GULF OF MAINE INSTITUTE

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

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Contents

LETTER FROM EDITOR
John Terry

Class 2017, whether graduating from high school or university, we wish you the best as you meet the environmental and political challenges of your time. Your commitment and can-do optimism well match you to them. To this point, earlier this summer, I had the opportunity to work with five GOMI high school student interns at the GOMI teacher Summer Workshop conducted at the Acadia University, Wolfville, Nova Scotia. Their energy and contributions were inspiring. You will hear more of and from them in our next issue. I had the opportunity to attend my grandson's high school graduation. His class Valor Victorian, Jackson Kealey, also happens to be a long time member of the Newburyport GOMI team.

Jackson's message was as challenging as it was inspiring. I pass on, with modest edits, his "straight talk." as to what his generation needs to learn and do as they grasp the baton of succession. It also serves as a reminder to us of older generations that, in building a sustainable, future we need to include our youth as rightful and engaged partners. This is a job for many hands and many generations. I turn the page over to Jackson

Jackson Kealey, Valor Dictorian, Newburyport High School, Class of 2017

In addition to being Valor Dictorian of his Class, Jackson has accrued hundreds of social service hours with Girls Forward, the National Honor Society, Mentors in Violence and the Newburyport GOMI Team. Jackson was captain of cross-country track team and competed in indoor and outdoor track. By self-admission, Jackson's, most prominent activities included the cross-country track and his membership in the GOMI Newburyport Team. From the former, in his words, he learned " … the importance of perseverance," and from the latter his, " … love for the sciences and a new and refined appreciation for the environment."

Valedictory Address:

Good morning, everyone: teachers, administrators, distinguished guests, friends, family members, my family, and, most importantly, the Class of 2017. I learned a whole lot in high school. Ethos is an author's credibility in his or her writing; the Gilded Age held mostly complacent presidents; the surface of photographic film consists of silver halide crystals. But what do all of these tidbits of information really mean? Are they truly important to who I am or

who I will be? Albert Einstein, the renowned physicist, once said, “Education is what remains after one has forgotten what one has learned in school.” So why would a scholar like Albert Einstein say something like this? Well, for one thing, Albert Einstein was not at the top of his class. In fact, he failed an entrance exam to Zurich Polytechnic School the first time that he took it. So maybe he had a little bad history with classical education. Ok. Fair enough. But Einstein also revolutionized what we once knew, or thought we knew about physics and the Universe. His creativity was unrivaled, and he questioned every current idea of the time, never taking anything at face value. There is no way he could have learned his discoveries in school, because, well, his theories weren’t even imagined yet.

You all have spent your four years in high school, memorizing facts and figures, writing essays, taking tests, but also learning skills, making memories, and hopefully enjoying yourselves. You have perhaps struggled through math courses, science courses, history courses, or English courses, asking yourself, “when will I ever need to use this,” and to be perfectly honest with you, I do not see how a business major will ever need to know a thing about Newtonian gravity or if a mechanical engineer will ever need to recite Shakespearean poetry in either of their respective fields. But never in a million years would I steer a future mechanical engineer away from literature, or a future business major away from the world of physics. Not only does a diverse education allow you to become more knowledgeable in a variety of subjects, but, more importantly, it will force you to think outside of your comfort zone. Life is not limited to the field that you choose to go into, so why should your education be? The mechanical engineer may one day need a romantic sonnet for that enchanting barista at the coffee shop.

There’s your Shakespeare. The business major may one day need an explanation for why his or her sales dropped this quarter. Newtonian gravity saves the day. Puzzles in life do not know the boundaries of defined subject areas, and sometimes, the answer to your problem may not be in the books you read every day. Do not be afraid to think beyond them.

Our class has shown that we certainly know how to secure amazing success in the classroom. Our beloved National Honors Society President Elizabeth had to read a record number of Gold Keys at the academic awards night. But we cannot become lost in the grades, the numbers, and the GPAs. In a world where often, we are no more than a barcode or a bubble in an answer sheet, we can easily forget the importance of learning as opposed to simply knowing.

I may now know how to use well over fifty formulas from the AP Physics equation sheet, but, more importantly, I have learned how to work under pressure, to slug through the mud with my fellow classmates and derive any formula.

You do not have to remember all that you have learned here. As I head off to college to study biochemistry, I may not remember that ethos is an author’s credibility in his or her writing, that the Gilded Age held mostly complacent presidents, or that the surface of the photographic film consists of silver halide crystals. Nobody will expect me to, and this will be much the same with many of you in your respective futures. But I can say this to you all; never discredit or discard learning because you do not believe you will ever use it.

I ask you to not worry about remembering every detail, every fact, and every formula from Newburyport High School. Instead, Class of 2017, take the tools that you were given, not the ability to remember, and spit back facts, but to question, to support one another, and to think, and to look beyond what we know today. One day, we could very well find ourselves in one of Mr. Cole's (Physics teacher) vivid test scenarios: behind the wheel of a car, slipping around an icy bend. We may not remember how to calculate the centripetal force, the coefficient of friction, or the radius of a loop; but in the end, it may be something beyond the physics that pulls us out.

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.

NOTES FROM OUR NATURALIST

John Halloran

Cycles: The Cosmic Mystery

It's spring, No Wait! It is now summer in the Gulf of Maine

As we move through the early spring past the Equinox, the dawns are earlier, the days are longer and the nights later. The sun's more direct light warms the ground and sap rises in trees. Rivers froze in winter, release huge bursts of icy water packed with nutrient into the Gulf of Maine causing enormous phytoplankton blooms in the cold waters of the Gulf. The sun provides these organisms the energy needed to rapidly multiply and as they do voracious zooplankton come to Nature's table to dine upon them. Fish of all sizes and seabirds soon join in the feeding frenzy. At last, the most conspicuous of the spring arrivals come to the party. They are the great whales of the Gulf of Maine.

Based on their feeding strategies, whales are classified into two groups. One is the Odontocetes, or toothed whales, which include dolphins, porpoises, and the rarer orcas of the Gulf. The other group is the Mysticetes, the baleen whales that are the majority of our endangered great whales. The word mysticetes derives from the Greek word mystax or mustache, referring to the plates of baleen hanging from their upper jaw. The ends are covered by hairy bristles that strain and capture the plankton and small fish that make up these whales diet. Additionally, our great whales, except the Right Whale, are called rorquals, a term from

Norwegian that refers to the folds that line the whales' throats. As these whales take in copious amounts of water, these pleats allow its throat to expand and fill with seawater and food. It squirts the water through the baleen plates and captures its prey with a flick of its great tongue (See Resources 1.).

Closer to shore, clammers become active in early May digging down 8-14 inches into the exposed mudflats at low tide for soft shelled clams (Mya arenaria). Clams use their rubbery necks to siphon in seawater, which they filter for their share of the plankton bounty. Smaller in structure, mussels are another shellfish that filters plankton from the water. The most common is the blue mussel (Mytilus edilus), which lives in the rocky intertidal zone. A planktonic bloom called red tide can contaminate both and make them unfit for humans to eat. Check with your local shellfish warden before consuming these popular delicacies.

Anadromous herring, both alewives, and blueback, begin running in May and end in early June. Anadromous fish are born in fresh water, migrate to the sea and live there as adults, and complete their life cycle by returning to their birth stream to spawn. Some of these fish can perform this cycle more than once while others only get one chance.

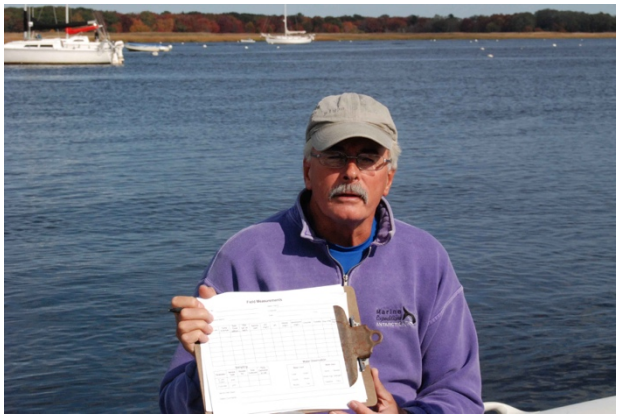
The full moon of June is called the Strawberry moon (See Resources 3.) and, as strawberries ripen in the fields, another ancient but predictable arrival occurs, the Horseshoe Crab (Limulus polyphenus). Having lived in deeper waters offshore where they gorged on smaller invertebrates, they emerge on Gulf beaches by the June full moon (see Resources 3.). This “crab,” is not a crab at all, but is instead more closely related to spiders and scorpions. Despite their fearsome appearance, they neither bite nor sting. Empty shells litter beaches, but these are usually “molts” out of which the animals have wriggled. Horseshoe crabs are descendants of early trilobites that lived on the ocean floor as many as 400 million years ago. They also help to save lives as a protein in their blood is used to test for bacterial toxins during medical operations. Their strings of greenish eggs are a bounty for migrating shorebirds like the red knot.

June 21, the Summer Solstice, is the day the North Pole is closest to the Sun. It is the longest day of the year. As we approach the Solstice, perhaps we should take a minute to consider why do we have seasons? A year we define as one revolution of the sun, but what causes seasons? Many think that summer heat is a result of the earth being closer to the sun and winter cold a result of it being further away. This is not so, what creates the seasons is the “tilt” of the earth. As it spins in summer, the Earth is tilted 23.5 degrees closer to the sun. The northern hemisphere where we live gets maximum exposure to sunlight even while being further away in its orbit. Six months from now, at the other end of its orbit, the northern hemisphere will be tilted away from the sun at the winter solstice, and the amount of light and heat will minimize even though our planet is in a closer orbit to the sun. That is easy to understand right! Enjoy the summer as you ponder that cosmic mystery!

Resources

1. Thurston, Harry 2011 The Atlantic Coast: A Natural History, Greystone Books, Vancouver BC pp164-5
2. Schmitt, Catherine 2008 A Coastal Companion: A Year in the Gulf of Maine Tillbury House Gardiner, Me pp119

3. Ibid pp 119-120



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

Every Turtle Counts

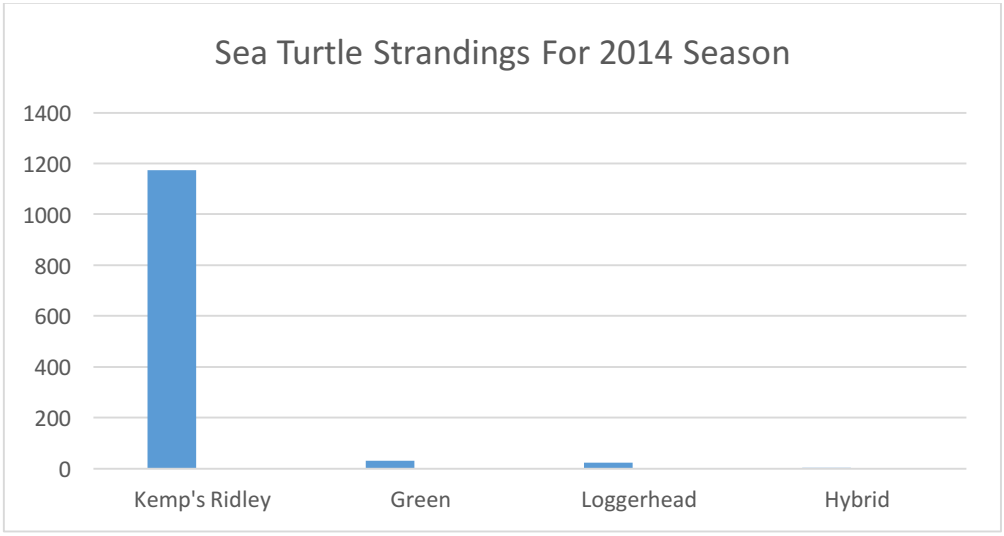
Valerie Bell

When you think of Cape Cod, you might think of sand dunes, salt marshes, and big ocean beaches. You might not think of sea turtles. But every summer several species of rare and endangered sea turtles come to Cape Cod to enjoy the warm water and abundant food supply. When the fall arrives these tropical creatures head back south to warmer waters. Well, most of them do. Turtles feeding in Cape Cod Bay are in danger of becoming trapped by the Cape's geography. Cape Cod sticks out about 65 miles into the Atlantic Ocean in an east west direction. This forms a barrier for turtles that are trying to head south from Cape Cod Bay.

Sea turtles are ectothermic, which means their body temperature is the same as the environment. When the water falls below 50 degrees Fahrenheit the bodies of the sea turtles start to shut down. They cannot swim anymore, so wind, tides, and currents push them around. Eventually, many of them are washed up on Cape Cod Bay beaches. The most critical time for cold stunned sea turtles is from November to the end of December. During these months volunteers walk the beaches at every high tide looking for stranded sea turtles. The air temperature at this time of year is much colder than the water. Turtles left on the beach die very quickly. If the turtles are found soon enough, they can be rescued, rehabilitated and released back into the wild.

Kemp's Ridley sea turtle stranded on an Eastham, MA beach. (photo courtesy of Wellfleet Bay Wildlife Sanctuary)

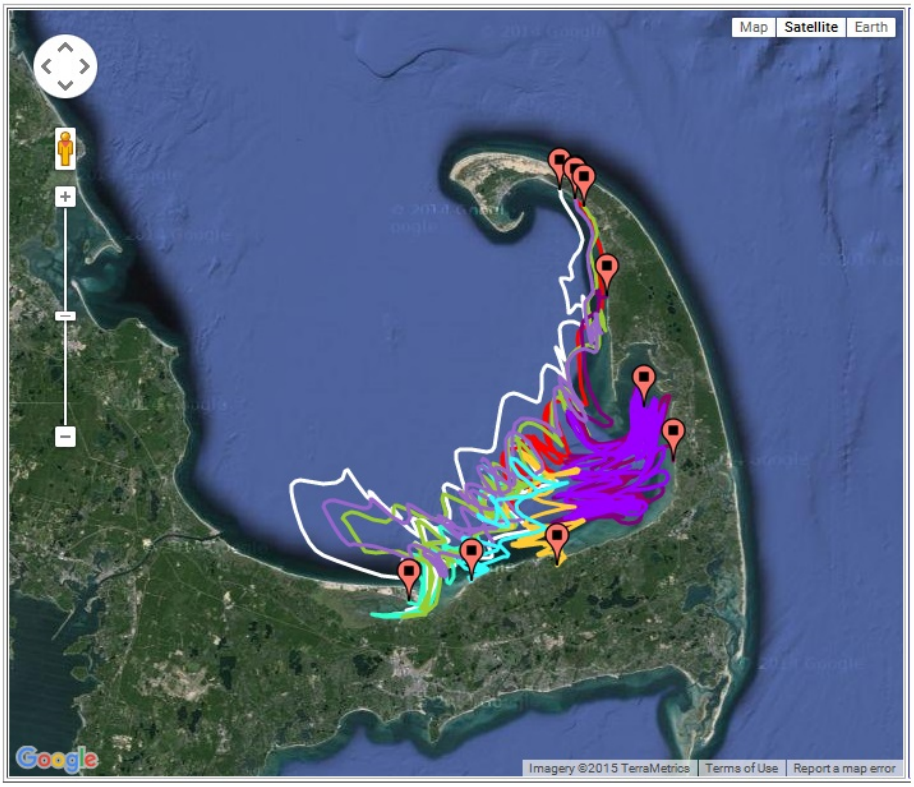
The most common sea turtle to strand is the Kemp's Ridley sea turtle (Lepidochelys kempi). In the 1940's there were estimated to be over 100,000 of these turtles. Today there are about 10,000. In 2014 over 1,000 Kemp's Ridley sea turtles were rescued on Cape Cod. Each one of these highly endangered turtles that safely makes it back into the wild may contribute to increasing the population.



Quickly finding stranded sea turtles is key to their survival. There are about 80 miles of shoreline along Cape Cod Bay and a limited number of volunteers to walk its beaches. How do the turtle rescuers know what beaches to walk? Audubon relies on experience to guide how they deploy their volunteers. There are beaches where turtles are historically found. We also know that certain wind conditions favor some beaches for strandings. But what if we could collect data on the local wind, current and tide conditions to help more accurately know where turtles are likely to strand? To this end, Wellfleet Audubon, GOMI, and local high school students embarked on a research project to do just that called "The Drifter project."

James Manning, a researcher from NOAA, had been working with students and GOMI for several years building and deploying ocean drifters all along the Gulf of Maine, of which Cape Cod Bay is a part. Students from two local Cape Cod high schools, Nauset Regional High School and Monomoy Regional High School, and Audubon staff started building and deploying drifters off the beaches of Cape Cod Bay during sea turtle stranding season. Drifters mimic the movements of cold stunned sea turtles by being pushed through the water by wind, waves, and tides. Each drifter has a GPS unit on it, so its movements are observed in real time. Eventually, the drifters are washed up on Cape Cod Bay beaches just like sea turtles. We hope that the drifter data will give us more information about where sea turtles are most likely to strand so that the rescue efforts can be more targeted and more turtles are found in time.

Wellfleet Bay Audubon/GOMI drifters in 2015



Wellfleet Bay Audubon GOMI Drifters 2015

Not every turtle makes it. Dead turtles are kept frozen until the stranding season is over. Then each turtle is necropsied. Data are recorded on the turtle's health, sex, and general condition. High school students have a unique opportunity to participate in these necropsies. Audubon staff brings turtles to the classroom and guide students through the necropsy process. Even in death, every turtle counts.

Nauset Regional High School students building a drifter

NRHS students deploying a drifter in Cape Cod Bay.

Nauset High School student with a rescued sea turtle.

Students and Audubon staff performing a necropsy

Valerie Bell taught high school science for 31 years on Cape Cod. She also has been a park ranger at the Cape Cod National Seashore for 20 years. Recently she has been working part time for the Massachusetts Audubon Wellfleet Bay Wildlife Sanctuary. Valerie has spent a lifetime connecting children and adults to the natural world through formal and informal classroom and outdoor programs. She has a B.S. from the University of Massachusetts and a Master of Education degree from Fitchburg State College. Valerie lives on Cape Cod with her family. She enjoys gardening, hiking, kayaking, biking and most activities that are outdoors. Valerie also volunteers on several boards of directors for local non-profit energy related organizations.

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IDEA EXCHANGE

Evaluating Your Outdoor Education Program
Anne Nordstrom PhD

All of us know that getting students out of the classroom works. Call it what you will (place-based education (PBE), environmental education, outdoor learning, meaningful watershed education experiences) this method teaches students to:

- Connect the dots,
- Actively learn about their place in communities --both human and ecological
- Deploy tools that allow them to understand and make tangible improvements
- Develop a fine-tuned understanding of the systems in which they live

All this provides them experiences that inspire, influence, and have a life-changing impact. As Lauren, a GOMI alumna writes elsewhere in this edition: "...GOMI has inspired me to be a lifelong activist. Through GOMI I recognized that environmental change does not come through watching documentaries, but rather through attending conservation commission meetings, educating the public, and performing citizen science." How can you argue with that? Lauren, and numerous students along with her have developed a set of personal values that stand for social and environmental justice and are rooted in a scientific, experiential approach to problem-

solving. They've learned to see the big picture and the intersecting, not insubstantial, role that humans play in stewarding the earth.

"So what?" (Why Evaluate?)

You understand and have seen first-hand that PBE makes a difference in the lives of students, but how do you communicate that knowledge to your community partners, your administrators, funders, and parents? When you want to convince others that this educational method is a worthy endeavor they should support, what case can you make, what tools do you have? How do you answer the question "so what?" when there are so many demands for so few resources and you want to prove what you know: i.e. students who have these experiences are more likely to go out and bring positive change to the world. As Lauren writes, "...and so I found myself protesting the North Dakota Access Pipeline, marching in the Climate March in Washington, D.C., and teaching school-age children about climate change".

Evaluation research is uniquely positioned to answer two questions: "How is it going?" and "What good did it do?" The answer to these can and should be used to:

- Justify funding.
- Advocate program continuation.
- Judge aspects of the program that are most or least effective.
- Make mid-course adjustments.

What evaluation cannot do is everything at once (just like the rest of us). Evaluators must frame the evaluation according to what is relevant to the program's goals and objectives and:

- Develop relevant questions.
- Choose appropriate methods.
- Communicate findings, promptly, to people who can best use them.

Evaluation vs. Educational Assessment

Evaluation, as classically defined, is a systematic method for obtaining and assessing information about human activity that can be used by planners, implementers, funders, participants, policy-makers, and other stakeholders to make decisions about the effectiveness of the activity. As educators, you are no strangers to planning and evaluation. You expect that, if you present subject matter correctly, students will learn what is taught. So you plan your curricula or project with specific goals, objectives and outcomes in mind. These can be social or academic or in combination, the latter being the case with place-based education. In any event, you judge the effectiveness of your approach through some form of measurement, often tests. In formal education settings, success is often narrowly defined and measured by standardized tests that yield a numeric assessment of students' abilities. Assessments like these have their place, but often receive over weighted importance in determining resource allocation, and the failure or success of a curriculum, program, school, student, or a teacher. As such, these metrics cannot assess many of the contextual and qualitative factors that nurture students' performance and growth. And, these are often key outcomes for place-based education.

To get at what works best in improving performance and outcomes (qualitative and metric) and sharing results meaningfully, evaluation can assume the broader approach. This requires four simple, but not easy steps, each with many components:
1. Ask questions of substance.
2. Gather relevant data.
3. Report answers.
4. Provide opportunities for mid-course adjustment.

When it comes to place-based education, which is a community-based, holistic, and systemic approach to learning, having a strong evaluation component is critical to showing its benefits to others. Research has shown that place-based education can have significant effects on students, to include:
1. Better academic performance and graduation rates.
2. Better engagement with teachers.
3. More student independence, self-reliance, better social skills.
4. Increased likeness to enter a STEM field.
5. Improved connection with community.
6. Greater knowledge of nature and their relationship to nature.

And, this type of educational learning is FUN! (For more on this see Resources and References at the end of this article.)

Start with a Plan
An evaluation plan can be formal or informal, but is useful in either case as it guides you through the basic steps mentioned above. Filling out a simple matrix will help you proceed and keep you on track (Herman, Morris and Fitz-Gibbon, 1987).
Simple Planning Matrix

Simple Planning Matrix

Activity to be examined (Question)	Data collection method (Instrument)	Source of data (Subjects)	Date and person responsible for data collection	Analysis and Reporting (Use)

Asking questions
What do you want to know? Do you have to collect information for funders, community partners, your administration, or other educators? Your target audiences, or stakeholders, often determine the focus of the questions you ask.

What are the program goals and objectives? What do you want students to be aware of, know and do? Specifying these outcomes as clearly as possible is an important first step in focusing the evaluation. Evaluators like to start by articulating a theory of change, laying out logically all the resources, processes and activities that lead to the desired changes in attitudes, knowledge, and behavior. Graphically portraying these relationships in a logic model is an effective exercise in

clarifying how the program is supposed to work. Logic models can be complex or simple, but always contain these basic pieces:

Use your model to help you zero in on evaluation questions to be answered, for example:

- Who is participating in your program?
- What materials and activities are most effective?
- What do the participants think and feel about being in the program?
- How have they changed as a result of participating?
- What were the greatest challenges in carrying out the program goals?
- What could be done better?

Gathering Data

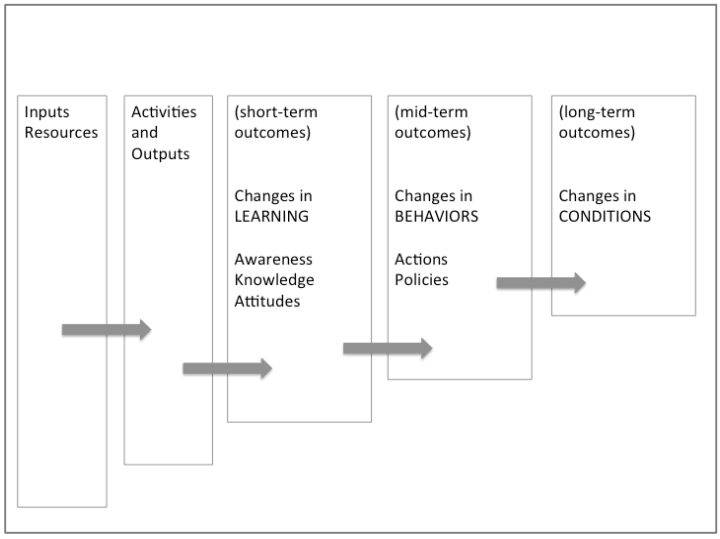
How will you get the information? Who is responsible, when will they do it and who/what will they get it from? Evaluators have a variety tools for answering evaluation questions, and we love to use a combination of story telling, images, and statistics. Our goal is to support quality improvement and to give you timely information that will help you make your program even better. Data collection tools include interviews, surveys, focus groups, videos, participant-observation, case studies, documents and records and are best used in combination to tell a complete story both in breadth and depth. You will find that different methods lend themselves better to different questions, for instance, a video interview with participants in-situ gives a clear perspective on how they think and feel whereas a survey is better suited to discovering what students know. Several key conditions must be met when collecting data: it is to be collected rigorously, systematically, and with the evaluation question(s) in mind. Nothing is more cringe-worthy than when a well-meaning planner chirps, "let's do a survey!" without having first described the purpose and the use of the results.

How are we doing?

How much did we do?

How well did we do it?

Is anyone better off?



Reporting and Using the Findings
Our ultimate goal is to report findings in ways that are meaningful to the planners/educators, ways that can be used to help you best see and make course adjustments; in ways that will provide compelling examples of how the program is working. This means providing an attractive-looking, easy-to-digest, relatively short report delivered at just the right time. Just the right time should include during program planning and implementation, periodically at strategically selected milestones in the program's development (formative), and at the program's end (summative).

Beginning Milestone 1	Milestone 2	Milestone 3	Conclusion

By the time we get to conclusion, we should have a good idea of how answering your evaluation questions will help you improve, justify, promote or celebrate your program and who the is your right audience(s).

When we planned your evaluation, we strove to ask thoughtful questions to inform, move the program forward. The job now is to help your audience to understand the results, and to take appropriate action based on the facts. This includes helping them to think of the lessons learned from the evaluation as a feedback loop. Program success is not achieved all at once, and incremental/iterative information can guide and keep progress on track.

Conclusion
Evaluation and place-based education are not dissimilar. The best evaluations are dynamic, taking into account context and participants, and helping programs evolve to achieve their ideal outcomes. Place-based education helps students to learn about the dynamics of the systems in which they live, become aware the role of relationships and act to make positive changes for the whole.

Resources for Environmental Education Teachers (www. meera.snre.unmich.edu)

Best Practices Guide to Program Evaluation for Aquatic Educators
Recreational Boating and Fishing Foundation
www.takemefishing.org

Does Your Project Make a Difference?
NSW Office of Environment and Heritage
www.environment.nsw.gov.au

Designing Evaluation for Education Projects
National Extension Water Outreach Education
www.fyi.uwex.edu

Evaluating EE in schools: A Practical Guide for Teachers (Oldie but goodie)

UNESCO-UNEP International Environmental Education Programme
www.unesdoc.unesco.org

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Herman, J.L, Morris, L.L., Fitz-Gibbon, C.T. (1987). Evaluator’s Handbook. Sage Publications. Newbury Park, CA.

Friedman, M. (2014). Results Accountability Workshop. Fiscal Policy Studies Institute.

Anne Nordstrom
Anne is a Sociologist who specializes in solving research design, statistical analysis and program evaluation problems. She brings more than 25 years of experience to the challenge of measuring success and progress in change efforts in the public and non-profit sectors, especially in higher education, community health, and environment.

She takes great pleasure in helping clients develop and refine their questions and then choosing the best analytic tools to answer them, providing comprehensive interpretation of data so as to inform decision-making about legislation and policy, curriculum choices, and program improvement.

She has extensive experience working qualitatively with all types of stakeholders, including community groups, students, faculty, researchers, CEOs, councils and committees, to solicit input, foster engagement and feeding back findings for real change.
Anne could be considered a life-long learner: she received her Ph.D. from Boston College; M.A. in Community Social-Psychology from UMass Lowell; B.A. from Boston College and graduated with the first Green MBA cohort from Antioch University New England in May 2009.

She also has a life, enjoying flying, water sports, gardening, and adventures.

STUDENT FORUM

GOMI's Influence on ME

Lauren Healey

"Who'd like to come and see the damage better"? Before I even answered, my feet were self-assuredly stepping off the spongy surface of peat and placing themselves down the incline. "Be careful the mud sticks." At that moment my mom's 1980's, army green, marsh boots hit the slick, salty mud of the salt marsh. I sunk deep into the mud. I wrenched on my right foot. I was stuck. As my body swayed to the left, I waited for the reassuring push back of an object. It never came. My body squelched into the mud. My entire left side: boot, knee, thigh, arm, hair, was coated in inches of rotten egg smelling mud. Thus, began my first Gulf of Maine Institute (GOMI) conference.

When I first arrived at the weeklong conference, which hosts all nine GOMI teams from Massachusetts to New Brunswick, Canada, I expected power points and lectures. Instead, I found myself sloping across the marsh, interacting with scientists, and presenting my findings to the city's mayor. At the conference, I learned public speaking, leadership and the confidence necessary to become an effective environmental activist. I remember I spent hours at my first conference memorizing my two-minute speech on ecosystem services. Now, I cannot believe that just last week I spontaneously delivered a thirty-minute presentation to a lecture hall of a hundred people with barely a tremble in my voice. As I attended my third conference, I confidently took charge and organized my group's speech. It was a striking difference to the passive, shy child I had been at the beginning of my journey with GOMI.

What amazes me the most about GOMI is it has continued to follow me throughout college. As I sat down in my Life after Biology class, which is meant to challenge you to think about your life after college, I was surrounded by the hesitancy, intimidation and even horror of my classmates as they stumbled their way through their first resume. I sheepishly handed over my resume with its two internships, outreach work, and hundreds of hours of community service for a peer-review session. I suddenly realized how well prepared I was for my life after college in comparison to my peers and how much of that I owe to GOMI. Because of a grant partnership with GOMI, I spent my summer as an intern with the U.S. Fish and Wildlife Service, (USFWS), Parker River National Wildlife Refuge, Newbury, MA. While working there, I woke up excited every day for work, immersed myself in field research and gained valuable skills such as Geographic Information System (GIS). Through the internship, I was able to prove my leadership and initiative skills and am now volunteering at the USFWS regional office in Hadley, which will set me up to work for the Service upon graduating.

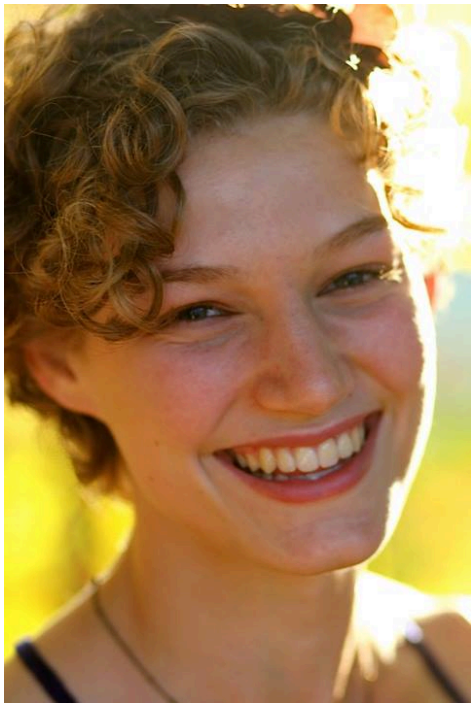
Finally, GOMI has inspired me to be a lifelong activist. Through GOMI I recognized that environmental change does not come through watching documentaries, but rather through attending conservation commission meetings, educating the public, and performing citizen science. After adjusting to UMASS, I could not ignore my deep calling to continue my environmental work. I could not stand to be a bystander to climate change, and so I found myself protesting the North Dakota Access Pipeline, marching in the Climate March in Washington,

D.C., and teaching school-age children about climate change. I know that upon graduating, I will continue to fight against climate wherever I end up.
Overall, GOMI has provided me with the skills to inform others, the opportunities to be competitive in an environmental field and the passion to be a lifelong environmental activist.

A successful Pepperweed pull as part of my internship with the Fish and Wildlife Service

Using GPS to locate NEKTON sampling sites.

One of many truckloads of pepperweed. There were over 300 bags in total.



Lauren is a junior at the University of Massachusetts Amherst where she majors in natural resources conservation. She is a GOMI alumnus and attended GOMI summer Workshops in both Canada and the United States. She is currently pursuing her biggest passion, vegetated/green rooftops, through an internship at Apex green roofs. She also engages in green roof research and outreach work at UMASS. Upon graduating she will work in the field or pursue graduate school as a wildlife biologist. She is not yet sure of the order.

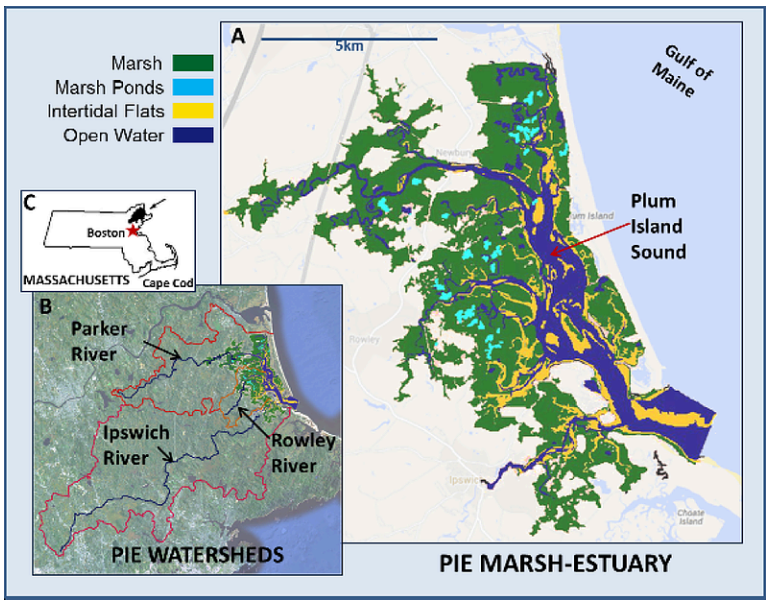
RESEARCH UPDATES

Learning to Understand and Protect our Marshes: the Importance of Long-term Studies
Dr. Jane Tucker

It's low tide, and as you look out over the expanse of grasses and tidal creeks of The Plum Island marshes and estuaries, you are likely to see wader-clad shapes slogging through the mud and bent over their rakes, collecting soft-shelled clams for dinner or market. These hardy souls are just the latest generation of fishermen engaged in one of many traditional uses of this natural resource. Or you might see another set of muddy individuals, out and about the marsh in all kinds of weather and carry unusual tools and paraphernalia. These are members of a team of scientists, engaged in studying the marsh and estuary as part of the Plum Island Ecosystems Long Term Ecological Research program, or PIE-LTER.

A couple of those strange scientists out on the marsh
(Dr. Anne Giblin and author heading out to collect sediment cores)

The marshes and estuaries studied by PIE-LTER are part of The Great Marsh, the largest expanse of intertidal marsh in the Northeast. Estuaries are often described as areas where rivers meet the sea, and in the PIE-LTER case, those rivers are the Parker, Rowley, and Ipswich, all three of which flow into Plum Island Sound. The Sound there meets the ocean at the southern end of Plum Island, a barrier island that shields the shallow waters and marshes behind it from the full force of the ocean. In fact, the formation of the marshes and estuaries ~ 4000 years ago began only after the formation of the barrier island. Thus scientists classify the Plum Island estuaries as coastal plain, bar-built estuaries. They are further classified as macrotidal, meaning their circulation is dominated by tidal flow. PIE has two high and two low tides each day, spanning a tidal range of 3 meters, and resulting in well-mixed waters in the estuaries and tidal creeks.



A. PIE Marsh-Estuary
B. The three watersheds that feed into the marsh estuary
C. Location of PIE-LTER site in Massachusetts

The Great Marsh includes extensive areas of productive, tidal marshes. On the salty to brackish end, smooth cordgrass, (Spartina alterniflora) lines the creek banks and saltmarsh hay (S. patens), with its characteristic "cow-lick" appearance, is found on higher ground of the marsh platform. On the freshwater end, the salt marsh grasses give way to cattails (Typha) and sedges (Scirpus and Carex). The estuaries include numerous creeks and wide areas of mudflats, home to a diversity of small fish, shellfish, crabs, and other invertebrates that are key components of the marsh-estuarine food web. Seasonal inhabitants of the estuary like striped bass and American eel are also supported by this food web, and link the system to the coastal ocean. Similarly, the marsh-estuary is a critical habitat and food resource for migratory birds, as well as year-round inhabitants.

Rowley River at low tide, exposing mud flats, and with Plum Island Sound and the Gulf of Maine in the distance. Straight-line ditches, as well as houses and boats, are evidence of human use of the marsh-estuary.

Humans have also long used the resources of the marshes. Before European settlement, Native Americans hunted and fished the area for subsistence, and also engaged in some planting and fur trading. European settlers arrived at the PIE area in the early 1600s, and in addition to fishing and hunting, began a more systematic and widespread transformation of the landscape for agriculture. The high marsh provided a "ready-made" pasture for livestock, and its grasses were harvested as salt marsh hay, a lucrative crop. Although salt marsh haying has declined in recent years, the estuaries continue to provide harvests of shellfish and finfish, fueling local economies through both commercial and recreational fishing, most famously for the softshell clam (Mya arenaria). The Great Marsh is also a popular destination for birders, duck hunters, boaters, artists and photographers, and those who simply enjoy the natural beauty of the area.

Marsh-estuary ecosystems also do a number of things for humans that are not so obvious, but are increasingly important in the face of global climate change. They buffer uplands from the impact of severe storms and help prevent coastal flooding. They are extremely productive systems, taking up large quantities of carbon dioxide (CO2) and ultimately storing it in the ground as dead roots and rhizomes. In this way, they represent a disproportionate carbon sink for the land area they cover and are therefore important players in the global carbon cycle.

Setting up the tall eddy flux tower
Sam Kelsey, Inke Forbrich, and Anne Giblin setting up an instrument tower used to measure the balance between CO2 release and uptake by the marsh.

At the PIE-LTER site, scientists are working to understand how climate change and other human impacts act -- and interact-- to alter these marshes and estuaries. To do so requires a multi-year and multi-disciplinary approach, so a large team of scientists is involved, conducting research on topics ranging from nutrient cycling to fish migrations, and combining research approaches of long-term monitoring and experimentation.

The primary effect of climate change on the Plum Island marshes is expected to be sea-level rise and specifically the future rate of sea-level rise. Marshes maintain their surface elevation relative to sea level by accumulating sediment and organic matter at least as fast as sea level is rising. At the rate of sea-level rise the marshes were facing over the last 100 years, about 2.8 mm/yr, PIE marshes have been able to maintain themselves. However, that rate has increased to ~4.8 mm/yr, and some areas of the marsh are not gaining elevation equal to the higher rate. One reason is that there is very little sediment delivery to the marshes from the rivers because dams trap the sediment upstream. With limited sediment supply, will PIE marshes be able to keep up with sea level rise? To address this question, PIE-LTER scientists measure inputs of sediment to the marshes from the rivers and the coastal ocean. We also measure sources of sediment and organic matter that come from the marsh itself. In a process coined "marsh cannibalization," we have found that some of the sediment eroded from the exposed edges of the marsh gets re-deposited back onto the surface of the marsh. In addition, we are assessing how much the marsh grasses themselves contribute to building elevation by quantifying how much of the plant material (organic matter) they produce each growing season gets buried and stored in marsh soils.

Another aspect of climate change affecting the PIE system is rising ocean temperatures. The Gulf of Maine is experiencing more rapid temperature increases than 99% of the world's oceans (Pershing et al. 2015), a trend implicated in the decline of cod and lobster fisheries. Warmer coastal waters may push cold-water species north, and they also open the door to new habitat for more southern species. Already we have documented a northerly range expansion of the fiddler crab into Plum Island marshes and further. Blue crabs also seem to be more common. We are watching for other species shifts, both into and out of the PIE system.

Climate change is also predicted to cause more extreme weather events in the GOM region. In fact, several storms with very high precipitation have occurred in the last 20 years, causing flooding in the watersheds of Plum Island Sound. Events such as these lead to large amounts of water running off paved surfaces and lawns in the ever-expanding development in the watersheds, carrying with it debris, fertilizers, and other pollutants that end up in streams, rivers, and ultimately the estuaries. On the other end of the spectrum, the area has recently experienced severe drought, with streams and ponds drying up and causing fish and other aquatic organisms to be isolated from their full habitat, or killed. Among these fish are species like river herring and alewives that normally return to the estuary after spawning upriver; changes in these populations could alter estuarine food web. PIE scientists study the effects of watershed events on the estuary in projects that monitor the transport and fate of water and other materials from the watershed to the estuaries [including sediments], and by studying food web dynamics in multiple habitats within the estuary and marshes.

With changes in sea level and freshwater inputs, estuaries may experience shifts in typical salinity distributions, particularly in the upper reaches of the estuary where fresh and salt water mix. These changes have implications for the organisms that live there, including the microbes. Though unseen, these microbes are fundamental to the functioning of the marshes and estuary. As a community, they possess an extraordinary range of metabolic capabilities, performing functions such as decomposition and denitrification, which also help buffer the coastal zone from

inputs from land. Research at PIE has found that some of these functions are sensitive to salinity.

The large team of scientists conducting research in association with the PIE-LTER includes students at all levels. Students from regional middle and high schools are involved in ongoing field projects that conduct surveys of marsh plants and help monitor invasive species like purple loosestrife and Phragmites. Students also take part in field studies to assess the local effects of sea level rise, using a spotting level on area beaches to locate and flag predicted high tide lines. Hands-on activities like these impart real-life awareness about the function and vulnerabilities of our coastal systems, while also contributing to the overall knowledge base about them. (For more see Lauren Healey's article in STUDENT FORUM).

The PIE marshes and estuaries are complex and dynamic, and that makes them exciting, challenging, and rewarding for scientists to study. The numerous benefits they provide to humans (so-called ecosystems services) make them important for society. In the face of climate change and other anthropogenic impacts, it is critical to understand how these systems function and protect them. PIE-LTER scientists seek to share what they learn and to learn from others, by partnering with local stakeholders and by involving students in our research. By doing so, we hope to contribute not only facts and figures about the marsh, but to impart an appreciation for the intrinsic value of these systems and the threats they are facing and to encourage and support public stewardship.

Dr. Tucker works at the National Marine Laboratory's Plum Island Long-Term Ecosystem Research Centre, (PIE-LTER) where she studies the effects of oil exposure on nutrient cycling in marsh sediments. Her primary role is to analyze samples and process data to determine rates and pathways of nitrate reduction to try to understand how the oil exposure alters the microbial community in marsh sediments, and therefore the biogeochemical processes active in the marsh.

Jane was always interested and curious about the natural world. She claims to have been a "nerdy kid" who asked for a microscope for Christmas but also loved to be outdoors. She had an aquarium as well as a variety of rescued pets, loved to identify seashells and tree leaves, and of course watched Jacques Cousteau and the Wild Kingdom. She grew up on the coast of NC, and loved the oceans and marshes and always wanted to know what and why. So for her, a career in science was the obvious path to take.

CLIMATE CAFE

Lessons from the Climate Café
Shari Melto

This has been an exciting year for the Climate Café – A dozen GOMI students facilitated eleven Cafés in six communities (including Wolfville, Nova Scotia), and engaged more than 400 people in meaningful conversations about extreme weather, sea level rise, tidal power, local food, and media literacy.

Most who come to the Cafés believe climate change is an urgent issue – they want to talk about what to do. Excited to have a forum like Climate Cafés, they eagerly share their ideas about recycling, composting, edible gardens and permeable roadways while forging new relationships with others who share their concerns.

Although adult-adult conversations about climate change are common, the icing on the cake for everyone at a Climate Café is interacting with students. Adults are surprised and inspired by students who are passionate, knowledgeable, and concerned about climate change. The students have a lot to say about being involved: "It is great to finally be taken seriously by adults," and "it opened my eyes how I can help my community." Both students and adults leave Cafés more hopeful about the future and eager to get more involved: "It was a great way to connect with others who care about our Earth and are working to make change." One guest summed it up by saying, "Cafés have tapped an unmet need – these students are making a difference!"

Climate Cafés are still a work in process. Each one is unique adventure, more like a jazz improvisation than a string quartet! As one student said, "it's like being on Broadway without a script or a rehearsal!" Here are a few challenges to consider if you're thinking about hosting a Climate Café.

- Who's on first? We never know how many students would be able to make it to a Café until the last minute. High school students have calendars packed with cross country events, science fairs, social activities and part-time jobs. Keeping them engaged for eleven Cafés is a challenge. However, there were always at least five or six at each Café -- perfect for 20-25 guests. Another challenge has been "succession." When experienced seniors shift their focus as graduation nears, the "junior varsity" must step up to the plate – ready or not! Cafés with less experienced students can be a bit rocky, but they catch on quickly.

• How much coffee? Sponsors or parents, who offer to bring refreshments, ask a logical question: "How many people – how much coffee?" Unfortunately, predicting the number of guests has been impossible. For one Café we did a media blitz -- posters, an op-ed, email blasts, and even a radio spot – and we had 25 guests. In another case, we sent out a handful of invitations and had standing room only for more than 50 people! We've learned to set up for 20-25 and have plenty of extra chairs, materials, and coffee available, just in case.

• Where to go? The ideal place to hold a Climate Café is a light, airy space with tables of four or five people. However, finding a free space like that for 25-50 people can be difficult. We held Cafés in a beautiful community center with flowers on the tables, in a crowded Sunday School room with only folding metal chairs, in a tiny rented storefront where we were packed like sardines and under a tent at the Farmer's Market. The best was a summer Café with comfy wicker chairs on a breezeway! The good news is that it didn't seem to matter – everyone had a great time wherever we were.

• What's up? Some people who come to their first Café are confused. They think a "conversation" is just the typical presentation with Q&A rather than an opportunity to engage with others. We found that a simple prompt gets a great conversation started. For example:

- Take a minute to draw a picture of your 'special place.
- How is climate change impacting your 'special place?
- What actions can you take, and what can you do as a community?

Once these conversations start, they take on a life of their own!

Is everyone listening? One important purpose of a Café is to practice respectful dialogue, to ensure that each person has an opportunity to say what is on his/her mind without interruption. Although most people are good listeners, there are always a few who interrupt, take off on a tangent or who just want to talk -- a LOT! To help students facilitate these challenging situations, we created Café Cards to encourage participants to practice five dialogue skills. Each speaker has a few uninterrupted minutes to share his or her ideas, and then the others in the group listen, inquire, confirm and explore. The process adds a bit of fun and helps prevent one person from hi-jacking the conversation.

• Please come again! Another challenge is keeping things interesting, so guests come back. Different conversation topics seem to help. For example, we hosted one Café about "fake news," using a set of Café Cards on misinformation techniques, e.g. red herring, cherry picking, and fake experts. Another Café focused on shifting the community toward local, seasonal, organic food. Both were lively conversations!

Overall, it has been a very successful and rewarding year! The conversations have been amazing, and feedback from participants has been overwhelmingly positive regardless of cramped spaces, uncomfortable chairs, or spilled coffee. Everyone agrees that the students are the 'secret sauce' – their energy and passion are contagious and they give everyone hope for the future!

Most Americans harbor an unsatisfied hunger for community.
– Daniel Yankelovich, The Magic of Dialogue

Shari Melto spent more than 20 years with global consulting firms in the fields of talent management and organization development. She was director of learning & development at McKinsey and director of staffing & recruiting at both Booz and Hewitt. With the support of a MacArthur grant, she partnered with arts boards in Chicago to strengthen their organizations. Shari believes that we have a moral obligation to ensure a healthy, sustainable future for our children and our earth—and working with GOMI provides a unique opportunity to do both.