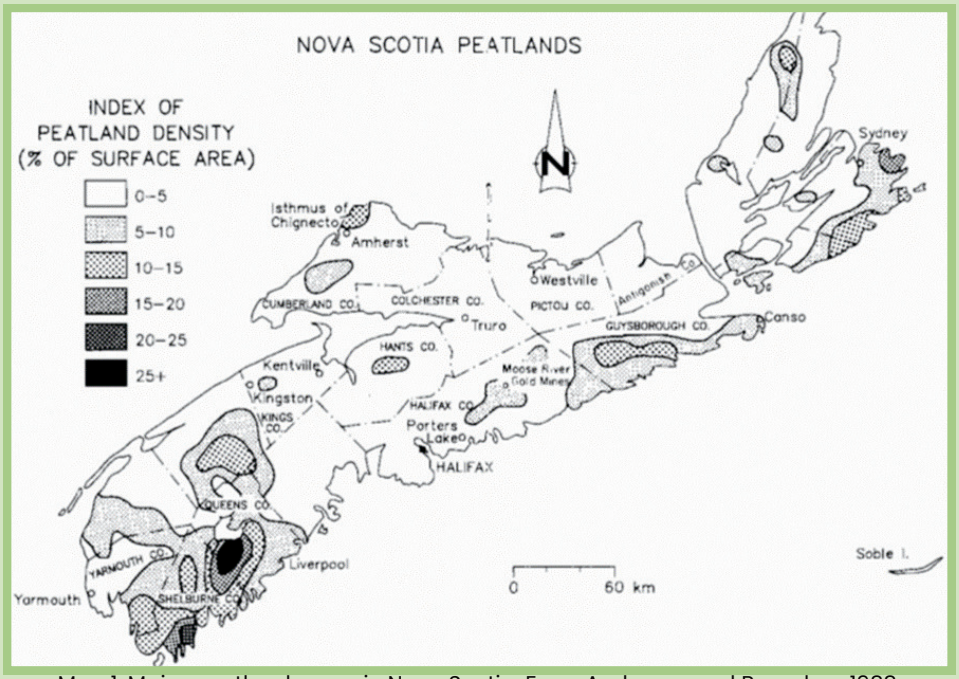
Canada contains a quarter of the world's peatland in bogs, fens and swamps and in northern permafrost areas. These peats form because decomposition is slow in wetlands especially where waters are acidic. Low fertility wetlands grow sedges and carpets of sphagnum moss. These plants form much of the peat that is the carbon store important in the fight to slow climate change(1).

Peat traditionally heated the crofters cottages of Scotland but burning peat generates two times more carbon dioxide for heat produced in comparison with natural gas (McLachlan, 2023)(2). Many worry here that not enough is being done to tackle climate change but change in public opinion can come quickly. Recently on a December trip to southwest England, I lit a wood fire to warm the room in the house that had no central heating but was warned that the neighbors don't like the low level smoke or the symbol of inefficient burning. Peat moss harvesting is still used in the horticulture industry and in gardens in North America but its use in England and Wales will be banned in 2024(3).

Society changes but there must be affordable alternatives. With the increase in heating costs, the use of peat in the Hebrides for heating in open fireplaces has predictably increased (McLachlan, 2023). Ensuring affordable heating must be a key block in a nation's climate change strategy or there will be a lobby and an argument for the use of fuels with poor ratios of CO2:Energy Output such as peat or coal or heavy fuel oils. The local changes made or not made are now, rightly or wrongly, broadcast to an international media: "Nova Scotia touted its huge "green" energy plant: turns out it's powered by coal" (4) ...we deserve better headlines and with wise resource use decisions, we can make this happen.

Nova Scotia Peatlands: Changing Values

In 1988, the jury was more split than today over the extractive use of peatland in Nova Scotia. There had been limited use of peat reserves but the map from Anderson and Broughm (Map 1: 1988, NSDNR, Mineral Resources Branch Bulletin ME 6) showed that peat reserves were abundant over the infertile rocks of the southern uplands and peatland density was greatest from south Queens through Shelburne County.



Map 1: Major peatland areas in Nova Scotia. From Anderson and Broughm, 1988.

In 1988, the Gaia Hypothesis and the threat of global warming was increasingly well understood as James Lovelock published "The Ages of Gaia". The beginning of concern over global warming/climate change may have helped change the province's approach to peat exploitation but there was also a biodiversity issue that became locally polarizing: the very bogs around Shelburne that were proposed for peat extraction supported the Nationally Endangered Thread-leaved Sundew.

Peat Bogs and Swamps are Long-term Carbon Storage facilities

Thread-leaved sundew, endangered 2001.

During this debate between the economics and opportunities of peat mining versus the importance of a very rare plant and endangerment of the hydrology of the habitat, researchers were busy looking for clues in the peat. Landry and Cwynar of University New Brunswick found preserved seeds of the endangered sundew throughout the peat at two of the four bogs. In these sites, radiocarbon dating of seeds showed that the plants had been resident in the same bogs for 2000 and 4000 years. This long-term loyalty of the plants to the bogs supported the conservation view that the plant's success in staying alive in Nova Scotia was related to the particular habitat—a peat bog was not any old peat bog—and the habitat should be protected.

Secondly, the data showed that peat took serious amounts of time to deposit. At Swaine's Road, each 10 . cm of peat represented 300 years of the deposition of organics—moss, sedge and twigs—and their decay. In comparison, at Villagedale, ten centimeters was a century. The talk of sustainable peat harvesting, therefore is talk.

On Brier Island, the restoration of Big Meadow Bog was begun in 2014. It had been ditched for agriculture in 1958 but the Province and ECCC were committed to bring back the habitat of one of the rarest species in Canada, the Eastern Mountain Avens. Avens makes many fewer seeds than sundews and these don't persist. So researchers focused on indicator Sphagnum mosses themselves and found that the peatland had changed three times in three thousand years: from marsh to swamp 2500 years ago, from swamp to fen 1700 years ago and from fen to bog 700 years ago. How much time was needed for each 10 cm of peat here? One hundred and seventy years.

Endangered Eastern Mountain Avens at Big Meadow Bog

Excavation of a ditch at Big Meadow Bog, ca. 1958. Courtesy: Dorothy Outhouse, Freeport, NS

Wisqoq trees at Ponhook swamp

The Nova Scotia Department of Environment and Climate Change is the lead agency in the protection of wetlands(5). There is a no-net loss of wetland policy that prevents wetland alteration or loss without documentation, the permission of the Department and a compensation plan (6). There are Wetlands of Special Significance where all alteration is prohibited. These are saltmarshes and tidal marshes and all wetlands that house listed species at risk.

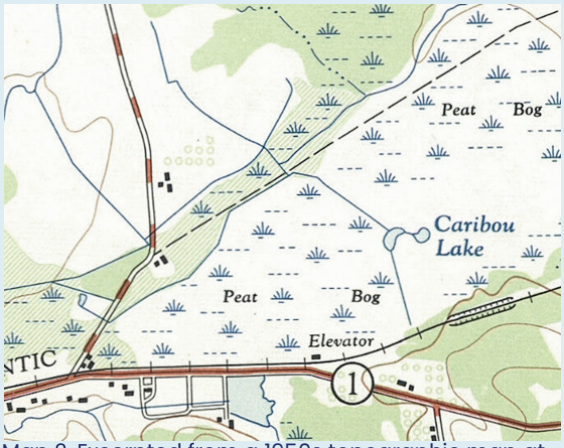
The Southwest Nova Biosphere Region is working with Wildcat Reserve and Acadia First Nation to conserve a Wetland of Special Significance, a Wisqoq or Black Ash swamp near the shore of Ponhook Lake ("ponhook" is a Mi'kmaw work for the first lake in a river system). These black ash are the oldest known in Nova Scotia at 120 years. Their growth rates are excruciatingly slow, averaging a millimetre of wood per year and we have just understood by dating charcoal layers in these swamps that the balance of organic inputs of moss and wood and the loss via microbial decomposition and fires has made a base of 70 cm of peat and each 10 cm represents 500 years!

References

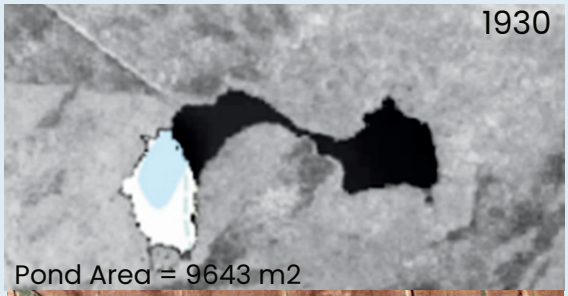
1)https://www.iucn.org/resources/issues-brief/peatlands-and-climate-change
2)https://www.pressandjournal.co.uk/fp/news/highlands-islands/5130442/crofters-turning-back-peat-fuel-cost-of-living-crisis-heating/
3)https://www.theguardian.com/environment/2021/dec/18/peat-sales-to-gardeners-in-england-and-wales-to-be-banned-by-2024.
4)https://www.theguardian.com/world/2022/oct/26/nova-scotia-green-energy-plant-coal-powered
5)https://novascotia.ca/nse/wetland/
6)https://novascotia.ca/nse/wetland/docs/Nova.Scotia.Wetland.Conservation.Policy.pdf

Peatlands as Water Filters and River Base Flow

Nick Hill with Levi Cliche, Executive Director, Clean Annapolis Rivers Project



Map 2. Excerpted from a 1950s topographic map at the headwaters where the two Valley rivers intertwine in a 4 metre deep peatland, Caribou Bog. This map also features Caribou Lake which was two small interconnected ponds



Peatlands are giant water filters and water supply regulators. They are maintained by Sphagnum mosses that build up bogs and scavenge nutrients from other plants. These mosses are the ecosystem engineers that build and shape the landscape. The water coming out of a spring below a swamp has been stored, regulated and filtered. In addition to the filtration, the peatland captures water and slows it down. The columns of trillions of moss stems are capillaries that draw water upward and hold it against gravity. At the landscape level, these bogs with their capillaries are linked in drainage systems to fens that discharge water through their peats, often with a central stream that flows at high water. The fens may feed streams or may lead down to a basin that is a swamp, usually another peatland that has tall shrubs—hollies or alders—or red maples and black spruce. The swamp can be a forest filled with frog calls, insects and birds (see MTRI's and John Brazner's articles on pages 14 and 19). There will be hummocks and tall cinnamon ferns.

Caribou Bog is a case in point (Map 2). The 1907 Farmer's Advocate and Home Magazine pointed out that the bog was not the source of either the Annapolis or Cornwallis rivers. Strictly, this was so—the river sources were swamps on the North and South Mountains—, but this 300 hectare peatland containing perhaps a million tons of peat (300 ha x 4m x 10,000 = m3 /1000 = tons) was storing and discharging clean water to both of these major rivers that are now substantially impacted by nutrients (N and P) and coliforms (Brylinski, 2014)(1). A friend recalled seeing a map on his schoolroom's wall showing Caribou Lake, a forgotten landform to most of us but one that communicates how the system worked. The swamps perched on top of the South and North Mountains discharged water into streams that ran down the mountains and slowed down to recharge the sphagnum peat. This absorbent filtered the waters and then discharged it to provide clean base flow for each river.

Peat is a long-term carbon store and a healthy bog is an on-going scrubber of atmospheric carbon as the mosses use carbon dioxide to photosynthesize but each year of growth becomes buried in the bog as the moss becomes peat. Sphagnum and its peat also filters and stores water for wells, for agriculture, for base flow of rivers and fish. Restoration of peatlands shows the social will to do it and the practicality that it can be done and is worth doing. We can get overwhelmed by the immensity of a global problem and how small and confounded we think our impacts are. But every positive thing we do has a knock-on effect to others who are overwhelmed by the same immensity.

1) https://novascotia.ca/nse/surface.water/docs/Annapolis-Valley-Baseline-Water-Quality-Survey-Report-2014.pdf)

BIODIVERSITY, BIODIVERSITY, BIODIVERSITY

Nick Hill, Southwest Nova Biosphere Region

.... the mantra of a colleague now retired from Nova Scotia Department Natural resources and Renewables, Wildlife Division who was responsible for Species at Risk and pushed biodiversity as hard as others pushed forestry or economy. "It's the economy, stupid" but biodiversity is an economic indicator as each loss of biodiversity indicates a loss in the condition of the habitat that supported the missing plant or animal. The loss of habitat integrity means a loss in ecological services. Biodiversity as a bottom line is not as crazy as it sounds and wetlands are the veins of gold in the landscape that maintain the rich tapestry of wild life. Almost all of the 22 Species at Risk plant species in wetlands. Most of the at Risk lichens need the humidity around or in wetlands (see page 22, Sean Haughian) and the Water Fan lichen grows in the clearest streams of the province. Two rare freshwater mussels (Brook Floater and Yellow Lamp Mussel) are likewise indicators of good water quality and an absence of excessive sedimentation of streams. The four at risk reptiles, the Wood, Blandings, Snapping Turtle and the Eastern Ribbon Snake have life cycles tied to streams and rivers. Wetlands affect the whole biological community of organisms. Aquatic insects have cycles of emergence that sustain fish but also a community of aerial insectivore birds, the majority now at risk: three swallows (Barn and Bank and the Chimney Swifts), the Common Nighthawk, the flycatchers (Eastern Wood Peewee, Olive Sided Flycatcher), the Eastern Whip-poor-will and the Canada Warbler. Wetlands are as Chad Simmons and others at Mersey Tobeatic assert: "worth their weight in gold"...and then some.

The Department of Natural Resources, Wildlife Habitat Division, is finishing a many year study that seeks to understand which birds are particularly tied to various wetlands. John Brazner reports here on this peer-reviewed research.

Wetlands: Worth Their Weight in Gold and MTRI's Work to Secure that Investment

Chad Simmons, Marie Racioppa, Laura Carter and Abby Lewis of Merey Tobeatic Research Institute

For the people working in wetlands, we are often asked "What's the point? Sure, some wetlands are pretty but aren't they just wasted space that could be fields or forests if we drain them?" At first glance, you can forgive people for thinking this. The high-water levels typical of wetlands can make it impossible for trees to grow so they can't produce timber products, the deep peat moss can make agriculture unfeasible, and the standing water attracts pesky insects. Some days even researchers almost dread going to wetlands because it often includes hip waders, deep holes, direct sun and swarming hungry insects. It doesn't take many visits though to notice something about these ecosystems that keep us coming back, the staggering diversity.

It's not just the biodiversity of wetlands, for which there are hundreds of species in Nova Scotia's wetlands, it's also the physical conditions. What we call wetlands are many communities that range in soil types and pH, drainage, sun exposure, proximity to waterways, nutrients, salinity and of course wetness. Some wetlands are really wet, like open bogs, which prevent trees from growing, while others are quite dry, especially during the summer, and look like typical forests. This range of conditions invites many species, including many of our provincial species at risk, and this is why Nova Scotia's wetlands are one of our most biodiverse and ecologically precious ecosystems.

Once you really start to look at wetlands another thing you will notice is how many there are in Nova Scotia. Wetland mapping has always been tricky and the need for more accurate maps is constant but what we have now shows that wetlands are everywhere! You can begin to see the extent of wetlands in Nova Scotia with the included map of Southwest Nova Scotia, Kespukwitk. There are almost 2 million wetlands in Nova Scotia covering about 4000 km2, that's about 10% of the province! Given their expanse, it is again no wonder why Nova Scotia has so many wetland species.

If you browse through our at-risk species you start to notice, it's a who's who of wetland residents. The Blanding's Turtle, Eastern Ribbonsnake, Black Ash, Boreal Felt Lichen, Eastern Mountain Avens, Canada Warbler, Mainland Moose and Monarch Butterfly, just to name a few, all depend on wetlands. Some species live in wetlands for their entire life, like the Black Ash and Boreal Felt Lichen, while others come and go depending on the time of year and stage of their life, like the Canada Warbler and Blanding's Turtle. Of course, not all

wetland species are rare or at risk of extinction. Some of our most common species live in wetlands, like Red Maple, Alders and Black Spruce but many of our most threatened species depend on wetlands and the destruction of these ecosystems is one reason why they are at risk.The Mersey Tobeatic Research Institute has actively worked on wetland research and monitoring over our 20-year history, usually through a species-at-risk perspective. Today we lead several major projects working to conserve wetlands and their species on all levels, from the federal government all the way down to land-owner outreach and incentives. All levels of conservation are needed to effectively protect wetlands.

Forested wetlands

One of our projects is through the Kespukwitk Conservation Collaborative (KCC - https://kswnsconservation.ca/). The KCC is a collaborative partnership of Mi'kmaq First Nations, Indigenous organizations, non-government organizations, academic institutions, and federal and provincial government departments. Established in 2017, the collaborative is working together to conserve species at risk and biodiversity in the Kespukwitk/Southwest Nova Scotia Priority Place. The KCC divides the priority place into key ecosystems (e.g. upland forests, forested wetlands, open freshwater wetlands..etc.) and creates multistakeholder groups dedicated to working on these ecosystems and their wildlife. MTRI leads the forested wetlands group for the KCC, and it was through this group that we heard about a recurring problem for wetland researchers, reliably finding wetland sites. That issue led us to launch the forested wetland research site inventory in 2022 to help the research community find sites appropriate to their needs quickly. It may sound boring but finding usable sites for some research projects can take years and cost thousands of dollars, delaying new insights and discoveries. Our project aims to slash that waste and encourage research into forested wetlands. Our goal is to launch the inventory dataset in late 2023 or early 2024.

Our second forested wetland project is a brand-new three-year study to better understand the benefits of leaving intact non-harvested forests, called buffers, around forested wetlands when conducting forestry operations. This project is supported through the federal government Nature Smart Climate Solutions Fund and will get underway this year. We are hopeful this project will reveal new best management practices to improve provincial policy and allow foresters to make decisions that better align with ecological-based forestry.

Municipalities

At MTRI we have also been striving to engage municipalities in environmental stewardship and this often involves conversations and policies on wetlands. In 2021, we launched a survey of 22 municipalities in the Kespukwitk/Southwest Nova Scotia Priority Place to inform the development of a species at risk (SAR) toolkit. We have given presentations to share the survey results and engage municipalities in the development of a SAR stewardship toolkit at council meetings in the Municipality of the District of Yarmouth, the Municipality of the District of Lunenburg, Region of Queen's Municipality, and the Municipality of the District of Digby. We've reviewed the land-use bylaws and planning strategies for each municipality to highlight and compare protection and development restrictions. For example, most municipalities require certain information to be prepared before approval of a development

proposal but very few specifically mandate the identification of any SAR habitat. The consideration of wetlands is generally more prevalent in municipal policies. For example, several municipalities have provisions specific to development in Shoreland Zones which can require at least some percentage of vegetation to be left undisturbed and wetlands maintained in a naturally vegetated state. Overall, there has been a positive response from council members and there is interest in implementing new policies to protect species at risk, but further support is required to elucidate the pathway forward.

Private land

Around two-thirds of our forests and wetlands in Nova Scotia are privately owned and throughout our years of species at risk research we've listened to landowners about the need for support in managing private woodlands for biodiversity. We heard their thoughts and are developing a Biodiversity Assessment Tool to assess the special features and wildlife habitats on a woodlot. The assessment looks at a variety of ecological features such as tree species, tree ages and heights, forest dead wood and special habitats like wetlands, watercourses and old forests. All these features can go hand in hand with active forest management and our tool uses this information to recommend practices that ensure these special characteristics are maintained or improved.

MTRI has also newly launched its Woodlands for Wildlife pilot program that utilizes landowner recognition and small financial incentives to encourage the protection of significant habitats for species at risk on private woodlands in Kespukwitk. The program targets a group of at-risk birds, turtles, lichens, and tree species and works with woodland owners to establish effective buffers around significant species-at-risk habitats on their property in addition to a series of species-specific beneficial management practices. Wetlands represent extremely important habitats for most species at risk included in the Woodlands for Wildlife program and are commonly buffered as significant habitats on participating properties. Woodland owners are rewarded for their conservation efforts through an annual incentive payment tied directly to the total merchantable forested area included within the established buffers.

For biologists and other researchers at MTRI, the importance of wetlands is obvious, but we are not the only ones needed to tackle the issues facing these ecosystems. Without the help of the public, community groups and all levels of government the stereotype of wetlands as wastelands may remain, putting their wildlife communities in peril. Mindsets can change though, especially when charismatic wildlife are involved. Join us and help show that wetlands are worth their weight in gold and deserve investment. You can learn more about MTRI and support our work by visiting our website (www.merseytobeatic.ca) and following us on Facebook and Instagram.

Springtime in the Swamps – Avian Oases

John Brazner, Habitat Division, DNRR

It's hard to pick, but spring is definitely one of my favourite times of year. For me, winters are a quieter, more contemplative time, with plenty of room for a good book and some serious napping by the woodstove. No complaints about that at all, and the older I get the more I appreciate what winter has to offer. There are still birds to be found around the feeders and even in the woods and other wild places if you are patient and hardy enough to venture out. Tracking animals in the snow can be great fun too and lead to understandings that would be impossible to gain in snowless months. But opportunities for observing wildlife are generally fewer and farther between in those colder months.

With spring comes a rebirth that is both a relief and exhilarating. A relief in that we rediscover that life truly does go on. Despite all the horrible news about climate change and environmental disasters that we are confronted with nonstop these days, spring brings life back - at least so far. For me, there are a few things that really standout as harbingers of spring. Reaffirmations that life truly will go on, lending hope to the idea that we may not have done irreparable damage to all of our nonhuman partners in this world. It's when wood frogs start quacking up a racket, and along with yellow spotted salamanders, lay their spongy egg masses in vernal pools. Its when red maple canopies open into full flower offering up the first widespread source of pollen and nectar to pollinators. It's when I hear the first woodcock peenting in the old field that was our lower pasture while the last of the snow fades away, and eventually, when the first white-throated sparrow comes along singing its praises for "oh, sweet Canada".

All that is now weeks in the past and so much more has followed. The warblers are piling in as I write, spring ephemerals like bloodroot and wild leeks have sprung, our forests are nearly fully leafed out, and dandelions and bumblebees are everywhere. Watching and listening and smelling it all unfold is beyond exhilarating, and for me, as a wildlife biologist, it is always a crazy time. With my focus being on wetlands and the birds that depend on them, this is the busiest time of year, and this spring has been a particularly wild one. As part of my job as a biologist with the Ecosystems and Habitats Program at the Department of Natural Resources and Renewables, I've been on a whirlwind tour setting up field sites with audio recorders to capture the songs and sounds of birds and amphibians in treed swamps and salt marshes around the province. Our hope is to collect data that will allow us to determine the current state of those ecosystems and say something about the state of biodiversity in Nova Scotia. From previous work we've done, we know forested wetlands are biodiversity hotspots, particularly for birds, that they store tremendous amounts of carbon and play a key role in moderating flood events in many of our watersheds. That is why we chose mixed wood treed swamps as one of the focal ecosystems we will be studying as part of our efforts to report on the state of biodiversity. Treed swamps are also the wetland type that is most often lost to human development in Nova Scotia and the one we know least about restoring. Typically, if an approval is given to alter a swamp for development, the province requires that restoration be done elsewhere as part of compensation for the loss. Unfortunately, other wetland types are typically restored, resulting in a net loss of swamp habitat. Harvesting timber from treed swamps is also still common practice and does not require an alteration

approval from government. After harvesting, these sites become considerably wetter because the trees that were cut are no longer removing water through evapotranspiration, and as a result, the ground becomes too wet for natural regeneration of the trees that will become the swamp. However, treed swamps are now considered sensitive habitats under the new harvesting prescriptions for Crown lands developed in response to the Lahey Report, so harvesting of these sites in coming years should be substantially reduced.

This is good news given the high conservation value of forested wetlands in Nova Scotia's landscapes. Our work a few years ago on three different types of forested wetlands – wooded peatlands, tall shrub swamps and treed swamps - at a couple hundred sites spread across western Nova Scotia demonstrated that there were rich bird communities associated with each of these different wetland types and that these communities differed depending on which geographic region we surveyed. We ended up detecting breeding evidence for 95 species, which is nearly half of all bird species thought to breed in Nova Scotia. Five of these species are listed as at-risk provincially. Species like Canada warbler and Eastern wood-pewee were common in and strongly associated with treed swamps, Olive-sided flycatchers were observed at all three wetland types, but most common along the edges of wooded peatlands, and Rusty blackbirds were extremely rare and mainly observed in shrub swamps. It was a bit surprising that shrub swamps and peatlands had more species and higher abundances than treed swamps, and Valley sites had the highest species richness and abundance compared to the Fundy Shore and Western Ecoregions. All of this suggests that shrub swamps, particularly in the Valley Ecoregion, have higher conservation value than previously thought and are acting as important refugia for birds in this highly fragmented landscape. It also highlights that the high conservation value of wooded peatlands and treed swamps, but more-so due to the at-risk species they support.

About the time we were completing these first studies on the conservation value of forested wetlands, the Lahey Report was released and the province began moving toward an ecological forestry management approach. As part of the paradigm shift in perspective to one where biodiversity and ecological integrity are given top priority in forest management, it became even more essential that land managers have the ability to make informed assessments about the relative biodiversity value of various habitats in landscapes they were managing. Without that knowledge they would not be able to fully assess the conservation consequences of different management options. In response, we expanded our focus beyond forested wetlands to provide an understanding of the relative conservation value of different forest types. We started working on this about five years ago by surveying breeding bird communities in 18 forested wetlands from our previous study, as well as 18 mature and regenerating forest stands in the landscapes immediately adjacent to the forested wetlands. The main goal was to determine if forested wetlands were biodiversity hotspots relative to adjacent upland forests. We found there were distinct bird communities in each forest type and that species richness, diversity, overall abundance and abundance of several guilds and species of conservation concern were all highest in forested wetlands. Wooded bogs and shrub swamps had the highest number of species with strong habitat affinities, but treed swamps and mature sites had unique suites of strongly associated species and guilds - several of conservation concern. Regenerating sites were occupied mainly by forest edge-disturbance species with weak habitat associations although Olive-sided flycatchers and

Old-growth mixed-wood swamp near Cloud Lake, Nova Scotia

Rusty blackbird

Chimney swifts were occasionally observed at these sites. Overall, this second study highlighted the importance of forested wetlands to bird conservation and strongly supported the idea that forested wetlands are biodiversity hotspots for birds.

More recently we've been examining the role of protected areas and whether they are functioning to enhance the biodiversity value of the landscapes in which they are embedded. Once again, our focus was on the breeding bird communities in forested wetlands, but this time some were inside and some were outside of Cloud Lake Wilderness Area. Protected areas are a key component of most conservation strategies because they are thought to enhance biodiversity value relative to similar habitats in working landscapes. Although monitoring changes in biodiversity associated with protected areas is critical to assessing conservation success, it has only been done in a limited way (mostly in National Parks) across much of Canada, including here in Nova Scotia.

What we found was that there were rich bird communities and many species of conservation concern at sites both inside and outside of Cloud Lake Wilderness Area, indicating that both types of sites are playing important conservation roles. While bird communities at different types of outside sites were dominated by disturbance-tolerant species such as crows, jays and robins, they still supported high species diversity (higher in fact, than within the protected area) and several at-risk bird species. This strongly suggests to us that forested wetlands outside of protected areas are acting as important refugia for birds despite the higher intensity of human disturbance adjacent to these sites. Our results also support the idea that protected areas are providing critical additional support to key groups of birds, such as long-distance migrants and insectivores, that are currently in steep decline in many regions of the world.

The results from this study, as well as those from our earlier work, support the idea that forested wetland ecosystems merit the special protection now provided by the new silvicultural guidelines that prescribe no harvesting of trees in wet forests on Crown lands in Nova Scotia. In addition, they suggest that there is potential for biodiversity gains through investments in conservation strategies on private lands and highlight the need for working lands conservation. Only time will tell, but moving towards ecological forestry in Nova Scotia by prioritizing biodiversity conservation over other forest values seems like a sensible first step in that direction and worth careful evaluation in the coming years.

Lichens, invertebrates, and clearcuts in swamps

Sean R. Haughian, Curator of Botany at the Nova Scotia Museum; sean.haughian@novascotia.ca

If you've been paying attention to news about conservation and forestry in Nova Scotia over the last few years, there's a good chance you've heard about some conflicts between rare lichen habitat protection and logging. Lichens, which are essentially photosynthetic fungi, are among the most species rich groups in Nova Scotia's forested wetlands. But because most of these lichens grow directly on the trees, and because they're sensitive to changes in light and humidity that accompany logging on nearby properties, clearcut logging tends to be bad for lichens.

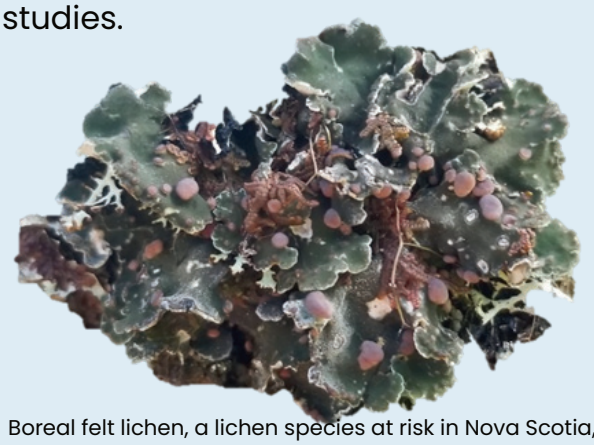
Another threat to at-risk lichens is that several invasive slugs like to eat them (Cameron 2009). We don't know as much about invertebrate (bugs & slugs) biodiversity in forested wetlands, but at least one study has shown that lichen and invertebrate diversity are linked (Pettersson et al. 1995).

Since nobody had studied the indirect impacts of logging (called "edge influence") on lichens or invertebrates in Nova Scotia, my colleague (Dr. Karen Harper) and I started a long-term study of these effects in 2018, to understand how clearcut edges affect invertebrates and lichens in Nova Scotia's forested wetlands.

Using a set of 13 field sites from across Nova Scotia where a clearcut was adjacent to a forested wetland, we measured lichen cover on trees, and we trapped tree-dwelling invertebrates on a gradient between the clearcut and the interior of the forested wetland. We also measured a bunch of other things around each lichen survey tree that relate to forest structure and light.

Our main findings were that, while some common lichen species are abundant at forest edges, some rare species have very low cover up to 80 m from the clearcut edges. In addition, slug grazing marks on the lichens were more abundant near edges, and the diversity and abundance of invasive slugs (from the genus Arion) were greater near these same edges.

So far, our work suggests that clearcut logging can have indirect negative impacts on rare lichens close to the edges of forested wetlands by facilitating the spread of invasive slugs. Because we couldn't detect edge influence beyond 80 m, we hypothesize that this may be a safer 'buffer' distance for forest companies to use around forested wetlands than the traditional 30 m for open wetlands, but we hope to test this hypothesis with upcoming studies.



Boreal felt lichen, a lichen species at risk in Nova Scotia, photo by Sean Haughian

A typical mixed wood forested wetland in Nova Scotia; photo by Sean Haughian

Progress on OECMS and Wilderness Areas: How to get involved.

In 1992, 150 world leaders signed the Rio Declaration at the United Nations Convention on Biological Diversity. This summit was a realization that before any real or equitable biodiversity conservation could happen, the basic needs and living conditions of humans had to be cared for. For the first time, it was recognized in international law that the conservation of biodiversity is a concern common to all humankind and must be an integral part of development. About two decades later in Aichi Japan, 20 biodiversity targets were laid down among 5 Strategic Goals to:

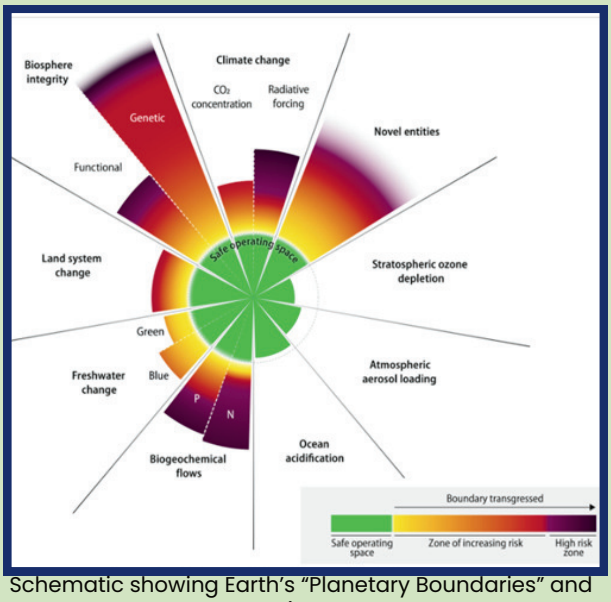
A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society,

B. Reduce the direct pressure on biodiversity and promote sustainable use,

C. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity,

D. Enhance the benefits to all from biodiversity and ecosystem, services,

E. And Enhance implementation through participatory planning, knowledge management and capacity building.



Schematic showing Earth's "Planetary Boundaries" and how 6 of 9 are breached (from Richardson et al, 2023: https://www.science.org/doi/10.1126/sciadv.adh2458)

A healthy river bank along the Annapolis River.

The beat goes on and after three decades of meetings, commitments on actions though too little action, "there's been no clear progress on the headline ambition to slow and eventually reverse the loss of biological diversity around the world" (Nature editorial, 18 February 2020). This last week, Science magazine reported that 6 of 9 "planetary boundaries" essential for life on Earth had been transgressed. Figure 2 looks like cream cheese and peanut butter on a bagel but it actually shows how badly the Earth's biological operating system is out of balance, particularly Biosphere integrity and Biogeochemical flows (nitrogen and phosphorus). Biodiversity needs our help.

The Biosphere Reserve Associations throughout Canada have received funding to identify potential protected areas that can help Canada meet its 2030 commitment of having 30% of Canada protected. The project funds the identification and securement of OECMs ..Other Effective area based Conservation Measures. These are lands not managed with conservation in mind but important for the conservation of ecological processes and biodiversity. Such biodiversity important areas could be undeveloped military base lands or lands that protect the wellfields for municipal drinking water. We at Southwest Nova Biosphere Reserve Association are working with various municipalities to identify such lands. One area is a

wellfield that includes biodiverse river floodplain and a stand of the Threatened Eastern White Cedar. Another water supply watershed area provides a continuity of mature forest, some with pit and mound microtopography.

We are working with the Protected Areas branch of Nova Scotia Department Environment and Climate Change. Once we identify an area, this branch assesses it more fully and at present, recommends that the area be regarded as a tentative Wilderness Area or a Nature Reserve. On the Nova Scotian front, 13% of the land base is now protected but the Nova Scotia has committed to protecting 20% of its lands by 2030. Roughly 70% of the Province is privately owned and given the limitation of the amount of the Crown land base and the amount already committed to protection, especially in Kespukwitk, you may be the biggest help for the Province to reach its conservation pledge.

If you are concerned about nature and its conservation and well being into the future, and have a natural landscape you want to see protected to help save biodiversity and reach these conservation targets, there are many options. Email (nick@swbiosphere.ca) or call (Nick at 902-698-0416) to discuss options. Every piece of natural area works for nature and together they can make bigger corridors for moose or areas for goshawks. The wetlands support a multitude of rare species and help maintain the healthy drainages to rivers to support otters and fish.

Some Biosphere Events 2023

In late April, Southwest Nova Biosphere Association hosted the gathering of the three Atlantic Biospheres: Bras D'Or, Fundy and the Southwest. It was a getting to know each other event and we found excellent accommodations and food at the Mersey Chalets on Highway 8. We convened on Day One at Wildcat Reserve. Jamie Jermey opened the gathering with traditional drumming and Scott Jermey, Ecology Program Manager, welcomed us to Wildcat. Mi'kmaw writer and poet, Shalan Joudry led the group in a sharing circle. After a lunch of beans, coleslaw and ham prepared just like I like it by Val Whynot, the group found ten canoes equipped for an afternoon's paddle down the Wildcat River to Ponhook Lake. There were mild protestations half way at Maplesue Point (photo 12) but the day was sunny and memorable. We landed at the Wisqoq swamp currently held by the Southwest Biosphere in talks to pass the swamp that holds the densest and oldest Black Ash (wisqoq) stand in Kespukwitk to Acadia First Nation. Cody and Karlene Whynot were there to meet us and pick up the canoes. The Whynots studied adventure tourism at Thompson Rivers University and set up Whynot Adventures. Day two was hosted by Kejimkujik National Park. Andy Sharpe and Matt Smith welcomed us to the Park and Shalan led us in the morning's circle. After lunch from the Hollow Log restaurant, Ursula Johnson, Cultural Interpreter at Parks Canada and Mi'kmaw artist, discussed the goals for indigenous co-management of the Park. Ursula carried out a closing ceremony on banks of the Mersey River.

In May, as part of the Recovery Team for the Eastern Mountain Avens, we participated in a week long dialog and exploration of whether conservation and most notably the Species At

Relaxing at the wind-blown Maplesue Point, exceptional Atlantic Coastal Plain habitat of Ponhook Lake.

Wetland course at Uniacke Estate, NS Museum. Kevin Keys looks on at group delineating swamp

Risk division of the Department of Natural Resources and Renewables should consider and even facilitate Ex Situ conservation management for species facing greatest threat from climate change. We had presented evidence in this same year to the Canadian Botanical Association about the threat faced by the arctic-alpine refugee, the Avens on Brier Island, from documented dramatic changes in temperature that have occurred over the last 30 years (increase of more than 2.5oC in some winter months, 1.7oC annually). The group explored all angles of the issue in a week long session that was facilitated by a climate change conservation consultancy (The Canadian Species Initiative). At week's end, we had green lighted the start of an ex situ nursery to be developed at Acadia university using seeds collected from Brier Island, and also, though with more caution, a pilot study to test how controlled sowings of seeds of the Endangered Avens taken from the field in Brier Island would fare when transplanted to cooler peatlands of Cape Breton. No one is giving up on in situ conservation—the 10 year restoration program of Big Meadow is on-going—but the pattern of temperature increase on the Digby Peninsula and what is known of ocean water temperature change in the Gulf of Maine, not having an insurance plan is much more risky than any considerations we raised about ex situ recovery plans.

In June, we put on a short course of wetland function and delineation for Mersey Tobeatic Research Institute. Water levels were high—we got thoroughly wet many times—but so were spirits. In early August, the Biosphere Association put on a wetland delineation course at Uniacke House from the Carriage House. This is the 8th time Nick Hill and Kevin Keys have offered wetland delineation courses but the first time this was done as a Biosphere function. The students came from the consulting industry, Perennia, SBRA, Dalhousie University and Ducks Unlimited.

In August, Adam Deveau presented information on the Southwest Nova Biosphere Association and its Two Billion Trees program at the Lawrencetown Exhibition.

In September, the Kespukwitk Conservation Collaborative held a field day in the heart of the Southwest at Mersey Tobeatic Research Institute, Kejimkujic National Park and Wildcat Reserve. Many participants came to see first hand the goings on with Black Ash plantings at Merrymakedge Beach by Kejimkujic National Park, a private landowner's property where land use incentives have helped protect Species At Risk (Jane Barker and Laura Carter), and at Wildcat where we heard about the EarthKeepers program and visited the Wisqoq swamp to understand the wetland strategies of the black ash.

In Memoriam: Steve Mockford (1954-2023)

On Sunday, May 21st, Southwest Nova Biosphere Reserve lost an advocate and a friend. Steve Mockford was an engaged citizen and scientist deeply committed to conservation and sustainable communities. For many years Steve served as Board Chair of the Mersey Tobeatic Research Institute (MTRI), a community-based research and education cooperative and foundational partner of SNBR. He helped to shape the direction and evolution of MTRI, which has promoted biodiversity conservation and wise resource use in southwest Nova Scotia since 2004.

There were many dimensions to Steve; few of us experienced them all, but to encounter even some was enriching and joyful. Steve touched, and indeed lived, many lives. As diverse as his lives were, there were common threads woven throughout – humour, kindness, patience, determination, an exuberance for life, and respect for humanity.

I first met Steve in 1991 as he was retiring from one set of lives, in the Canadian Armed Forces, to another set, in the halls of Academe at Acadia University. His wisdom and insatiable curiosity were readily apparent, and he became my first Honours student with grandchildren but no high school diploma! After completing his first degree, he moved on to complete a Ph.D. in population genetics at Dalhousie, returning to Acadia as a professor in Biology, where he taught until his second retirement.

As an academic, Steve was a superb colleague to all, inside and outside the department, providing wise counsel or simply lending an ear. He served two terms as Acting Department Head, provided direction and focus to curriculum and program development, and sat on countless committees. Yet his focus first and foremost was always on students; they shaped his teaching and his research.

As a mentor, Steve had few equals. He knew all his students, whether they were first year or graduate. He had the ability to draw them out and to see the possibilities; he encouraged enthusiasms, spawned careers, and changed lives. Steve got great pleasure from teaching, whether it was Intro Biology or a graduate seminar in conservation genetics. But his mentoring extended well beyond the classroom, to all ages. Even as preschoolers his grandchildren, who lovingly called Steve ‘Big Guy’, had a grasp of science rivalling that of most adults!

As a conservation biologist, Steve blended curiosity and application. It was no accident that he was elected the first President of the Canadian Herpetological Society, an organization created by the merger of two well established sister societies, one focused on the science of herpetology and the other on amphibian and reptile conservation. He was intensely collaborative, particularly with students. His innovative work on population genetic structure in Blanding’s Turtle in Nova Scotia changed both our understanding and our approach to recovery of this endangered species. Steve’s commitment to doing science in service of community was epitomized by his long tenure as Board Chair of MTRI, which under his

leadership became increasingly recognized as an honest broker in conservation conversations in southwest Nova Scotia.

His unique talents were recognized by the Nova Scotia government when he was appointed to a small task force to draft the province's first Biodiversity Strategy. As a skilled and respectful listener with broad knowledge of conservation and sustainable resource use, Steve was able to reach out to a diverse audience; the strategy that resulted raised the profile of biodiversity conservation in the province at a critical time.

In Memoriam Courtesy the estate of Steve Mockford

As a citizen activist, Steve was no stranger to the political arena. He saw social justice and environmental justice as two sides of the same coin. In pursuit of either, Steve's approach was always evidence-based and direct; he could be forceful, but he was always respectful, even of those with whom he vehemently disagreed. This made him both an effective advocate and a worthy and memorable opponent.

As an artist, Steve was a gifted photographer with a remarkable eye for light and for finding the extraordinary in the ordinary. Dawn was his preferred time to shoot, but even with the distraction of sunrises, he was able to indulge his fascination with human landscapes and timeworn buildings – a reminder of our fallibility and ultimate bond with nature. After his second retirement, Steve devoted much of his time to his art, leaving a rich legacy of images for all to enjoy.

The one constant in all of Steve's lives and pursuits was his deep connection to family. His wife Lorraine, the love of his life for 50 years, his parents, siblings, son and daughters, and grandchildren were always on his mind and in his heart. He was immensely proud of who they were and what they accomplished. And we are all indebted to them for graciously sharing him with us.

As a human, Steve understood our responsibilities to one another and to the planet better than most. On his last day, with family gathered at his bedside, his final words were to remind us all "to do collective good". Sage advice indeed, and what better way to honour his memory.

Tom Herman
June 22, 2023