GULF OF MAINE INSTITUTE

Update on GOMI Journal: *Learning to Steward the Gulf*

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LETTER FROM THE EDITOR

John Terry

Have you ever wondered why some park-like appearing places are called commons? In the days of the Roman Empire, by the law of res communes, things used by everyone were held in common and could be owned by no one. In 17th century Europe, England, and the New World certain agricultural, grazing and forestlands that uniquely benefitted everyone were held as "commons." Every family had an equal right to graze their cow and other cattle on the commons. As western societies' food production became more industrialized and capitalized, the need for commons dwindled and those left were used primarily for recreational purposes. The rise of the conservation movement and the presidency of Teddy Roosevelt in the US saw a renewed use of the concept in the rationale for protecting national natural treasures, biological and geological, as parks, refuges, and sanctuaries and thereby removing them, in perpetuity, from commercial exploitation. The current US Administration aligned with powerful coal, mineral and logging interests, is currently applying strong pressure to privatize these parks, refuges and sanctuaries so they may be opened to commercial use. Similar trends may be found in Canada. Lost in the lust for markets are res communes and the common good.

Writing in the 2012 publication Wealth of the Commons: A World Beyond Market and State [1], Ugo Matte, [2]explains: The commons are not concessions. They are resources that belong to the people as a matter of life necessity. Everybody has a right to an equal share of the commons and must be empowered by law to claim equal and direct access to it. Everybody has equal responsibility to the commons and shares a direct responsibility to transfer its wealth to future generations. The commons radically oppose both the State and private property as shaped by market forces, and are powerful sources of emancipation and social justice. However, they have been buried by the dominant academic discourse grounded in scientific positivism.

Dr. Graham Daborn, our guest editor, brings the more philosophical discussion home as he puts forward a compelling case as to why the Gulf of Maine and Bay of Fundy should be so designated. The Maritimes and New England share these vital and biologically rich water resources. They, he argues, fit well the original purpose of res communes. Natural ecosystems, he stresses, "… do not adhere to political boundaries. These waters are shared between Canada and the USA, and between three states and two provinces. Demand for increased services related to aquaculture, energy, and tourism, and concern for endangered species and habitats engenders new conflicts with existing resource use and users." It is clear from his discussion that the Gulf and Bay are of importance worldwide in sustaining marine life and as a source of food and recreation.

Dr. John Colton's, article narrows the focus to a growing controversy in the Bay of Fundy: tidal

energy development. The approach was developed several decades ago relevant to the mining industry, and has since expanded. "Social license is intangible," writes Dr. Colton, " and "associated with acceptance, approval, consent, demands, expectations, and reputation. It is not a statutory framework but rather a concept that implies that developers and government will do the right thing in moving a project forward." Very familiar with tidal energy politics, he clearly explains how conflicting vested interests make getting a balanced and fair social license agreement difficult, and implementing that agreement even more so. Where the approach differs from res communes is the in the designation of developers and governments as the main stakeholders and the assumption they will end up doing the right thing. One has to ask, where are the "people" here? With adaptations, however, the approach may be very useful in moving the conversation effort forward. While defining the common good may be a reasonably manageable intellectual exercise, getting to a fair and representative solution is not. Public support is essential.

The tipping point in favor of a contemporary res communes designation will occur when the general public recognizes the consequences of human exploitation of the Gulf and the Bay. Included in the implementation would need to be legal authority to ensure sustainability in perpetuity. The Gulf of Maine Council, had as its vision something akin to this, however, the Council lacked the political and legal authority to achieve the vision. Dr. Daborn suggests the Council may yet be able to play a very important role by convening an annual open forum to exchange ideas and work on a method for collective stewardship. This seems both elegant and wise. The Council is the most credible entity to convene such a forum, which would have public outreach as a priority. That outreach, from a GOMI perspective, would include youth. Youth are, after all, the future stewards. It could encourage more consensuses building locally and bioregionally. Such a forum could facilitate the discussion on how we educate ourselves and our progeny to be more civically and environmentally engaged citizen stewards. How do we sustain the bioregion we deserve?

Endnotes

1. A collection of 73 essays that describe the potential of the commons in conceptualizing and building a better future, edited by David Bollier and Silke Helfinch and published in 2012 by Levellers Press, Amherst, MA>

2. Ugo Mattei is Professor of International and Comparative Law at the University of California, Hastings College of Law.

John P. Terry, founded the Gulf of Maine Institute in 1999. John was Editor-in-Chief, CYD (Community Youth Development) Journal from Aug. 1994 to Nov. 2002. John has broad teaching and administrative experience at the university level including the Massachusetts Institute of Technology, 1969-1984, University of Massachusetts, Lowell, 1985-1992, and Union College, Schenectady, NY, 1964-1969. John received national recognition in 2006 when selected as Civic Ventures,' Lead with Experience Program 2006 Purpose Prize Fellows. He is also a 2008 recipient of the Gulf of Maine Council on the Marine Environment Visionary Award.

GUEST EDITOR

Managing the Commons of the Gulf of Maine/Bay of Fundy in a Changing World
Graham R. Daborn

Summary

The Bay of Fundy and Gulf of Maine constitute biologically rich, diverse, and internationally important coastal ecosystems that are continuously changing as a result of both human actions and natural, long term processes. For centuries, these ecosystems and their watershed have provided critical resources to a residential human population that now totals more than 10 million. More recently, exploitation of other resources such as aquaculture and marine renewable energy has begun or is being considered. The high biological productivity of the Gulf of Maine and Bay of Fundy system has supported numerous species, some of which are now rare or endangered, including many that migrate vast distances to the region. Through these migrants, the Bay of Fundy and Gulf of Maine are biologically connected to the whole of the Atlantic, to the Arctic, and to Europe. Human activities, however, increasingly threaten the integrity of these ecosystems.

Natural ecosystems obviously do not adhere to political boundaries. These waters are shared between Canada and the USA, and between three states and two provinces. Demand for increased services related to aquaculture, energy, and tourism, and concern for endangered species and habitats, engender new conflicts with existing resource use and users. In addition, the continuing natural changes in these ecosystems together with changes in climate and global trade mean that the objectives for management and conservation are increasingly unclear. These factors represent significant challenges for the governance of the Gulf of Maine and Bay of Fundy (hereafter FGM). Experiments in community-based management have increased public understanding of issues, but have generally failed to lead to effective decision-making or to resolve conflicts. What is clearly needed is a renewed effort at public engagement and regulatory action to avoid a new "tragedy of the commons" in these ecosystems.

Introduction

Human activities increasingly threaten the integrity of productive coastal ecosystems such as FGM. For example:

- Overexploitation has led to significant declines in some fish species (such as cod, halibut and haddock);
- Shoreline development has resulted in loss of wetlands and reduced the resilience of the natural coastal ecosystem to respond to storms or to sea level rise;
- River dams for hydroelectricity or transportation have changed the patterns of freshwater and sediment input into the system; and
- Land-based pollution[1] continues to undermine the quality of waters in the Bay and the Gulf.

The biological connectedness of the FGM itself requires that management and conservation of the living resources must recognise a broader stewardship context than the economic interests of just those that live in the watershed.

The Gulf of Maine Council on the Marine Environment, established in 1989, provides a potential mechanism for shared information exchange and decision-making. It has no regulatory authority, but achieves some influence on environmental and resource decisions by facilitating public awareness and being closely linked to regulatory authorities at federal, state, and provincial levels. Management of existing fisheries is the responsibility of the two federal governments and/or the states and provinces, and licensing and quota assignment practices often differ on each side of the international boundary, even when they involve trans-boundary stocks[2]. In spite of policy statements to the contrary, an ecosystem basis for decision-making is largely absent. The

management of fisheries, for example, is commonly species-specific rather than ecosystem-based. Consequently, management of the common resources of the FGM at the present time might best be described as a melange of policies and actions that are conceptually appropriate, but often narrowly focussed, short-sighted, and inconsistent.
Changes in climate and global trade represent significant challenges for governance of the Gulf of Maine and Bay of Fundy. Demand for increased services related to aquaculture, energy, and tourism, and concern for endangered species and habitats engenders new potential conflicts with existing resource use and users. Garrett Hardin pointed out almost 40 years ago[3], that exploiters of common resources on public land (and sea) act primarily in their own self-interest unless there are strong incentives to respect a higher societal or community interest. In the absence of a strong vision for management of the ecosystem as a whole, and a community-supported regulatory agency with real decision-making power, the prospects for the Gulf of Maine and Bay of Fundy to become yet another example of the "tragedy of the commons" are indeed high. Experiments in community-based management such as the Atlantic Coastal Action Program (ACAP) have attempted to increase the awareness and involvement of local communities in management of the coastal environment, but real progress has been slow.

The Tragedy of the Commons Concept

Garrett Hardin's seminal 1968 article outlined an important dynamic that operates where separate exploiters target a common resource: an individual resource user's best interests are favoured by taking a larger fraction of the resource relative to other competing resource users. Hardin's analogy was with the common grazing lands shared by members of a local community. Each cattle herder would derive the full benefit of every additional animal in his own herd, while the potential costs (e.g. of overgrazing or disease) would be shared by the whole community. If every herder follows the same policy, the potential exists for overgrazing to destroy the resource itself. This inequity of cost and benefit can only be countered through establishment of a protective policy that places the best interests of society above that of individual interests. Otherwise, as Hardin states: "Freedom in a commons brings ruin to all." (Ironically, Hardin's solution is an economic one: privatization of the commons).

Hardin makes it very clear that the oceans represent such a commons. Unlike a well-defined grazing land, however, the renewable resources of interest to people (e.g. fish) include species that move freely between different regions and ecosystems. Consequently, the human community that has an interest in the sustainable use of any resource extends well beyond the local community of fishers[4]. Hardin's primary focus in the article dealt with the implications of the growth of the human population on the Earth. Increasingly, the rising demand for food is being met from ocean food resources, especially aquaculture[5], because land-based production has become inadequate: there is limited land space, much of it degraded by overexploitation or climate changes, and technical achievements aimed at increasing production (e.g. fertilizers, pesticides, and genetic modification) have not really provided sufficient rates of increase to match the increased human population. As Hardin points out, there may be no technical solution to the problem.[6]
For a long time, it was thought that the oceans were inexhaustible. One only had to develop larger vessels and nets and travel further to increase the effective size of the resource. The reality is quite the contrary. With few exceptions, the open oceans have very low productivity and the

vast majority of available fish resources are in the coastal zone, where they have been exploited for centuries. Consequently, the coastal zone requires consideration as a limited commons.

Changing Ecosystems

A fundamental reality that is often unrecognized is that the Fundy and Gulf of Maine ecosystems are continuously changing. Tidal range, for example, has been increasing steadily over the last 4,000 years as a result of sea level rise, post-glacial changes in land level, and shoreline and sea-bottom erosion. On top of this are the many changes wrought by human action both in the coastal sea and the watershed: salt marsh conversion; damming of tributaries and estuaries; deforestation; nutrient, sediment and contaminant inputs; overfishing; aggregate removal; and harbour construction, for example. It is now apparent that even the cool, tidally mixed waters of the FGM system are not invulnerable to global warming.

Temperature records show that the mean temperature of the Gulf of Maine has increased by about 0.2°C over the last 30 years as a result of changes in the atmospheric jet stream and shifts in the movement of the Gulf Stream. Although lobster stocks have increased exponentially in the Bay of Fundy and Eastern Gulf of Maine since the 1990s, they have recently collapsed south of Cape Cod. It appears that the distributions of several species are shifting north as coastal waters become warmer. The prospects for some cold-water species, such as cod, halibut and haddock, do not seem very positive. Recent political moves in the United States to undermine environmental monitoring programs, withdraw from the Paris Accord, and lift restrictions on coal use, could enhance acid precipitation in the Gulf watershed, accelerating ocean acidification and damaging freshwater fish habitats. Against this changing background, how can one forecast the future of the Gulf of Maine and Bay of Fundy, manage its resources wisely, and conserve its richness?

It is a common perception that established resource uses such as fisheries must take priority over new enterprises that may use the same space or otherwise interfere with existing practice. Indeed, the responses of local fishers to proposals for new activities in the coastal zone — such as aquaculture, establishment of marine protected areas or reserves, harbour modification or energy development — is generally to protest and campaign to prevent any such development. The holding of a license to exploit one resource is interpreted as individual ownership of part of the commons.

This antagonistic relationship continues to complicate decision-making in coastal zone management. Fragmentation of governance responsibility between federal and provincial/state levels, and between departments of government (e.g. environment, fisheries or resource development agencies) has impeded the development of coastal zone management plans. This is in spite of the fact that Canadian policy statements[7] commonly refer to basic principles to facilitate decision-making (sustainable development, integrated management and the precautionary approach) and emphasize the importance of involving the “community.”[8] At present, there is no over-arching vision for management of the FGM that could provide a sound and recognized framework for decision-making in cases of perceived conflict.

Apart from government policies and actions, a critical element is the awareness and support of the community that lives near and depends upon the resources of the coastal commons. Most fishers are not immune to the best interests of the community in which they live. After all, to benefit from a fishery resource, the community needs other resources: energy to keep warm, cook, and run fish processing plants; funds to maintain harbour facilities; aggregate for

community roads or harbours. Nonetheless, when there are challenges to continued exploitation of a resource as a result of environmental changes or new resource exploitation proposals, the general reaction is negative and fragmented. Even the fisheries sector itself is comprised of numerous fishermen's groups representing those using a particular technique (e.g. fixed gear, mobile gear, seiners, weir fishers, etc.), fishing in a specific area, or pursuing an individual species (e.g. scallop, lobster). Not only is their response to change uncoordinated, they are frequently antagonistic to one another[9].

Quo Vadis?

Policy statements in the USA and Canada commonly refer to comprehensive ocean planning and community engagement. In Canada, the Atlantic Coastal Action Program[10] was initiated in 1991 to explore ways to empower communities to contribute to decision-making in the management of their coastal environment. These groups, and other NGOs such as the Bay of Fundy Ecosystem Partnership (BoFEP)[11], and the Gulf of Maine Institute (GOMI), have assisted government and quasi-government organizations such as the Gulf of Maine Council to raise the levels of public awareness of the state of the environment and the issues facing the ecosystem. They do not appear, however, to have made much difference to the fundamental underlying dynamic of competitive behaviour between individual and sector interests.

What is clearly needed is an expansion of the present educational initiatives such as GOMI's experiential education program, better dissemination of existing information, and a broad, regular (i.e. annual) forum in which these individual interests can be discussed in the context of both community economic development and the changes to be expected in resources as the environment changes in the future. The Gulf of Maine Council on the Marine Environment is clearly well positioned to sponsor such a forum. It would hopefully lead to better coordination of policies between the various governments involved in the Bay of Fundy and Gulf of Maine ecosystems, and ultimately, perhaps, avoid the FGM system becoming another example of the "tragedy of the commons."

[1] In addition to nutrients and contaminants, a proposal in the United States for returning to the burning of coal for electricity raises the spectre of increasing acid rain that has caused problems in the past for some poorly-buffered waters in the Gulf of Maine watershed, and may accelerate ocean acidification in the Gulf.

[2] Also referred to as 'straddling stocks'. Several bi-national committees serve to facilitate coordination for management of specific stocks.

[3] Hardin, G. 1968. The Tragedy of the Commons. Science Vol. 162: 1243-1248.

[4] Hardin also points out that the oceans represent a "negative commons" in that they have become used for "the commonization of a negative cost" such as pollution. Contaminants may have been generated by people living a long way away from the ocean who do not directly bear the costs of releasing their wastes.

[5]cf. FAO The State of World Fisheries and Aquaculture 2014 http://www.fao.org/3/a-i3720e.pdf

[6] An exception might be made for aquaculture, in which higher productivity can be achieved by nutrient additions, exclusion of predators, genetic modifications, etc., but has often led to competition for space or concerns over disease affecting wild stocks.

[7]e.g. Oceans Act 1997; Canada's Ocean Strategy 2002.

[8] In the USA, on the other hand, the Northeast Ocean Management Plan (2016) seems) seems to have been pursued more effectively. See: http://neoceanplanning.org/

[9] An excellent summary of some of the issues is to be found in: Percy, J. A. 2001 Managing Fundy's Fisheries: Who should write the Rules? Fundy Issues #20, Bay of Fundy Ecosystem Partnership.

[10] See: http://www.publications.gc.ca/collections/collection_2008/ec/En1-42-2007E.pdf; Also: Robinson, G.M 1997. Environment and Community: Canada's Atlantic Coastal Action Program (ACAP). London Journal of Canadian Studies Vol. 13: 121-137.

[11] see: http://www.bofep.org/wpbofep/

Graham Daborn is Professor Emeritus at Acadia University. He received his BA in English and Biology from the University of Keele (UK), and MSC and PhD degrees in Zoology from the University of Alberta. He was Professor of Biology at Acadia from 1973 to 2004, the Founding Director of the Acadia Centre for Estuarine Research (1984-2004), and Founding Director of the Arthur Irving Academy for the Environment (2004-2007). At Acadia, he taught courses in ecology, limnology, estuarine biology, and introductory biology. His research has dealt with the ecology of the Bay of Fundy with particular respect to the environmental implications of tidal power. He has been a member of the Experts Committee on Marine Renewable Energy for the International Energy Agency, a volunteer member of the Environmental Monitoring Advisory Committee (EMAC) for the Fundy Ocean Research Centre (FORCE) since its establishment in 2009, and a member of the Research Advisory Committee for the Offshore Energy Research Association (OERA).

NOTES FROM THE NATURALIST

John Halloran

Fall is a great time to pay attention to the natural world. There is so much life activity now that will soon be gone. The buzzing insects are still active on the warm days, but some of their company is moving out. Dragonflies are leaving the fields and coastal marshes and heading south along the Atlantic coast. The same can be said of monarch butterflies, which I can happily report that I have seen more of this year than in the recent past.

The stars of the show are the birds and the fall season, which give us the stirring sights of migration, as skeins of birds assemble and fly in great numbers to the warmer climes. A rise in hormonal levels causes coastal birds to begin to prepare for their long migrations to Central and South America. Shorter days trigger enhanced appetites, as those on the move accumulate energy for the journey. Some birds are able to take advantage of the rich carbohydrates in late summer-fall berries, while many others like ospreys and egrets gorge on migratory fish headed to sea. The birds accumulate fat and store it as energy. Different species begin to gather in huge flocks called staging, awaiting the right mix of conditions. And when they arrive, some silent trigger causes them to rise as one, and away! 1

Some migrate non-stop, which means they must accumulate enough energy and fat to fly continuously, and still have enough in reserve to survive and reproduce lest they risk falling out of the sky. Others migrate in stages, spending their days eating and flying by night, where the cooler denser air helps keep them aloft with fewer wing beats. Birds also use the changing and then clearing weather of fall storms and the resulting tailwinds to help them conserve and save energy.2 No matter how they travel, whether it be by a genetically coded imprint, sunlight, starlight or the earth's magnetic field, birds find their way to wintering grounds beyond the Gulf of Maine.

Birds undergo changes in appearance in late summer, as breeding plumage fades away. Off the Massachusetts and New Hampshire coast in August, flocks of small gulls appear with a black spot on their head. These are the Bonaparte gulls, and they keep their distance from the much larger herring and black-backed gulls. The black spot is the only remnant of the jet-black head plumage of the breeding season. Migrating birds have different strategies for navigating and also for the paths they take. Many birds follow a leading line approach either following the spine of a mountain chain or the coast. They are attracted by buoyant updrafts and ample food along the way. Shorebirds fly great distances over open water, but most birds avoid this and follow the coastline south.

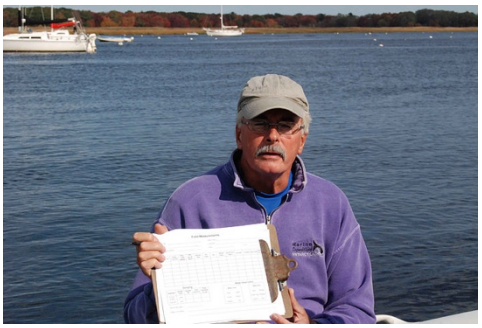
In the upper reaches of the Bay of Fundy, the semipalmated sandpiper congregates in great swarms over the very productive mud flats. Over 95% of this bird's population stops on the Bay to feed enough to provide the energy for their flight to South America. The principal prey is the amphipod Corophium volutator, commonly known as the mud shrimp.3 This fat rich crustacean feeds on benthic (bottom growing) algae, which cover the flats. Meanwhile, at the other end of the Gulf of Maine, the pelagic seabirds are spreading further in their search for food. Pelagic birds are seen on the open ocean only and are not usually seen from land. They hunt the ocean and return to offshore rookeries. The most easily seen are shearwaters, storm petrels, and

gannets, which often approach only a few miles from shore. The storm petrels forage far out to sea, returning to their colonies at night. Fishermen call them the "Jesus" bird because they seem to be walking on water as they stir up plankton with their feet.

Gannets are a large and quite magnificent seabird that gathers in tight-packed colonies on offshore rocks and cliffs. They are expert fliers and plunge divers. Their vertical descent into the sea from hundreds of feet to snare a mackerel is a thrilling sight only to be outdone by dozens of them working a shoal of fish. Shearwaters are also magnificent fliers that glide over the wave tops seemingly "shearing off" the top of the wave as they snatch small fish. Shearwaters are here to avoid the winter in the South Atlantic to which they will soon return as our winter approaches. These pelagic birds are fishing near shore this third week of September, so close that you can see them less than half a mile from shore along with another open water resident of the Gulf...humpback whales.

Everything in the marine and nearshore environment is in transition as the migratory animals store energy in the form of fat in preparation for their migrations.

Resources:
1 Schmitt, Catherine A Coastal Companion, Gardiner, Maine 2008 Tillbury House
2 Ibid.
3 Thurston, Harry The Atlantic Coast: A Natural History, Vancouver, Canada 2011, Greystone Books



John Halloran is the Director of Science for GOMI and a member of the GOMI Guide Team. John's interests focus on the ocean environment where he pursues educational adventure travel, research, and recreation by sail, paddle, and scuba.John is the founder and director of Adventure Learning, Newburyport, MA, which has been involved with educational outreach in area schools and recreational programs for teens and adults since 1980. A long-time educator, John was at the forefront of the experiential education movement in the U.S.For 36 years, he taught natural science in the Newburyport Public Schools. John has special interest and expertise in teacher training and standards for learning in math and science. His role has included direct teaching, teacher training, program development, grant writing, and developing partnerships with professionals in the field.

NOTES FROM THE FIELD

At the Salty Edge
Ellen Link

The best present that I have ever received is a sign that reads, "You Smell Like Low Tide." The real gift was not the wood that the words are painted on, but the fact that my family knows the conditions where I feel most myself….at the salty edge, preferably at low tide.

Helping young people connect to the environment and find their own "low tide" is by far the most important aspect of my work. This past summer, 38 students ages 11 to 18 from seven towns joined a coalition of scientists and citizen activists working to preserve the Great Marsh located on the North Shore of Massachusetts and build resilience in their communities.

The students contributed valuable energy to three inter-related projects focused on restoring eelgrass beds, understanding the population dynamics of green crabs and developing commercial markets for this invasive species.

Students collected data (lots of data) on green crabs and harvested and planted eelgrass for projects spearheaded by Dr. Alyssa Novak, coastal ecologist at Boston University, and Peter Phippen of MassBays National Estuary Program as part of the Hurricane Sandy Resiliency Grant.

They had opportunities for both "muddy boots" work and "dress-to-impress" work for Roger Warner, who is leading the Green Crab R&D Project's effort to encourage consumers to "eat the enemy."

On the leading edge of a steep curve to understand the green crab molting process, a select group of meticulous high school and college students completed painstaking work trapping and examining crabs for obscure signs of imminent molting. When softshell crabs were needed to feed to Senator Bruce Tarr, a hardy crew went to work hand-collecting crabs through a technique we coined "flipping seaweed."

A group of middle schoolers proved to be especially adept at using their knowledge and creativity to draw crowds at area festivals-- entertaining, informing and engaging the public in solutions simultaneously. It was at one of these events that Katie Gootkind of Newburyport was recognized for her verbal acuity and asked to star in a documentary film about the issue.

It was tremendously satisfying to do authentic work alongside these interesting and capable young people. And, it matters little to me whether they found that they love field work or that they hate it. I am as pleased for the young man who found that he likes photography more than he likes the ocean, as I am for those who are applying to college with marine science as their intended major. We all have to find our own low tide.

Ellen Link is a science teacher in Gloucester, Massachusetts who specializes in project-based science and ocean literacy. She holds degrees in resource management, geography, marine affairs, and science education and came to teaching after working in the fields of environmental education and marine resource management. She believes that helping young people connect to nature and gain skills of agency are key to their ability to be stewards of a changing world. She is happiest when tromping around outdoors with children...preferably at the salty edge. Ellen's overview of the summer citizen science project is followed by accounts of two student interns, Caroline Link and Tucker Hase, who followed her to the salty edge and beyond.

Finding My Passion

Caroline Link

Going into my senior year at Newburyport High, I feel comfortable saying that I have a fairly good idea of what high school is like. Name any type of project, paper or presentation, and it's likely that I've completed it at some point in my educational career. However, something that I've struggled with throughout the past four years has been a nagging feeling that even though I'm always busy, I'm never truly doing anything. It's often hard for me to see the meaning behind my assignments, they are usually busy work without any personal sense of purpose. In all of the clutter of test taking and typing essays, 12-point Times New Roman font-always, it can be far too easy to lose sight of the purpose of it all. I spend all of my time working to gain knowledge and develop new skills, but often find myself asking when will this begin to apply to something I'm actually passionate about? That is, until last May.

I'll admit it, when I was first asked to drive one of Boston University's research boats out to a site in the Essex River at 5am on a Sunday, I wasn't exactly thrilled by the idea. I was even less excited when I was recruited to measure and sex over a hundred agitated green crabs. But, despite my initial hesitation, I quickly realized that this was the fulfillment of my interests and application of my knowledge I was missing in high school. There's no telling whether it was being crouched in 55-degree water when the sun was still rising over

the salt marsh or the unmistakable sound of 30 pounds of crab legs scrabbling around against the plastic of 40-gallon buckets, but I was immediately sold. I had finally found my big breakthrough: gaining experience doing the type of work that I'd like to pursue while also contributing to actual scientific research and public outreach in my community? How could I possibly pass up such an opportunity? I quickly began to help out with both the green crab R&D and eelgrass efforts in whatever ways I could whenever I got the chance.

After I had learned about both the objectives of the two projects, and how to assist with them, I began looking for ways to take on a leadership role within the programs. For example, in August I was able to coordinate and lead a day of green crab data collection as a part of a tri-annual assessment of the abundance of the invasive species in the Parker River watershed. For this event, I was charged with providing the materials needed for the data collection, recruiting and training volunteers and ensuring that the data being collected was accurate. One of my favorite aspects of that day was the fact that all of the volunteers were either my peers or younger students that I know from my former elementary school. Seeing as I had been so changed by my participation in "citizen science," I was excited share this same experience with members of my own community. And, though counting green crabs for hours at a time certainly try one's patience and commitment, by the end of the day, you could tell that something had changed in the eyes of the participants. I remember one girl excitedly telling me that "I thought that this was going to be super boring, but it was actually pretty fun!"

Throughout their education, students gain lots of experience with conceptualizing; we design science experiments, we think about how a certain math topic could be applied, and write papers

on how we might solve current world issues, but very rarely are we given the chance to actually implement our solutions or ideas in the real world. We spend our time developing critical thinking and creative problem solving skills in preparation for a future in which we'll have an opportunity to apply them to a real issue, but why does that kind of valuable experience have to wait until adulthood? There is an undeniable power in the process of striving to solve a real problem and being able to see the concrete products of that effort. This is especially true for young people who are still working to find their purpose in their communities, and the sooner we provide students with the opportunity to do so, the sooner we begin to motivate the next generation of engaged citizens.

Caroline Link is a senior at Newburyport High School. In her sophomore year, she attended the Coastal Studies for Girls semester school, where she presented the results of an original research experiment to the public at the Gulf of Maine Research Institute. Her involvement with GOMI has included helping to facilitate two Climate Cafes. This past summer Caroline also became involved in the green crab research and eelgrass restoration efforts run by Dr. Alyssa Novak, Dr. Peter Phippen and Roger Warner and interned at Gloucester Maritime's Sea Pocket Aquarium. Caroline is very interested in both the public outreach and research aspects of marine science and plans to pursue them in college.

Environmental Science Internship

Tucker Hase

The first thing I heard was the annoying, blaring sound of "marimba" my phone plays at 4 a.m. I sighed and rolled out of bed. I plodded my way over to the bathroom where I accidentally put shaving cream on my toothbrush and began to brush. Within seconds I realized my mistake and spit out the blue Gillette formula. I proceeded to brush my teeth with proper toothpaste and attempted to take a shower, where I slipped and fell. Laying there, at 4:10 a.m. on my shower floor, scalding hot water pouring down on me with the gross taste of toothpaste and shaving cream in my mouth, all that comes across my mind is "do I really want to do this internship?" I was close to getting up and going back to bed. But something inside me that day prevented me from going back to my warm, cozy bed and made me drive out to Essex to plant eelgrass in freezing cold water. And all I can do is thank that little part of me that kept me motivated to go help because that internship was one of the best experiences of my life.

Since childhood I have been intrigued by the ocean and how it works. I grew up in Rockport and

later Manchester, so being on the ocean was never a problem for me. Also, as a kid, I did a summer camp called “Gloucester Museum School” where kids learn about the Greater Essex Marsh and the ecosystem. But to a kid, I never really learned in depth about what was going on. All I remember being told is that the marsh was collapsing. I didn’t know why until last year when I decided to take AP Biology and a class called “Authentic Scientific Research.” AP Bio and Authentic Scientific Research (or “ASR” for short) was a very influential duo for me. I loved biology, and the entire goal of the ASR class was to get a summer internship. The duo made me focus my attention on getting a biology related internship for the summer. It was brutal. I had to email over 95 different people. I had two potential internships that fell through. Literally every student in my class had an internship before me. But then I found my calling. When my aunt mentioned to me her friend at BU studies environmental sciences, I was excited. But then I read the BU website page on her studies. The amount of excitement I had was uncontrollable. Help save the marsh that I literally grew up on and played in as a kid, which later served as my first real experience as a job? The place that brings me so much solace and comfort? Where so many fond memories were forged that I reminisce in almost every day? What could possibly be more perfect? I remember emailing my teacher that day in all caps, “I FOUND THE ONE!” The next school day I was already on the phone with Alyssa Novak, the main researcher behind the projects. I remember her telling me about all the projects that she was working on, and when she asked me “Which project would you like to do?” all I could muster was “Uhh… all of them.” So that’s what I did.

Over the course of the summer I worked all three projects Alyssa let me. I worked the Eelgrass Restoration Project, Green Crab Research, and in Marsh Edge Erosion. All three were incredibly important to me. The first thing I worked in was the Eelgrass Restoration project. I remember I met up with Ellen Link, a main researcher working alongside Alyssa, in a Friendly’s parking lot. She and a few volunteers were in a tattered minivan that resembled one my family owned when I was a kid. That afternoon we went to a nearby beach where eelgrass is flourishing in order to root some up and later plant them in places where the eelgrass is needed. This was necessary to

do because eelgrass is an incredibly stabilizing element to the Greater Essex Marsh, and there were lots of places where it is needed due to green crabs destroying it's population. Anyway, that day we got about two coolers worth of eelgrass. It was an incredible experience, and I was super stoked to be part of the team. But then I asked a question that I thought I would regret. "So when are we gonna plant these?" Ellen turned to me and said, "Well 5 a.m. tomorrow is the next tide, so then. Would you like to come?" Without hesitation I replied "Of course!" Then immediately after I realized the implications of my actions. I would have to wake up early that very next morning. But, I knew it was for the best. I felt like it was necessary for me to do it. So that next morning, I woke up at 4 a.m. to get ready.

The second project I worked on was Green Crab Research. This really opened my eyes to what research is. I met up with Peter Phippen, another main researcher specializing in green crabs and marsh edge erosion. We went out on his small boat and pulled thirteen traps. It didn't sound like much at first, but as soon as I pulled the first trap I realized how wrong I was. The trap contained over one hundred crabs. After somehow managing to fit thirteen traps on the boat, we headed towards the dock. I thought all that was going to happen was I was going to carry the traps to a truck or something and they were going to be counted elsewhere and I could go home. I was wrong. Peter and I met up with Alyssa, Ellen's daughter Caroline, and a few other volunteers from a school in Boston to count and classify each crab from each trap. So there I was, out in blazing hot weather with no sunscreen saying "Male. 4.5 centimeters. Female. 4 centimeters. Gravid" for hours on end. By the time, I got home I was scalded and drained of all energy. That day we counted upwards of 800 crabs. Despite all this, it was an incredible time. I learned so much about how green crabs came over here in the ballast of ships from Europe in the 1800s, how they are one of the biggest factors in the eelgrass decline, how they are an invasive species with exponential growth and that's why they were undetectable beforehand, and so much more. It was a phenomenal experience.

The third project I worked on was Marsh Edge Erosion, and although short lived, I did learn a lot from my experience. Walking out two miles on the marsh and being absolutely devoured by

greenheads and horseflies, to take a few measurements seemed trivial to me at first, but yet again I was wrong. I was with Alyssa and Peter that day and we took way more measurements than I expected. We used a tape measure and wooden stakes to measure how much the marsh had eroded since the last measurements were taken. We always had record a bearing perpendicular to the edge of the marsh. On the edges we used a "quadrat," which is a meter by a meter in area, to measure things such as holes in the marsh and algae, indicative of excess nutrients. As my mentors explained to me, the holes are generally caused by green crab burrowing (which could be part of the cause for marsh erosion). Also, excess nutrients could cause less of a "cement" for the marsh, again weakening it's structure. We used cameras to verify if crabs are burrowing into the marsh and have a visual statement of the measured area. On the way out, I was also shown a type of weed that infests the marsh and is detrimental toward the marsh's structure. I was also shown a potential idea to help save the marsh, which was putting sand on the marsh and seeing if the marsh grew through the sand. This was one way to help restore the marsh.
All in all, my experience was incredibly valuable and important to me. I learned more about the North Eastern ecosystem than most people will ever get a chance to learn. Sure, getting up at 5 a.m. to plant Eelgrass in freezing water, or getting sunburned so bad it hurts to sit due to counting and classifying crabs all day, or getting absolutely mauled by greenheads wasn't pleasant. But it was so worth it. I actually felt like I contributed something while also getting a fantastic education on our ecosystem and marine biology. Not only that, but I was introduced to what it is like to be a researcher and how much fun it can be and how much I have to learn. Overall, it was an experience that really helped shape what I want to do with my life and it will never be forgotten.

Tucker Hase is completing his senior year of high school in Manchester, Massachusetts. His academic interests are science based with love physics and chemistry and a keen interest in biology. Tucker became interested in environmental science as a result of his early childhood experience at a salt marsh camp. There, in his words, " The seed was planted in my mind that grew over time; what else caused salt marsh deterioration? How does the ecosystem work?" So his seed, nourished over time field experiences flourished into a passion for biology that is leading him to major in environmental science.

STUDENT FORUM

Forming a Better Understanding of the Waters of the Bay of Fundy

Steve Millar

The students in the grade 10 Pre-IB Geography class and grade 11 IB Geography class at Horton High School studied the waters of the Bay of Fundy last spring. Students constructed two drifters and decorated the sails with the logos of the various groups involved in its creation.

Mr. Millar was able to drop off the drifters with a lobster boat captain who anchors in Harbourville, Nova Scotia, and he was able to deploy the drifters just off the waters of Isle Haute. This would allow students to see how the water moved within the bay and possibly make predictions regarding what might be found on the beaches in the area.

Students followed the movement of the drifters online as the tides pushed and pulled it into and out of the mouth of the Minas Basin via the satellite transmitter mounted on the top of the drifter. Here is a link (goo.gl/CL6s2d) to the route of the two drifters (and another drifter launched with a different school group off of the Southwestern tip of Nova Scotia).

Students saw how the dramatic tides of the Bay of Fundy impact the movement of water (and possible debris) in the area and how fast the water must move around Cape Split and the mouth of the Minas Channel (near where the new FORCE tidal power generation site is located). Grade

11 student, Grace Munro commented that “the drifters indicated that the waters were circulated relatively close to the shore and stayed within the Bay of Fundy because the drifters didn't leave the bay, they just circulated within it.”

Grade 11 student, Elena Thompson-Hayes mentioned that “the drifters got caught in certain places and moved along the same lines for a long time, which tells us that the tides are strong and oscillate back and forth.”

With this knowledge in mind, students were asked to predict what kinds of garbage they predicted to find on the beaches in the area. Presented with the choices of “residential, commercial, industrial or recreational,” students predicted that residential forms of garbage would be the most likely types of garbage recovered from the beach.

react-text: 2713 On a grey day in June, the students of both classes arrived on the southern shore of the Bay of Fundy near Harbourville, Nova Scotia to do a beach clean up. /react-text

While the rocky beach appeared mostly clean at first glance, a closer inspection of the high water line near the trees revealed a truck load of garbage that the students proceeded to remove from the beach. Student Aidan Karcha observed “there was plenty of fishing gear such as ropes and some cages that if dropped into the Bay of Fundy wouldn't be flushed out into the ocean but instead held in the waters of the bay until they wash up on shore.”

Some of the garbage was just sitting on the surface of the beach but a fair amount had to be dug up collected for removal by placing it by the side of the road for pick up by King's County waste removal services. The variety of garbage was broad but the bulk of the garbage was related to the fishing industry operating in the bay.

In the end, students collected enough garbage to fill the back of the truck sent from the county for pick up. The students then had an hour looking into the tidal pools revealed at low tide searching for various kinds of aquatic life. Overall, the classes had fun, developed a better understanding of the Bay of Fundy, and did a great job cleaning up one of their local beaches.


ACADIA

Steve Millar has taught for close to 20 years in Nova Scotia and Ontario in grades K-12. Currently he teaches Global Geography 12, Pre-IB Geography 10, IB Geography 11 and IB Geography 12 at Horton High School, in Greenwich, Nova Scotia. Steve is a member of Gulf of Maine Institute's "Learning 2 Steward The Gulf Project." The Project connects Canadian teachers from the Annapolis Valley (near the Bay of Fundy) and American teachers from Massachusetts, New Hampshire, and Maine. Steve is a life-long learner and loves educating youth. He has also worked as a first aid instructor, and an officer and Cadet Instructor, with the Canadian Forces Cadet Instructor Cadre, teaching Canada's youth. He received his MEd from Mount Saint Vincent University, his BEd from the University of Toronto, and his BSc in Geography and Environmental and Resource Studies from Trent University.

Tidal Power's Potential in the Bay of Fundy

Grace Ellsworth

This summer I attended the GOMI summer workshop at Acadia University and was able to interview professors and listen to presentations concerning tidal power. Evident by the work being done in Nova Scotia, fossil fuels have become a less viable energy source for the future causing scientists to start looking for new forms of renewable energy such as tidal power. For years now, researchers have been testing the potential of tidal power in the Bay of Fundy, adjacent to Nova Scotia because the tides there are the greatest in the world reaching 53 feet (16 meters). Tidal power converts the energy obtained from the tides into electricity. Not all tidal power stations are the same. For instance, unlike many other turbines that operate one way, the Nova Scotia turbines both as work the tide goes in and out. Therefore, they are operating 80 to 90% of the time. In other locations, turbines only convert the power from outgoing water, and are only operating 30% of the time. The benefit of tidal energy over wind or solar is that it is much more reliable since it is known when the tide comes and goes every day. However, there is opposition and concerns regarding the effect tidal turbines will have on fish and the ecosystems.

The turbines in Nova Scotia are still in the testing phases, and the influence they have on their

surrounding environment is being closely monitored. These turbines cannot be tested in labs because it is impossible to simulate the harsh conditions of the tides in the Bay of Fundy. The most recent design was removed last spring because it kept breaking and needed regular fixes. In the Minas Passage, the location of interest in the Bay of Fundy, the flow rate is roughly six meters per second. This incredibly fast water, combined with the turbidity and the amount of particles in the water can damage the turbine, for the abrasion caused by particles wears down the turbine. These conditions make it significantly harder to track the organisms and to obtain high-quality data on the turbine.

In theory, a single turbine is comparatively very small in relation to the rest of the bay. The turbines have been known to create pressure domes making the fish more likely to flow over the turbine. At a turbine site in Cobscook Bay in Maine, a recent study was conducted to assess the effect turbines would have on fish. The components they studied included hydrodynamic, how the turbine manipulated water flow; and acoustic output, the sound produced by the turbine, and potential fish kill. Through the use of hydroacoustics, they located at what level of the water the majority of the fish were found and if these fish encountered the turbine how they would react: whether they went over it, swerved last second in avoidance, passed through, or were hit. They were able to find that the probability of a fish encountering the turbine was only 3% and the chance they would get hit was even less.

Tidal power is still pretty far from commercial development since it is very costly and the ideal design has not been found. Tidal power has a lot of benefits such as a low carbon footprint, but there are only a few places in the world where the tide is great enough for it to be practical.

I was lucky enough to be able to interview Dr. Anna Redden, a professor at Acadia University and the director of the Acadia Tidal Energy Institute. She believes that tidal power has the potential to provide 10% of the Nova Scotia's future energy. She explains how "tidal energy is only available in a small number of places globally and if it can be harnessed sustainably in those places, it can contribute a large percentage of the local area's energy needs, but on a global level, it's potential is small." Redden argues that the Bay of Fundy has been the ideal place to test since "the wow factor of the locations gets funding for the project." Although tidal power is not ready to be commercially used, it does have the ability to provide significant amounts of energy in places with large tides including various locations along the Gulf of Maine.

It's important to remember that most places are looking to have as much diversity in their energy resources as possible, so they are not relying on one source.

Grace Ellsworth is a senior at Newburyport High School in Massachusetts and has been a member of the Newburyport GOMI team for three years. This summer Grace served as an intern at the US Fish and Wildlife Parker River Wildlife Refuge, Newburyport. She has, over high school years, worked on related projects including Climate Change Cafe (community dialogues on local effects of climate change) and invasive plant species. In the summer of 2017, she attended the GOMI Learning to Steward the Gulf conference in Nova Scotia as a Newburyport team student representative. Next year, Grace plans on pursuing environmental science and conservation at a liberal arts school in New England.

RESEARCH UPDATES

Developing a Social License for Tidal Energy Development in Nova Scotia
Dr. John Colton

Introduction

Marine renewable energy (MRE) provides meaningful opportunities for regions like Nova Scotia to contribute to carbon reduction strategies, to develop greater energy security, support economic development, and serve as a catalyst for innovation of MRE technology. While this has been certainly true for offshore wind development, the same might apply for the development of wave and tidal energy production. Given the potential for MRE development with respect to wind, wave and tidal energy there has been a growing interest in exploring the role of social acceptance or social license with respect to marine renewable energy development projects. Nova Scotia, Canada is well positioned to develop tidal energy in its Bay of Fundy and has already initiated research projects and stakeholder engagement processes to develop the social acceptance or social license necessary to advance this type of renewable energy development.

What is Social License?

The term social license originated two decades ago in the mining industry context but has since been widely adopted by proponents (i.e., government and industry) of energy projects, to address a range of stakeholder issues largely dealing with issues of trust and legitimacy. Social license is intangible and "associated with acceptance, approval, consent, demands, expectations, and reputation." It is not a statutory framework but rather a concept that implies that developers and government will do the right thing in moving a project forward. The right things might include extensive stakeholder consultation, early and on-going engagement, sharing of relevant information and data, and knowledge that stakeholders' voices are heard. Collectively, these efforts may result in a "social contract" which, like other contracts, may be broken if expectations of the benefits and impacts are not realized.

While measuring social license is challenging, four factors emerged from earlier research that include: economic legitimacy, socio-political legitimacy, interactional trust, and institutionalized trust. Simply stated, economic legitimacy refers to the perception that the project will provide economic benefits. In most instances, this implies job creation both short and long term, local and regional economic development, and the development of a local supply chain. Socio-political legitimacy is the idea that the development will contribute to regional well-being, the project respects local ways of life, and there is a shared vision for the future. Interactional trust refers to the perception that a development project addresses and is responsive to the concerns of stakeholders, that what is promised is delivered, that the project is perceived as beneficial, and relationships between the project and stakeholders are good. Institutionalized trust implies that the project provides support to those impacted, decision-making is shared, stakeholder concerns and interests are considered, and that data and other information relevant to the project are shared.

Nova Scotia Tidal Energy and Social License

Nova Scotia's vision for tidal energy development has been guided, in part, by the Nova Scotia Marine Renewable Energy Strategy and an earlier Department of Energy Discussion Paper on Marine Renewable Energy Legislation for Nova Scotia. These documents discuss how tidal energy development should proceed, providing the context for how a social license might be developed in Nova Scotia.

Developing tidal energy in Nova Scotia is a game changer and the challenge for government, industry, and other proponents of tidal energy development is building legitimacy for this type of development. As noted earlier, social license can be distilled down to the issue of legitimacy noted as a "condition reflecting cultural alignment, normative support, or consonance with relevant rules or laws." Building legitimacy for the Nova Scotia tidal industry is challenging. It is important to note that the first test turbine deployed failed, having its blades blown out by the powerful currents and sheer volume of water. While this initial test provided significant insight into engineering and water flow dynamics, the image of the turbine pulled from the water with its blown blades influenced public perception regarding developing tidal energy in the Bay of Fundy. With respect to legitimacy, it is uncertain whether stakeholders or the public at large view tidal energy development as a viable form of renewable energy development. However, this has not stopped the flow of tidal energy related research, the development of tidal energy stakeholder networks, and the deployment and retrieval of a second Open Hydro turbine.

With respect to economic and socio-political legitimacy, a significant amount of research and networking has been accomplished. Most significantly, a recent Value Proposition Report noted the sizable extent of the economic impact from 300 MW of developed tidal energy. Projects like this could position Nova Scotia as a net energy producer like its neighbor Newfoundland and Labrador. In Newfoundland, increased energy production and export have provided significant revenue to provincial coffers resulting in increased funding to essential government services including health and education. Nova Scotia could realize the same outcomes if tidal energy development plans are realized. If this development takes into account the concerns articulated by the many stakeholders consulted in the Strategic Environmental Assessment (SEA) and the Mi'kmaq Ecological Studies (MEKS), then tidal energy development may have socio-political legitimacy as it moves from testing to commercial deployment of tidal arrays in the Bay of

Fundy. Keeping key stakeholders informed throughout the deployment, operations, and maintenance stages will be critical to maintaining socio-political legitimacy, as these are the stages where consultation slackens significantly. Establishing the stakeholder roundtable as noted in the Nova Scotia Marine Renewable Energy Strategy and using this body as an on-going advisory committee for tidal energy development in Nova Scotia would help ensure on-going socio-political legitimacy.

Social license has also been supported by the level of interactional trust established with respect to tidal energy development. Nowhere is this more apparent than in the Strategic Environmental Assessment Update for Tidal Energy in the Bay of Fundy which documented the extent to which recommendations were implemented from the earlier 2009 Strategic Environmental Assessment. For example, given the lack of knowledge regarding tidal energy turbines and fish interaction, the precautionary and adaptive management principles were applied to ongoing tidal energy development. This demonstrated a commitment by industry and government to address stakeholder concerns raised in community consultation sessions.

The Fundy Energy Research Network (FERN), government organizations supporting tidal energy research (e.g., Offshore Energy Research Association), and not-for-profit tidal energy test centers like the Fundy Ocean Research Centre for Energy (FORCE) support institutionalized trust. Collectively, organizations like these collaborate, share data, and address stakeholder concerns. In fact, FERN recently initiated a gap analysis exercise with key industry, academic, and government stakeholders. In this analysis, a key issue identified was the general publics' public's lack of knowledge regarding tidal energy development issues. Initiatives by various organizations have begun to address this important issue.

Given the extent to which tidal energy development issues have been addressed one might assume that a social license has been achieved for this type of energy development in Nova Scotia. In other jurisdictions where far less research and oversight has occurred, industry and government have, in fact, made claims to achieving a social license. But this has not been the case in Nova Scotia. No industry or government organization have claimed a social license. And as concerns grow among some stakeholder groups, especially people within the fishing industry that fear tidal turbines may adversely impact fish and marine mammals, organizations like the Offshore Energy Research Association and the Fundy Ocean Research Centre for Energy have initiated research programs in attempts to address these concerns. In this sense, the approach to social license is more dynamic, reflecting the importance of continued and on-going engagement. This method appears to address the life-cycle of a development project and the importance of addressing concerns throughout the stages of this process. Tidal energy development organizations in Nova Scotia open to this style of engagement begin to reflect the key values underlying social license; trust and legitimacy.

Reviewing how Nova Scotia is working toward a social license for tidal energy development is an important exercise. It both identifies and reminds one of the many factors at play in this type of development. But what the many studies on tidal energy and its potential fail to highlight is the sense of attachment that people have to the Bay of Fundy. This attachment or sense of place is deeply rooted in the many people and communities adjacent to the Bay of Fundy. Developers of tidal energy and other proponents must be cognizant of this rootedness and find meaningful

ways to honor this expression of attachment. Coupling this knowledge of attachment with the other research and data related to tidal energy development in Nova Scotia provides a point from which social license might be claimed.

Dr. John Colton is a professor in the Community Development and the Environmental and Sustainability Studies programs at Acadia University. Dr. Colton's research interests include sustainable tourism, community sustainability, stakeholder engagement processes, and issues related to social acceptance of renewable energy projects. He is the co-author of the Community and Business Tidal Energy Toolkit and the Handbook of Community Engagement for Tidal Energy. He is the East Coast sustainable tourism expert for National Geographic's' World Legacy Program and has served as an expedition leader for Northern Canadian river-based expeditions for several organizations. He is past co-chair of the Atlantic Aboriginal Health Research Program, Chair of the Centre for Rural Sustainability, and served on the Nova Scotia Renewable Energy Steering Committee that drafted the Nova Scotia renewable energy targets. He is a founding member of the Acadia Tidal Energy Institute.