GREENovation

Fall 2011

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Cover Photos:

GMU limnology students practice field techniques to study freshwater ecosystems at Mason Pond

by Samantha Oester
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The 2011 meeting of the International Whaling Commission was a meeting of two parts this year. The first part, the meeting of the Scientific Committee (SC), was held in June in Tromsø, Norway. The second part, the meeting of the Commission itself, was a month later on the island of Jersey, in the English Channel.

The SC meeting brought some of the leading cetacean scientists together for two weeks in this remote coastal town above the Arctic Circle. One of the key issues discussed was what would happen to the so-called “scientific whaling” program of the Japanese in the wake of the recent tsunami and subsequent nuclear disaster. Although the delegates were very sympathetic to the plight of the Japanese people, eyebrows were raised at the quickness with which the Japanese government requested a change in its sampling regime (i.e., the locations where they would hunt whales). Comments were made that the previous sampling regime had been selected with the rationale that these specific locations were required to answer the “research” hypotheses, but apparently this was no longer the case. In addition, whale meat in markets had already been found with traces of radioactive cesium contamination. As this element can bioaccumulate, it does raise concerns about the human health impacts of consuming cetacean meat caught in some of the Japanese hunts.

The debate continues over the number of Antarctic minke whales—the most recent circumpolar estimates are nearly a third less than previous estimates. At present there are two models that produce differing population size estimates: 1,062,000 minke whales (past estimate) versus 612,000 (current estimate) or 612,000 (past) versus 421,000 (present). Regardless, both models indicate a substantive decline in numbers. As yet there is no good explanation for the decline—it might be due to the survey and estimate methods or it might be due to a real decline in Antarctic minke whales (although no mass mortality has been observed).

One of the SC sub-committees is the Environmental Concerns Standing Working Group (E), where many emerging threats to the marine environment are discussed. In fact, the E sessions always begin with a discussion of the State of the Cetacean Environment Report, which highlights published research and newsworthy events from the past year that might impact cetaceans. This year’s report highlighted the southern ocean and problems related to climate change, reductions in krill stocks, and over-fishing, all of which could have major impacts on many of the world’s whales. Other topics followed closely by this group are underwater noise and emerging marine diseases. This year the group also debated a new topic, the impact of the Deepwater Horizon oil spill on the Gulf of Mexico. There has been an unusually high number of dolphin strandings in the Gulf region, in particular a high rate of calf mortalities, and these may be linked to the spill. Research is being undertaken to investigate these issues.

Other conservation topics discussed at the meeting included scientific research on the impacts of whalewatching and the effectiveness of whalewatching guidelines, rates of mortality from ship strikes, and entanglement in fishing gear and marine litter. A special focus of the Small Cetaceans Sub-Committee (which covers beaked whales, belugas and narwhals, dolphins, and porpoises) was beaked whales in the north Atlantic, in particular their vulnerability to human sound (from military activities and oil and gas exploration). Specific species that were highlighted were the boto (or Amazon river dolphin), which is being killed in large numbers for fish bait, primarily in Brazil, and the critically endangered vaquita or Gulf of California harbor porpoise, the most endangered small cetacean in the world. The sub-committee has warned that unless gillnets in the Gulf of California are removed completely, the species will soon go extinct.
The second part of the IWC, the Commission meeting, is the political arena, and it is here where Commissioners (typically governmental appointees from environment, natural resources, or fisheries departments) discuss the SC report and various operational issues of the IWC. The meeting kicked off with the unveiling of a new Commission chair. The previous chair, the Commissioner for Chile, had retired due to “ill health,” although in reality he had been recalled by his government for publicly acting against Chile’s whaling policy (the Chilean government is very anti-whaling and pro-conservation, and it was considered that the previous Commissioner had not been promoting that policy at the IWC). In addition, the 2010 vice-chair, the Commissioner from Antigua and Barbuda, had been implicated in a “sting” operation by a British newspaper (The Times on Sunday) when he was caught on film admitting that Japan had paid for luxury hotel accommodation for him and provided aid money in exchange for votes on Japan’s behalf at the IWC. The newspaper also quoted the IWC Commissioner for Guinea, who admitted to receiving a spending allowance of $1000 a day from Japan during the IWC meeting and for meetings in Japan, and the Commissioner from Tanzania was quoted as saying prostitutes were provided to ministers and IWC government officials at IWC-related meetings in Japan (Sunday Times, 13 June 2010). So it was with a background of these shady dealings that the 2011 meeting began…

The new IWC chair was Herman Oosthuizen – the Commissioner for South Africa, and one-time member of the IWC Scientific Committee. At the SC, Oosthuizen had been a proponent of sustainable whalewatching as an alternative use of whales, and a proponent of cetacean conservation. He was also a chum and occasional drinking companion of the author of this article. Probably the most significant development during the Commission meeting was a proposal drafted by the UK (and submitted on behalf of all the EU parties) for a major overhaul of the IWC’s financial procedures. This included making audited financial statements available online and requiring fees for IWC membership to be paid by bank transfers from governments, rather than with bundles of cash (as has happened on occasion). The proposal also called for making IWC materials freely available on its website and for all decisions to be accurately and clearly presented in writing (Resolution 2011-1). The EU proposal had also called for greater representation of civil society, through presentations and participation by non-governmental organizations (NGOs), but protests from pro-whaling nations led to these clauses being dropped.

Concern was raised by the pro-conservation countries at the number of fin whales being taken in Iceland’s commercial whaling operations – in 2009 120 were taken (fin whales are listed as endangered by the IUCN Red List). The only non-controversial quota number suggested by the IWC SC was a maximum of 46 fin whales.

The activities of the NGO Sea Shepherd were also discussed, including their harassment of Japanese whaling vessels. The IWC passed a resolution stating that “the Commission and its Contracting Governments do not condone and in fact condemn any actions that are a risk to human life and property in relation to the activities of vessels at sea” (Resolution 2011-2).

Finally, pro-conservation countries from South and Central America (the Latin bloc) requested discussion and adoption of a South Atlantic sanctuary for whales. This sanctuary has been discussed at the IWC for more than 10 years, but the call at this meeting for a discussion and vote led to a temporary walk-out by many of the pro-whaling countries. Although discussion of this sanctuary was tabled for next year’s meeting (to be held in Panama), so much time was spent on debating the UK/EU resolution and the South Atlantic sanctuary that the Commission meeting ran out of time to discuss anything else. Important issues that were left unaddressed included the report of the Conservation Committee, which covered topics such as whale deaths from ship strikes and management of whalewatching. Hopefully, these issues will be addressed next year. But in the meantime, the UK/EU initiative may do something to clean up the IWC’s international image, although perhaps it’s too little, too late.

Dr. Chris Parsons is an associate professor and the undergraduate coordinator in the Department of Environmental Science and Policy. He is the marine section president and a governor of the Society for Conservation Biology, the program co-chair for the 2011 International Marine Conservation Congress and a national delegate to the Scientific and Conservation Committees of the International Whaling Commission
This year, while discussing Francisco Redi’s experiments with meat, a high school freshman in my Honors Biology class asked, “What purpose does a fly have?” I was taken aback and asked her to clarify the question. She was genuinely confused by the insects’ existence. After some probing, I discovered that she was really inquiring about the benefit of houseflies to mankind. This kind of anthropocentric thinking is rampant in society. I tried to calmly explain that insects were here long before us and that we share the environment, but this puzzled most of my students. To them, houseflies are a throw-away inconvenience in a plastic, lithium-powered world of throw-away conveniences. We see ourselves as solitary passengers on earth. This is our playground and everything else is for our benefit.

Humans evolved the ability to remember and to sort data into boxes. This is what has allowed us to survive and develop technologies, but this intellectual gift has been our downfall. Technological advances have allowed us to expand beyond our natural carrying capacities. They have allowed an organism with no camouflage, claws, razor-sharp teeth or any of the cool adaptations found in other mammals, to build machines, guns and computers that do work for us. However, recently, our memories and skills of deduction have failed us. We have forgotten what it was like 100, 200, 300 years ago before modern conveniences; so much so that Redi’s breakthrough experiment in 1668, proving that maggots do not spontaneously generate out of meat, seems laughable now. There are refrigerators; why would I worry about maggots? We have forgotten what it is like to be part of the food web rather than standing atop it with harpoon in hand. We have forgotten which plants we need because our food has been fortified for us. We have been introverted for so long that we have forgotten how to interact with nature.

Our technology has become the fly in the ointment and is making us forget how to interact with one another as well. We are so inundated with sound bites, flashing images and virtual friendships that we have forgotten what the real world is like. We rely on convenient, throw-away stories to go along with the throw-away world. Stories that entice throw-away comments with no face-to-face repercussions. This inhibits our interactions with nature. The more time spent building web-based relationships, the less time spent understanding real-world ones, not only with other humans, but with other organisms as well. The simplification of these relationships also polarizes our political views. Debates, in the digital age, consist of nothing more than a slew of catchphrases and finger pointing. Acceptance of such factless glimpses of real views leads the public to view the world as a series of flashing images and sound bites, detracting from in-depth, data driven, scientific understandings of the world.

We are not above the environment; we are a trapped in its web. The human environment is the natural environment. The further we put ourselves above the fragile systems that stabilize this planet, the more resources we will deplete and the harder we will crash. The remedy lies in early intervention: Both outdoor education and educating outdoors, even sitting in the sun to learn about mathematics or to feel the grass while you study American history, will go a long way. Reintroducing nature as a part of everyday life will rejuvenate and educate the youth.

Most students will not learn any life sciences after freshman or sophomore year in high school. This means the average U.S. citizen will discontinue the study of life at age 15. Teaching the value of nature by example and by experience will un-spontaneously generate lifelong learners. Teach this in conjunction with a heavy dose of media literacy and, maybe, people will grow to understand the intrinsic value of a fly, or a tree, or the entire web of life that sustains our habits.

- Sean R. Tracy is a professional educator working in Fairfax County Public Schools and a student of Environmental Science and Public Policy at GMU. He teaches Honors Biology and IB Environmental Systems and Societies in Falls Church, Va.
Green Happenings @ Mason

- On Oct. 19, the Sustainable Living Roadshow was welcomed to Mason. SLR’s educators and entertainers tour the U.S. in renewable fuel vehicles to set up eco-carnivals with interactive learning villages to educate the public on living sustainably.

- The Patriot Green Fund was established to finance projects proposed by students, faculty and staff with a high value in areas of sustainability. Processed by the Office of Sustainability, the first applications for funds were turned in on Oct. 1. For more information, visit http://green.gmu.edu/pgf/aboutpgf.html.

- The Ecological Inequalities and Interventions Conference in September examined the current and future impacts of ongoing, globalized environmental crises and possible sustainable solutions.

- The ESP booth at the Sally Ride Festival taught young girls and their parents about aquatic ecology, local issues and ways sustainable practices can help maintain our watersheds. The festival seeks to enhance the science education of girls and improve opportunities for the future women of science. (More on page 8.)

Graduate Column:

Sustainability & Hunting

By Lorelei Crerar,
GMU Ph.D. Candidate

The largest dictionary I know is the Merriam-Webster dictionary. Luckily for those of us with no place to house such an enormous tomb, all of that information is on-line (http://www.m-w.com). In order to continue the idea of sustainability for this issue, the first thing I did was to look up the word. Merriam-Webster states that this word means “capable of being sustained.” I have always hated definitions that use the root word within them. What does that really tell us? So I read further: “of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged <sustainable techniques> <sustainable agriculture>”. This definition seems better to me.

However, this was not the most interesting thing I turned up while perusing the Merriam-Webster site. Did you know that the word was first used around 1727? That was a long time ago and it is also a century near and dear to my heart. This was the century in which a young German, working for Peter I in Russia, made the only description of a living animal that is now known as Hydrodamalis gigas. In non-scientific terminology, the now extinct animal is called the Steller’s sea cow after the only person to ever describe the living animal for science.

Georg Wilhelm Steller was an amazing man. He was attached to the Second Kamchatka Expedition under Vitus Bering as a mineralogist. He was also Bering’s personal physician. Some researchers state that Steller had quite a temper and that he was difficult to get along with, while others state that this is just hearsay. I prefer to think of Steller as brilliant and constantly in motion. Steller, himself, describes his journey across Kamchatka in Russia after returning from the Second Kamchatka Expedition. This voyage incidentally claimed not only Bering’s life, but almost half of the remaining crew of the St. Peter as well. Steller was everywhere on that peninsula after his return. In winter and summer, he roved across the land, talking to people and collecting specimens. He was adventurous. He was dynamic. He also was a fan of sustainability.

I found it amazing when I read a document Steller sent
Community Engagement:

Encouraging young girls to consider careers in environmental science at the Sally Ride Festival

On Saturday, September 17, the Sally Ride Festival visited George Mason University. Sally Ride Science was founded by Dr. Sally Ride, best known as America’s first woman in space, to support young (5th-8th grade) girls’ interests in science. I hosted a booth and workshop at Sally Ride 2011, along with ESP undergraduate students. At the booth, we informed the visiting students about the formation and causes of low oxygen zones in the Chesapeake Bay and other marine ecosystems with an interactive display, explaining how sustainable practices and research can benefit the entire watershed. To add to the fun, students could win sea creature tattoos by playing a fishing game. At the workshop, we taught the students to identify aquatic invertebrates and fish, while educating them about the value of biodiversity. We turned a conference room into a fish lab with microscopes, trays with fish and shellfish and 20 future environmental scientists bustling around to identify the species.

Thanks to the help of Kate Hoefer, Natalia Ainsfield, Bridgette Barnhart, Lindsay Denny and Scott Downs, both the booth and the workshop were a great success.

Dr. Kim de Mutsert joined the faculty of the ESP Department in fall 2011. Her research interests include fish ecology in the marine, estuarine and freshwater environment.
The position of Fellow of Sustainability Studies (FoSS) was established in the Office of the Provost in 2009. ESP-affiliated Dr. Sharon deMonsabert served as the first fellow, followed by ESP professor Dr. Dann Sklarew since August 2010. Mandated to promote sustainability scholarship across Mason’s academic units, the FoSS has made great strides towards advancing sustainability in Mason’s curricula. Working alongside sustainability partners within Mason and the wider community, the FoSS has introduced a number of initiatives. For instance, these professors contributed advocacy and support for Mason’s new Energy and Sustainability Studies major, minors in renewable energy and in sustainability studies, and new graduate-level concentrations in Conservation Science and Policy (MS) and Energy and Sustainability (MAIS).

They also formulated creation of an inter-collegiate Sustainability Studies Advisory Council (SSAC). To date, six of Mason’s eleven top-level academic units have joined the SSAC – the College of Science, College of Humanities and Social Services, Volgenau School of Engineering, School of Public Policy, School of Management and College of Education and Human Development. Representatives from each unit help to advise the FoSS in promoting sustainability across the curriculum and through inter-collegiate scholarship.

In August 2010, Dr. Dann was also instrumental in Mason becoming a charter member of the Sustainability Tracking Assessment & Rating System (STARS) of the Association for the Advancement of Sustainability in Higher Education (AASHE). A year later, Mason was one of the first 40 schools in the country to attain AASHE’s STARS Silver sustainability designation. Evidence supporting Mason’s rating can be found on the STARS website at https://stars.aashe.org/institutions/george-mason-university-va/report/2011-08-09/.

Mason is also one of the Princeton’s Review “Green Colleges,” and is listed in the top 100 of Sierra’s ranking of the greenest schools in the United States - America’s Coolest Schools. Early this year, the FoSS and SSAC created a “green leaf” designation for credit courses that are either sustainability-focused or sustainability-related. The number of green leaf courses has since grown from 25 to 74. “Green Leaf” courses and academic programs are listed in the 2011-2012 course catalog and continuously updated on the sustainability studies website (http://sustainabilitystudies.gmu.edu/). Students majoring in green leaf academic programs are also eligible for an annual “Storm Sustainability Scholarship” award.

Other initiatives that Dr. Dann has been helping to co-organize include a record number of sustainability events during Mason’s Earth Week in April 2011; showcasing sustainability studies initiatives at Mason’s annual Innovations in Teaching & Learning conferences; and most recently the 6th Potomac Trash Summit at Arlington campus on October 19, 2011.

The FoSS has many stimulating sustainability events and activities planned for the remainder of academic year. Look forward to celebrating Earth Week 2012 - April 16 - 22, 2011 including a community fair at the Arlington Campus; innovating for sustainability showcase on the Fairfax campus; and a green careers event at the Prince William campus. You can find out about upcoming sustainability events at: http://green.gmu.edu/calendar.

There will be further work on propelling Mason’s sustainability studies curricula through research symposia, curricula workshops and introduction of new and revitalization of dormant green leaf courses. One such course is GGS307- Sustainable Development course, which will be offered in Spring 2012. (Taught by the FoSS’ first graduate...
GREENovation asked graduate students to submit their best environmental pics for our first photo contest. We received a lot of fantastic snapshots in three categories: 1) Animals, Plants and Fungi, 2) Ecosystems and 3) Human Dimensions of the Environment. The categories were meant to visualize the main areas of study within the Environmental Science and Policy Department.

Photo submissions were judged by area photographers and artists, as well as ESP faculty and students. Judging criteria included interpretation of the category, aesthetic value, photo quality and subject matter chosen. (Photos were required to include minimal to no photo editing.) Each student could submit up to three entries. Winners were chosen without knowledge of the photographer.

In each category, one to two first place winners and three honorable mention winners were chosen. First place winners will receive a prize from the Environmental Science and Policy Department.

Look for more chances to submit photos, art and other creative environmental works in future issues of GREENovation.
GREENovation Photo Contest:

Animals, Plants & Fungi

FIRST PLACE WINNERS

Seahorse in Deep Blue
By Neil Ransom
The empty dark-blue background reminds me of challenges facing seahorse populations throughout the world. Once common, seahorses are now endangered from overfishing for use in traditional medicines and habitat loss. Photo taken in New Orleans, Louisiana.

Reflection
By Whitney Denham
A green turtle swimming off the coast of Oahu, Hawaii.

Honorable Mentions

Binna Burra Moth
By Craig Beatty

Pelican Party
By Ryan Valdez

Bighorn Sheep in Jackson Hole
By Nicola Cowen
**GREENovation Photo Contest:**

**Ecosystems**

**FIRST PLACE WINNER**

*Grand Canyon*

By Brittany North

A sunset rainbow at Shoshonee Point on the Southern Rim of the Grand Canyon in 2010.

**Honorable Mentions**

*Inside the Great Blue Hole*

By Katheryn Patterson

*Serenity*

By Jessye Wojtusik

*Mangroves*

By Meredith Penthorn
GREENovation Photo Contest:

Human Dimensions of the Environment

FIRST PLACE WINNER

Forgotten Energy
By Whitney Denham
A wind farm on Big Island, Hawaii.

Honorable Mentions

Urban Safari
By Sarah Josway

Houses on Stilts
By Whitney Denham

Too Big to Win
By Sarah Josway
Hardly a day goes by without a news report about the state of the Chesapeake Bay, which has suffered from the effects of regional population growth, urbanization, excess nutrient run-off and overharvesting of its natural terrestrial and aquatic resources. Efforts to clean up or restore the Chesapeake Bay’s habitats to the Clean Water Act standard of “fishable and swimmable” show mixed results, despite a multitude of government and industry programs. Recent efforts to reinvigorate the Bay restoration process include the Clean Water Act Total Maximum Daily Load (TMDL) requirements for the Bay watershed states, as well as President Obama’s Executive Order 13508 directing federal agencies to coordinate federal restoration efforts.

**Citizen science and environmental stewardship**

Citizen science, or volunteer-based public participation in scientific projects, isn’t a new idea, and citizen scientists have played an important role in a variety of Chesapeake Bay restoration activities. Citizen science activities in the United States date back as early as the start of the National Audubon Society’s annual Christmas Bird Count in 1900. In the mid 1990s, researchers coined the term “citizen science” to reflect the growing interest of the general public to participate in scientist-driven projects. Citizen science refers to the participatory work of volunteers engaged as field assistants in scientific studies. The volunteers participate in scientific projects usually as a result of their interests in the environment and are not required to possess prior scientific training.

Citizen science volunteer organizations advance scientific knowledge by providing large quantities of research data at relatively low cost. These citizen scientist-collected data sets enable professional scientists to reduce research costs while increasing data collection efforts over a larger geographical scale. Citizen science data reliability can be achieved through volunteer training and the use of specific protocols to test the data, and the volunteer-collected data can be relied upon as equal to data collected by professionals.

Perhaps most importantly, citizen science organizations increase environmental stewardship by providing participants an opportunity to become a part of the scientific process. In particular, volunteers who participate in citizen science projects, such as water quality monitoring, have an overall positive impact on the total number of watershed activities, making citizen science an effective method to promote environmental protection of waterways and shape public debate and policies.

Examples of citizen science in action in the Chesapeake Bay watershed include many volunteer-based water quality monitoring projects. The organizations leading these projects routinely collect water quality samples to detect dissolved oxygen, salinity, temperature, nitrogen, phosphorus and turbidity at numerous locations within the Bay. Some of these organizations have state or federal agency quality assurance plans, enabling them to provide certified water quality data to state and federal reporting mechanisms.

**Citizen science research**

During the 2010-2011 academic year, I conducted a research project focusing on volunteer water quality

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Mason Events:

Youth Science Summit Brings High School Students to Mason

By Richard Friesner, WYSE Program Director

While most of their friends spent the summer piddling around town or working at a fast food restaurant, about 125 rising high school seniors from all over the country spent a week with us at Mason as part of the 2011 Washington Youth Summit on the Environment (http://wyse.gmu.edu). The students live and learn on the Fairfax campus and enjoy a number of trips into Washington, D.C., to meet with nationally known experts and perform hands-on activities centered on environmental science, conservation, sustainability, engineering, policy and law.

The students were treated to a private screening of the documentary “On Coal River” (http://oncoalriver.com/), hosted by director Adams Wood. After watching the film, the students spent an hour discussing the environmental concerns, policies and politics involved in the mountain top coal mining removal debate. Later in the week, the students participated in a simulation activity where they took on the roles of a variety of community members, government officials and convened a community meeting to discuss the potential for extending mountain top removal activities or reducing them.

George Mason University, along with its distinguished partners the National Geographic Society and the National Zoo, hosts the Washington Youth Summit on the Environment (WYSE) each summer. Highlights from the 2011 youth summit included visits to the Smithsonian National Zoo, the National Geographic Society’s headquarters and meetings with congressional representatives on Capitol Hill, as well as speakers from the Nature Conservancy, the Washington Post, the U.S. Coast Guard, the U.S. Geological Survey. Many government officials and Mason faculty, alumni and staff also participated. A full list can be found at: http://wyse.gmu.edu/speakersStaff.asp

The students also had the opportunity to tour the Washington National’s Baseball Park and learn about some of the innovative and sustainable building practices that went into making the park the first “green” Major League Baseball park in the country. The park has also earned the US Green Building Council’s LEED Silver rating (http://www.usgbc.org/ShowFile.aspx?DocumentID=5108).

The week was capped off by the 2011 Washington Youth Summit on the Environment Gala held at the Mason Inn, the first USGBC LEED Gold hotel in Virginia (http://news.gmu.edu/articles/5362).

This summer, the 2011 Washington Youth Summit on the Environment showcased many of the excellent opportunities to study the environment at George Mason University. We were very impressed by the excellent aptitude of the students and level at which they discussed a variety of environmental and sustainability topics, from energy to marine mammal conservations and everything in between. As we prepare for the 2012 summit in June, we look forward to an even more exciting summit.

- For more information of the Washington Youth Summit on the Environment and how you can participate in 2012, please contact Program Director Richard Friesner at rfriesne@gmu.edu
Polar bears have learned to hunt ringed seals under the sea ice by building a snow wall next to the seal’s breathing hole and hiding behind it. When an unsuspecting seal emerges for air, the polar bear leaps from behind the wall and, wrote Frans Van de Velde, “paws, claws, snout, and teeth—to give a blow that is so rapid that the seal has hardly a chance of getting away.” Not surprising, Inuit hunters living in the same region use a tactic nearly identical to the polar bears’ when hunting ringed seals. They carefully select an active breathing hole, build a snow blind to hide behind and patiently wait for a seal to emerge. Some have suggested early Inuit ancestors may have learned this hunting technique by observing and mimicking polar bears. A few accounts have been recorded of elders teaching young hunters to mimic the polar bear when hunting ringed seals.

The Inuit, and many other placed-based or indigenous peoples who live off the land, see nature as an encyclopedia of useful knowledge that can be adapted to fit their needs. In the same spirit as indigenous people the world over, scientists and engineers are now looking toward nature for inspiration to solve social problems. The emerging field of biomimicry, also known as bionics, biomimetics or bio-inspiration (from the Greek bios, or life, and mimikos, or imitation), attempts to translate nature’s processes and structure into solutions to contemporary human problems. Biomimetic research is more than just a way for biologists and engineers to turn natural phenomenon into machines -- it is a practice that encourages us to regain a respect for natural processes and learn to live more in harmony with all life on our planet.

Central to the practice of biomimicry is the knowledge that the biodiversity now present on the earth has been evolving on our planet for 3.8 billion years. The unique adaptations that have developed over the ages represent systems and structures far exceeding humankind’s most advanced technologies. Dolphins, for example, use echolocation to identify distance, shape, size and the internal structure of objects at resolution far surpassing any artificial sonar technology, as described in the book Bulletproof Feathers: How Science Uses Nature’s Secrets to Design Cutting-Edge Technology. Biomimicry scientists and engineers believe these amazing evolutionary adaptations can be observed then translated into beneficial technologies. They also see nature as an encyclopedia of solutions to modern-day problems.

One of the most exciting opportunities for the use of biomimicry research is in the field of sustainability. Unlike our present technologies and systems, which use nonrenewable resources, create hazardous byproducts and decrease biodiversity, nature’s approach is efficient, nontoxic and prolific.

The BBC reported the world population surpassed 7 billion this October, reminding us of the many global challenges facing our planet. By applying principles learned from nature, biomimicry has the potential to radically redesign our current global systems into ones more in tune with ecological principles of sustainability, conservation and diversity. Current biomimetic research is changing the sustainability landscape through efficient form, integrated systems and beneficial building methods.

One example comes from humpback whales. When it comes to shape and form, evolution favors efficiency, aerodynamics and simplicity. The bumps on humpback whale pectoral flippers, called leading edge turbercles, have been
found to increase lift by 50 percent, decrease stall by 30 percent and drastically reduce drag, as reported by F.E. Fish et al in a 2008 edition of the journal *Integrative and Comparative Biology*. Humpback whales migrate up to 25,000 kilometers a year and leading edge tubercles make them more efficient swimmers by increasing the aerodynamics of the whale’s pectoral flippers. After discovering the amazing properties of these bumps, Dr. Fish, director of the Liquid Life Lab at West Chester University, started the company WhalePower to develop and market fan and propulsion blades designed with this whale-inspired technology. WhalePower blades outperform traditional blades in every way and can easily be made to retrofit existing systems like windmills, drastically improving their performance. Scientists are now exploring how to apply this design to improve efficiency and performance of airplanes and other applications.

Beyond looking at individual animals and applying their adaptations to specific problems, scientists are also examining entire systems for clues on how to make human-made systems more sustainable. The prairie is a robust ecological system, which encourages biodiversity and builds fertile soil. Wes Jackson and the scientists at the Land Institute in Kansas are reinventing our agricultural system to act like a prairie by crossbreeding major agricultural crops, such as corn, sorghum, sunflower and wheat with their perennial ancestors. This will create new varieties of crops that only need to be planted every five years, produce annual yields as high as modern varieties and require little or no maintenance, according to the Land Institute. These new varieties will be planted together in the same field so they can grow together, like a prairie — robust, diverse, productive and balanced. A world farming system designed to mimic a prairie would eliminate the need for artificial fertilizers and pesticides, reduce the cost of farming and increase global food security. “Prairie” farming may be our only hope to feed our growing population.

Cement, the most important building material of our time, requires huge amounts of heat and energy to produce. For every ton of cement manufactured, one ton of CO$_2$ greenhouse gas is released into the atmosphere. The company Calera has developed a procedure to manufacture cement in a way that mimics the process ocean corals use to make their skeletons. Coral and cement are essentially the same material, calcium carbonate, and Calera has developed a method which takes CO$_2$-rich flue gas from coal-fired power plants and bubbles it through seawater. The process requires very little energy, removes 90 percent of the CO$_2$ from the flue gas and creates approximately one ton of cement for every two tons of CO$_2$ that is captured. If their new “coral” cement technology can be implemented on a large scale, it has the power to drastically reduce global CO$_2$ emissions and possibly slow the rate of global climate change.

Biomimicry research can help us become more sustainable by developing technologies and systems based on the billions of years that life has been evolving on our planet. As biology and engineering students take more interest in exploring and describing the natural world around them, more information will become available for biomimetic research. Additionally, there is a great need for increased conservation efforts to help ensure we do not lose plant and animal species that may hold the key to future technologies and systems.

Biomimetic research also helps to remind us that we can never expect to create a sustainable system that has the drive of endless consumption at its core. In nature, there are no throwaway societies, consumer cultures or one percent. If we want to live in a more sustainable world, we cannot expect biomimicry and other technologies to solve our environmental and population problems unless we move away from an economic and political system founded on the exploitation of people and nature, over-consumption of natural resources and the creation of toxic wastes. When we carefully observe and respect natural processes, we will not only learn how to apply nature’s adaptations to our problems, but see how the problems we have created are harming beautiful and complex creatures who have so much to teach us about living well. We will want to become more like a prairie—resilient, diverse, enriching and adaptable.

- Neil Ransom is a second year PhD student in the Environmental Science and Policy program. He is interested in studying the role small-scale technologies, Do-It-Yourself organizations and tinkering traditions can play in increasing adaptive capacity to climate change. He plans to do his research in Kenya, where he grew up as a child.
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to the Scientific Academy in Russia that recommended a halt on the practice of hunting the sea cows. This document was written in 1742 when Steller and the small remainder of the crew of the St. Peter returned from the winter they spent shipwrecked on Bering Island. The two most amazing things about this are that anyone survived a shipwreck in the North Pacific in the winter on a deserted island and that, at this time in history, Steller recognized the need to preserve these animals.

When Steller found this population, there were less than 1500 animals remaining. Calculations have been made using the geography of the island and the availability of freshwater sources for the animals to drink. This figure is likely a bit low but probably close to accurate. Keep the date in mind -- it was 1742. In the ensuing decades, Russian fur traders moved across the North Pacific hunting sea otters for their pelts. During that time, they made great use of the sea cows. These animals were very docile and fairly easy to hunt. They were also over 30 feet long and extremely tasty.

In order for a population to be sustainable, whether or not it is being hunted, it must not be depleted or permanently damaged. Steller could not see sustainability happening if the sea cows were hunted in large numbers. Even in 1742, Steller was thinking like a modern scientist. He was thinking of preserving a remnant population of a unique animal. What would have happened if Steller had lived longer than 1746? We will never know. Perhaps he would have championed the sea cow and stopped the hunting. Perhaps not. Sea cows were hunted to extinction in 1768. Sustainable? I think not.

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graduate sustainability assistant, GGS 307 will explore the concepts, applications and tools for analysis and decision-making in support of environmentally sustainable development and will include topics such as the Millennium Development Goals (MDGs), The Earth Charter Initiative and Sustainable development issues leading up to Rio+20 in June 2012.) Dr. Dann is also a faculty member of the student-organized Patriot Green Fund (PGF) Committee. The PGF is an annual fund of $100,000 devoted to making Mason’s campuses more sustainable and promoting sustainability research, with strong emphasis on student participation. Preliminary applications to the PGF closes April 1 and October 16 each year (see http://pgf.gmu.edu for additional information).

- Allison Richards is a new graduate student in Environmental Science and Public Policy. She hails from the island of Jamaica West Indies and studied as a graduate student in geography at Southern Illinois University Carbondale. She received her undergraduate degree at the University of the West Indies Mona. Her research interests include sustainable development and water resources management and planning.

- Lorelei Crerar is a Ph.D. candidate at GMU. Her research interests focus on sirenian population genetics.

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Graduate Essay:

Sustainable Tourism in the National Parks

By Meredith Penthorn,
GMU Graduate Student

The National Parks of the United States invoke images of fathomless canyons, pristine old-growth forests and an astonishing array of novelty gift shops. Originally set aside in the late 19th century to preserve some of the nation’s most splendid natural features and wildlife, Yellowstone and other fledgling parks were an escape from the drudgery and choking smog of city life. Railroad expansion and subsequent hotel establishment facilitated tourism from the east coast, and advertisements touted spectacular views, geologic formations and, unfortunately, opportunities to feed bears. Today, tourists from myriad countries come to enjoy national parks in all corners of the United States. According to the National Park Service (NPS) website, national parks log about 280 million visitors a year that come largely for recreational purposes, such as sightseeing and ecotourism.

While the parks are meant to be attractions, there may be a dark side to their role as a vacation destination. Tourism for the sake of appreciating nature seems superficially innocuous, if not beneficial. It allows people to rediscover their romantic roots and learn about some of the country’s most magnificent natural features. Yet at what point does it cross the line to become detrimental, and even risk changing the aesthetic dynamic of the park itself? Two sister canyons in Zion National Park are good examples. In the first, tourism flourished, increasing development and driving natural predators away. As a result, the canyon became devoid of the rare birds, butterflies and plants that abounded in its undeveloped twin, as outline in William Stolzenburg’s book Where the Wild Things Were: Life, Death, and Ecological Wreckage in a Land of Vanishing Predators (Bloomsbury, 2008). Perhaps a more well-known example is the wolf extirpation near Grand Canyon National Park, so that visitors would be able to see large, free-ranging herds of deer. This naturally led to an explosion in ungulate populations that devastated vegetation communities and the animals themselves.

If consumption of the national parks as a resource were to continue unbridled, they could enter into a dangerous cycle of development and degradation approaching the standard model of human settlement (complete with buildings, utilities and roads). Increased tourism, both national and international, would increase the demand for accommodations. This in turn would put pressure on lawmakers to open more of the parks to development, which would increase the capacity for tourists. The NPS is charged with managing these areas and maintaining a balance between economic growth and environmental protection, but external pressure from multiple stakeholders on all sides of the political arena can certainly complicate this aim.

Garrett Hardin, in his iconic paper “The Tragedy of the Commons,” put forth the notion that national parks could be privatized to maintain their natural integrity. Even the most eco-phobic American would find this idea absurd, as the parks are as much a symbol of national heritage as the Statue of Liberty. However, restricting access to these magnificent places may become the only solution to preserving their beauty for future generations, and perhaps more importantly, for safeguarding plant and animal communities that rely on the parks’ protection to survive. Imposing monetary restrictions on national parks would certainly reduce usage of this public good, but it seems to violate the spirit of open access to all. Rather than restrict tourism through the use of park passes and elevated fees, it may be more sensible to limit park exploitation.
monitoring organizations in which efforts could complement the federal government’s efforts to restore the Bay. While conducting research, I compiled data on the organization’s volunteer training methods, types of water quality measurements collected and the use of the volunteer-collected data for reporting purposes.

The results affirmed the importance of volunteer citizen scientists in raising overall watershed stewardship. For example, in the interviews I conducted with volunteer water quality monitoring organizations in the Bay watershed, many of the interviewees stated their volunteer efforts made a difference in raising environmental awareness and community participation in local watershed advocacy in a variety of areas.

Some volunteer organizations lobbied local government officials to improve local sewage treatment facilities as a result of data collected showing an increased presence of E. coli downstream of a wastewater treatment plant. Other volunteer water quality monitors saw their role within the community as “watershed ambassadors” to promote the restoration of clean waterways and the Bay. Some organizations established partnerships with local colleges and universities for laboratory support to process water samples -- a win-win for the volunteer organizations and the students performing the laboratory analysis.

Next steps

Advances in cost-effective technology for field-level monitoring may help volunteer water quality monitoring organizations collect additional types of environmental data. Marcellus shale mining in Pennsylvania is one example of an emerging area for citizen science-based monitoring work in the Bay. Other emerging areas include endocrine disruptor monitoring, plankton analysis, real-time nutrient monitoring and site-specific stormwater runoff analysis.

Citizen science water quality monitoring programs complement many of the federal Bay restoration goals, specifically the citizen stewardship goals. These monitoring programs also align with several federal agency-specific goals and strategies, such as the National Park Service’s efforts to expand master watershed programs and build partnerships along national trails, the U.S. Forest Service’s green school initiatives and the National Oceanic and Atmospheric Administration’s initiative to increase environmental literacy in primary and secondary school systems through the B-WET program (supported in part by GMU’s Environmental Research & Education Center, PEREC).

Citizen science has shown its worth in increasing environmental stewardship within communities while enabling interested volunteers to participate in scientist studies, including ongoing studies in the Chesapeake Bay region. As the region moves forward with its Chesapeake Bay TMDL and federal Executive Order goals and requirements, citizen scientists should play an integral part in the process.

- Michelle Ryan is an Environmental Science and Policy doctoral student in Dr. Dann Sklarew’s lab, pursuing research into the Chesapeake Bay watershed restoration efforts and the role of citizen science. In her spare time, she volunteers as a water quality monitor for Arlington County, Va., and is active in the Northern Virginia area in the Master Naturalist Program, a Commonwealth-wide volunteer program helping to conserve Virginia’s natural resources.

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In addition to existing regulations, the NPS could discourage certain manners of accessing natural features and wildlife hotspots. Not only is it far more rewarding to explore nature on foot or by kayak than through car or tour bus windows, it is more ecologically sound. The slower pace of non-motorized transportation allows the visitor to witness the full spectrum of montane wildflowers or discern the subtle movements of pronghorn antelope amid a tallgrass savannah. Vehicles such as airboats not only disturb wildlife with their noise level, but release emissions into the air and water. Many would agree that off-roading across a prairie is not exactly conducive to its long-term preservation.

Alternatively, the NPS could offer credits toward the opportunity to visit parks. This would function as a reciprocal relationship between the NPS and private citizens in which volunteering to restore or enhance local parks or reserves would earn a certain amount of credit. Such a program would serve the dual purpose of permitting groups to visit the parks on a budget and instilling in people an idea of what is required to maintain these natural treasures.

Everyone should be able to experience the wonders of the National Parks. Yet in order for them to persist for future generations, tourism must adapt to sustainable use. The parks were intended to be natural, not metropolitan.

- Meredith Penthorn is a graduate student in environmental science and policy at GMU. A graduate of University of Wisconsin-Madison, she enjoys outdoor activities, studying wildlife and spending time with her cockatiel.
In the Cap Haitien area, on Haiti’s northern shore, small glimpses of a former paradise can be caught amidst mounds of litter and urban slums. Eyes unfocused on poverty and illness can see limited beaches, scattered palm-trees and tiny mountainside forests. These small surprises are understandably difficult to concentrate on when there are so many unsettling distractions to a newcomer, but they may be the key to convincing outsiders there is hope in Haiti.

“When I was 18, I remember, it was so beautiful,” Gerda Birchell, now in her 70s, thoughtfully explained in a 2010 interview. “People came from all over to visit Haiti. Cruise ships came every day, and celebrities visited. The famous people, they had private residences here and even got married and had their honeymoons here.” Birchell now lives in Florida and is a certified nursing assistant and educator. She travels back to Haiti to assist those in need. “It’s very, very, very sad now. This is not the Haiti I knew.”

According to Columbia University’s Earth Institute, Haiti lost 98 percent of its forests to unsustainable land-use practices, including total clear-cutting for charcoal production. The 1988 Environmental Profile of Haiti, funded by USAID, asserted that Haiti’s environmental degradation will continue to be a major cause of political controversy, social anxiety, violent interactions and chronic poverty. A 2010 USAID Market Analysis of Haiti stated, “About 85 percent Haiti’s watersheds are severely degraded, resulting in soil erosion, loss of fertility and reduction of water quantity and quality.” Brutal dictatorships, beginning in 1957 with Francois Duvalier, propelled Haiti’s environmental destruction and political instability. Decades since that time have seen a cycle of deteriorating political, public health, economic and environmental issues.

“Haitians should not be identified with the problems of the country,” Dr. Maklin Eugene said in a 2010 interview. Eugene, a physician in Cap Haitien, has been trying to improve conditions from the bottom up by helping to provide much-needed medical care, as well as small business and education opportunities. “Most Haitians work hard and try to help each other the best they can. It’s difficult without any real government help or structure, but they want so badly to make Haiti a better place. They are willing to do what it takes, but do not have the opportunity to do it.”

At a recent international conservation conference, the representatives of ten organizations conducting projects in the Caribbean were asked about the possibility of doing works in Haiti to bring much-needed aid to the people there. Responses included the country is considered “too far gone,” “too degraded,” “doomed,” “beyond help,” “too corrupt” and “completely unfixable.” Resources for conservation are limited, and priority is logically given to areas in which the effects will hopefully last. This could mean a bleak future for hopeful Haitians, whose struggles are intimately tied to an unhealthy environment.

Columbia University, however, sees value in attempting to restore Haiti’s watersheds. Partnering with the United Nations Environment Programme, the University’s Earth Institute has several initiatives and projects in place to rejuvenate Haiti’s environment through sustainable development. USAID has also helped to fund projects to sustainably restore watersheds and instill sustainable island agriculture by the Haitian NGO Organization for the Rehabilitation of the Environment (ORE). The 2010 earthquake, however, dampened funding for Columbia University’s and ORE’s projects, while leaving Haiti dilapidated. “But we can’t lose hope,” Eugene asserted. “Public education is the key. We can teach Haitians how to make their environment better. They just need a little help and resources, and they will succeed.”

“They just need to be shown, and they will rise to help,” Birchell confidently stated. “It will be hard work, and it will long work, but I know, in my heart, we will recover. … I will get my Haiti back.”

**Samantha Oester is a former journalist, editor and policy analyst, now a student of Environmental Science and Policy at GMU.**