Of Butterflies and Rainbow Smelt

Often, the uglier the looming disasters, the more the public and my own scientific interests are piqued. The asteroid near miss and the direct hit of Russia's Chebarkul Lake by a show-stealing meteor were the most recent eye magnets. I wonder about the genesis of these coincidental events, and whether Lorenz's butterfly effect theory (popularized in the Ashton Kutcher movie) might be applied to space. A cosmic butterfly creating meteor showers? Not likely, but the abstruse flapping of jaws here on Earth seems to obscure the reality of flapping butterfly wings; if not a driver of cascading extreme weather and other chaotic unintended consequences, butterflies and meteors remain pretty miraculous spectacles.

Climate change has been big news on the heels of 2012, the warmest year in recorded history, an unprecedented one degree warmer than the next warmest year (1998). One degree does not seem like much, but in the inescapable precision of climate response, this is a rapid change that strains organisms' abilities to adapt. Species able to expand their ranges quickly enough (animals are better at this than plants) might remain within acceptable thermal tolerances, but may not find sustenance and habitat requirements necessary to thrive. Crabs are known to crawl onto shore when waters are devoid of oxygen in a fun-sounding shindig called a "jubilee", attempting to reach oxygen-rich air. Crabs do not live on oxygen alone. Nature cuts its losses, and re-weaves the fabric of the ecosystem. A new normal is created – less diverse and less beneficial to our human needs and desires.

A scholarly group of 60 scientists, the National Climate Assessment and Development Advisory Committee (NCADAC), recently released a draft National Climate Assessment report. The NCADAC affirmed findings of the Intergovernmental Panel on Climate Change. Temperature, extreme events, and sea level rise continue to loom. The human equivalent of butterflies flapping their wings, our behavior, is collectively powerful enough to cause the increasingly apparent and troublesome changes in our climate.

The NCADAC findings portend alarming consequences for our society and economy. Threats to human health and well-being include "…impacts from increased extreme weather events, wildfire, decreased air quality, diseases transmitted by insects, food and water and threats to mental health." Human infrastructure, water supplies and food security are threatened, especially as the ecosystems that support us become more alien to our success as a species. Like crabs out of water, our responses are often defiant, stumbling, reactionary and perhaps futile – cutting off the butterfly's wings is unlikely to resolve the cascade of effects. The NCADAC provides an ecosystem context for our society and economy: 1) Multiple factors can affect climate change impact, e.g., land use, local economies, air and water pollution, sustainability practices; 2) Our behavior affects vulnerability to climate change impacts; 3) It is a global problem; 4) There will be unpredicted consequences as thresholds and tipping points are passed; and 5) Weather and climate extremes each can have devastating consequences, and require different strategies of preparedness.

What about the Rainbow Smelt?

A Regional Conservation Plan for Anadromous Rainbow Smelt in the U.S. Gulf of Maine (***www.wildlife.state.nh.us/marine/marine_PDFs/Smelt_Conservation_Plan.pdf***) was recently released. The plan concludes that this unique fishery is in decline, and like the cascading effects of climate change, the reasons are complex and interrelated. Major threats include: spawning habitat access and degradation, water quality effects, especially to eggs and larvae, fishing mortality, predator-prey relationships and climate change. There is underlying uncertainty about how these multiple stressors interact and contribute to rainbow smelt decline, and limited ability to restore the ecosystem integrity supportive of robust smelt populations. Therefore, recommendations center on monitoring and research to refine understanding of combined human, ecosystem and climate change impacts. Although recommendations vary among states, best immediate prospects for management reportedly include spawning habitat restoration, conservation measures, and stocking. We have taken ownership, often at a high cost and with uncertain outcomes, of what Nature used to carefully and optimally maintain for free.

This is the scientist's and manager's dilemma – ecosystems have many moving parts and interactive processes. They vary widely from year to year, even under relatively pristine conditions. Our challenge is to set the table for successful recovery and adaptation of ecosystems on a global scale and of rainbow smelt at the local scale. Both are at once challenging and burdensome as healthy ecosystems are intricate and may be irreparably altered by the press of human activity, including the consequences attributed to climate change.

Paul Stacey
Research Coordinator, GBNERR

Helping Yourself While Helping Others: The Benefits of Volunteering

With bills to pay, family to care for, or a home that needs constant upkeep, it can be hard to find time to volunteer. However, the potential benefits of volunteering can be enormous to you, your family, and your community. The right match can help you find new friends, connect to your community, learn a new skill, and even advance your career. Volunteering can also help protect your physical and mental health.

It takes a village - One of the most important benefits of volunteering is the positive impact it has on your community. Volunteers are often the ones that truly drive the culture of a community. Volunteering with others you might run into at the grocery store, the doctor's office or the gym, allows you to connect with people you may help one day, or may help you in your own time of need. Dedicating your time as a volunteer helps you make new friends, expand your network, and boost your social skills.

Get out of your shell - While some folks are naturally extroverted, others have a very hard time meeting new people. Working alongside other like-minded individuals gives you time to develop your relationships organically without pressure or time restrictions. Once you gain momentum, opportunities abound for meeting new friends and making social contacts.

A family affair - While it might be tricky to organize everyone's schedules, volunteering as a family has many far reaching and worthwhile benefits. Children learn by example, watching everything you do. By giving back to the community, you show them firsthand how volunteering makes a difference and how good it feels to help others. It's also a great way for you to find resources and activities that you can do as a family.

Volunteering is yoga for the mind and body - Pure and simple, it is good for you. Doing something good for others increases your natural sense of accomplishment, enhances your self-confidence, self-esteem and overall life satisfaction. Belonging to a volunteer family can give you a sense of identity and pride. And the better you feel about yourself, the more likely you are to have a positive outlook on your future. Volunteering combats depression by reducing social isolation. Having friends and a support system in place protects you from the sense of stress and fear that challenges all of us during difficult times. Lastly, it can help you stay physically healthy. Studies have shown that volunteers have a lower mortality rate than non-volunteers, even lessening symptoms of heart disease and chronic pain.

Gain valuable career experience - Looking to change careers or just starting out? Try volunteering in your intended line of work. Learning all about a field before you actually try to get a job in it, can enhance your interview performance and give you a real sense of whether or not you truly want to pursue that career. Also, if you are volunteering at an organization and a job opens up, you may have a leg-up over competition for the position.

Fun and fulfillment to your life - Volunteering is a fun and easy way to feed your true interests and passions. If you sit behind a desk all day and yearn to be outdoors, combining the two by volunteering to work in a community garden for example, can fulfill more than just your desire for a hobby.

Consider your goals and interests

You will have a richer and more enjoyable experience if you first take some time to identify your interests and goals. Are you a people person? Would you rather get a tooth pulled than stand up in front of a crowd? Do you love the challenge of creating a data base or technological solution for an organization, or does the idea of immersing your hands in the soil, while beautifying a property interest you? If you answered yes to any of these, the Great Bay National Estuarine Research Reserve may have your perfect match. Visit ***www.greatbay.org*** to learn more or call (603)778-0015 to explore your volunteer opportunities.

Kelle Loughlin
Education Coordinator, GBNERR
Director, Great Bay Discovery Center

President's Corner

I'd like to publicly welcome the newest members of the Great Bay Stewards Board of Trustees: Bruce Addison and Laura Byergo. Bruce Addison is a resident of Greenland and works in the financial services community in Portsmouth. We are grateful for Bruce's willingness to take the lead role in our fundraising efforts. Laura Byergo also resides in Greenland, and is a member of the Winnicut River Watershed Coalition and the UNH Marine Docent program.

I would also like to welcome Katherine Irshad, our new Administrative Coordinator. In addition to having considerable experience with the administrative functions of a non-profit, Katherine is also an accomplished oceanscape photographer. You can see her work at ***http://kgendreauphotography.com***.

There are a lot of interesting things happening around Great Bay and the entire state, which speak to a growing awareness of the need to monitor and protect our precious water resources. At the end of 2012, Newmarket agreed to accept the EPA nitrogen limits for its wastewater treatment plant, and started the process toward upgrading that plant. This January, Exeter agreed to accept the EPA's limits as well. The hope is that other communities around Great Bay will follow suit (instead of filing suits, as some have done). At the same time, it was interesting to note that the Gorham, NH wastewater treatment plant was selected by the EPA for a 2012 Excellence Award. Clearly, exemplary performance in wastewater treatment is possible, and is already happening in our state.

Nitrogen is recognized as one of the leading causes of pollution of our water resources, and there too, things are happening. The village of New Castle's Conservation Commission, in an effort to combat non-point source nitrogen pollution in the local waters, adopted the Lawns for Lobsters Program. This program was developed by the Kennebunkport Conservation Commission, UNE, and the Maine Lobsterman's Program to help homeowners understand how to maintain a healthy lawn with minimal impact to the environment. The Great Bay Stewards are working with NH Department of Environmental Services to develop a similar program for the communities around Great Bay.

Katherine Irshad

The Portsmouth Herald highlighted the partnership between TMS Architects and Altus Engineering to design and install rain gardens at various sites on the Seacoast. The article pointed out that rain gardens can be good for business, as well as good for managing storm water runoff.

Three NH State Senators have proposed legislation (still in committee, as of this writing) that will limit the nitrogen and phosphorous content of lawn fertilizers sold in the state. New Jersey enacted a similar law in 2011. And, as of last year, at least 11 other states have prohibited the use of fertilizers containing phosphorous, except in limited conditions.

It is encouraging to see that more and more communities and states recognize that protecting our water resources requires involvement and some time investments on all of our parts if we are to be successful. As those who live around Tampa Bay and Chesapeake Bay have learned, the cost of cleanup and restoration is far, far worse than the cost of prevention.

Jay Diener
President, Great Bay Stewards

GREAT BAY STEWARDS

PLEASE JOIN US!

All interested parties are cordially invited to become Great Bay Stewards. Members receive Great Bay Matters and other pertinent mailings.

Annual dues may be paid by check made payable to the **Great Bay Stewards** and sent to: Membership Committee, 89 Depot Road, Greenland, NH 03840

❑ Guardian $150 ❑ Protector $75

❑ Steward/Family $35 ❑ Student $20 ❑ Other $_____

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state _____ zip _____

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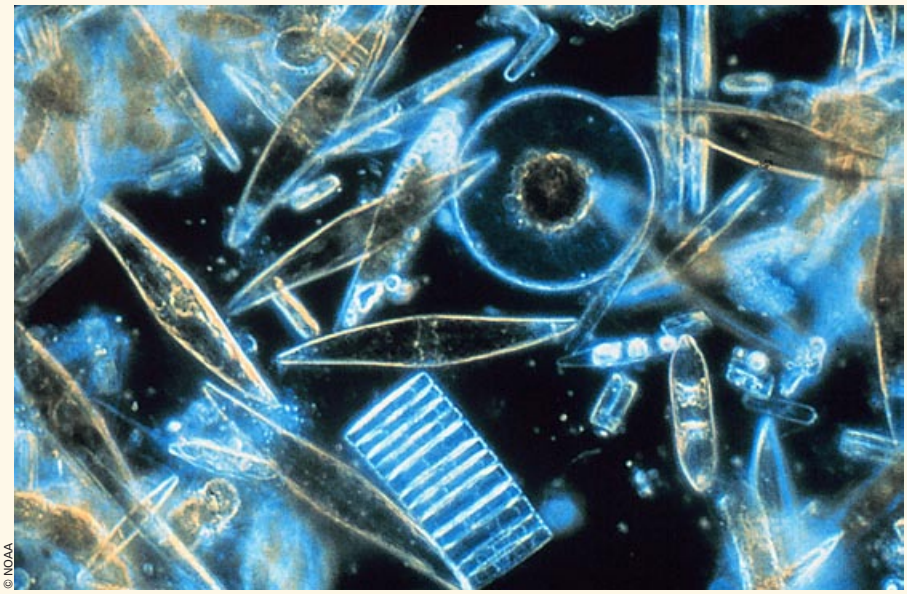
Microscopic Canaries

Did you know that two-thirds of the Earth's photosynthesis occurs in the ocean? Microscopic marine phytoplankton are busy at work every day absorbing carbon dioxide from the atmosphere and nutrients from the oceans. These tiny autotrophs create oxygen that humans and other terrestrial animals need to survive and, like any other living creature; their ability to function is directly related to the condition of their environment. Phytoplankton are the base of all marine and estuarine food pyramids and create primary energy which is transferred through each trophic level of the food chain. They are incredibly sensitive to environmental shifts and are consequently the first to be affected by climate change. Phytoplankton are the present day "canaries in the coal mine."



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Phytoplankton, which include microscopic algae and bacteria, engage in photosynthesis and are the primary producers that support all other organisms in the food web. Without these diverse organisms, marine life would come to a halt. Phytoplankton drift with ocean currents and photosynthesize in the upper strata of the water column and absorb chemical nutrients, such as nitrogen and phosphorous from the lower strata. The cool ocean waters contain the most nutrients and provide the compounds necessary for photosynthesis. As the oceans are warming, the water columns are becoming more stratified, creating more distance that plankton must travel for nutrients. Because phytoplankton rely solely on the currents to move them within the water column, this stratification will inevitably have adverse affects on nutrient recycling and phytoplankton populations. Since phytoplankton are vital to the functioning of marine food webs, this population shift could potentially affect hundreds of thousands of species from minute zooplankton to massive baleen whales.

We are all familiar with the term "red tide." This type of harmful algal bloom, or HAB, is triggerd by a sudden increase in nutrients that causes microscopic algae to flourish in the uppermost strata of the water column. This creates a red (green or brown, depending on the algae) blooming effect in the ocean that causes shellfish harvesting to shut down due to high levels of toxins in HABs. Many factors contribute to this damaging spike in aquatic nutrients such as the use of lawn fertilizers, sewer discharge and unsuitable farming methods. These introduce excess levels of nitrogen and phosphorous into coastal waters, thereby causing algae to flourish. Many of these HABs have high concentrations of toxic compounds that accumulate in oysters and other filter feeders; these toxins become magnified in animals that feed upon them, such as fish and shorebirds.

Are humans affected by phytoplankton? Yes – phytoplankton create nearly 50% of the world's oxygen. Every living organism, from snails to shorebirds to elephants owes their existence to autotrophic phytoplankton. Without these critical primary producers, oxygen levels on Earth would dramatically decrease. Locally, shellfish harvesters are affected by harmful algal blooms, and in southern states, beach closures and occasional upsurges in jellyfish populations can cause beach closures, significantly affecting coastal tourism.

It is important that we act locally to reduce our global impact on phytoplankton. The primary human sources of phosphorous are detergents and sewage. By reducing sewage runoff (including pet waste), we will lessen the chemical concentration in coastal waterways helping to mitigate harmful algal blooms and the significant affects these have on marine life. Instead of using traditional lawn fertilizers, which introduce excess nitrogen into the soil and groundwater, we can use naturally rich compost and lawn clippings. Phytoplankton are critical to ocean climate and ecological stability. Any change in their productivity could have a significant influence on biodiversity, human food supply, and the pace of global warming. Small local changes can have major global impacts.

Nicole Andrews
Naturalist, GBNERR

Destination: *Rhode Island*

Narragansett Bay National Estuarine Research Reserve

Narragansett Bay Reserve is located on four islands in the geographic center of Narragansett Bay in Rhode Island. The Reserve protects 2,533 acres of coastal and upland habitats on Prudence, Patience, Hope and Dyer Islands, as well as 1843 acres of water surrounding these islands. Narragansett Bay was the first Research Reserve be established in New England and was designated by NOAA in 1980. Of the four islands, all but Prudence are uninhabited.

Prudence Island is the largest of the islands and 60% lies within the Reserve's boundaries. The remaining land supports the 150 year-round residents and 1500 summer residents. Ecologically, Prudence Island is of great importance to the Reserve with its richly diverse habitats. The Island ranges from glacial till to pine barrens, from salt meadows to cobble beaches with forested uplands in between. These diverse habitats are home to many species, most notably the white-tailed deer. Prudence Island has the densest herd of white-tailed deer in New England. These deer swim between Prudence and Patience Island, a mere 900 feet to the northwest. Red fox, Eastern cottontail rabbits and threatened species of beetles all lay claim to Prudence Island. The large salt marshes are feeding areas for many wading birds such as herons, ibis, and great and snowy egrets. Pine warblers nest in the Pine Barrens on the island, the only known nesting site in Narragansett Bay.

NBNERR has some exciting advancements under way. Most recently, a pole-mounted solar array was installed on Prudence Island and will significantly reduce the Reserve's carbon footprint. In addition, the much anticipated education classroom and pavilion is closer to completion. This new multi-purpose room will provide Reserve educators the opportunity to reach out to more visitors and school-aged children about the importance of estuary stewardship. Groundbreaking will begin this spring and the pavilion will be completed in the summer.

Getting to Prudence Island is a quick ferry ride from nearby Bristol, with ferries leaving at regular intervals. While cars are not recommended on the island, visitors may bring bicycles via ferry. Prudence is the only island that allows foot traffic, as the other three islands are major nesting sites for migratory and wintering shorebirds. Seal watching and guided tours of Prudence are always a hit among visitors, especially in the early spring. If you are interested in visiting this unique habitat, visit ***www.nbnerr.org***.

Nicole Andrews
Naturalist, GBNERR