WHEN LIFE GIVES YOU CATTAILS, MAKE BIOFUEL

Looking over Cheboygan Marsh, the untrained eye would see the expanse of reedy green and think, “Yep, that’s a marsh.” Loyola University professor and UMBS researcher Nancy Tuchman sees a perfect storm of man-made conditions that threaten the marsh’s very existence. But she also sees potential, not only to revive the marsh, but to harvest a fuel source at the same time. “Removing invasive plants from these wetlands allows native biodiversity to recover, and using the harvested biomass for energy reduces fossil fuel use and is environmentally sustainable,” she says.

Several invasive plant species are changing the very character of Great Lakes marshes. The infamous Phragmites australis is to blame, as is reed canary grass (Phalaris arundinacea). But Tuchman’s group has focused its studies on two prominent cattail species, the invasive Typha angustifolia and the native-invasive hybrid, Typha x glauca (hereafter, Typha).

“A combination of physiological and structural advantages make Typha a superior competitor in degraded Great Lakes’ wetlands,” explains Shane Lishawa, a Loyola Research Associate on Tuchman’s team. Typha foliage is taller and denser than native species, so it shades them out. Its dead leaves create a thick litter layer that further excludes native seed stock. It spreads aggressively via underground rhizomes. And it thrives on two human modifications of its environment: altered wetland hydrology and elevated nitrogen levels from fertilizer runoff.

In addition to Tuchman and Lishawa, the research group, a.k.a. “Team Typha,” includes Oregon State University Assistant Professor and UMBS instructor Dennis Albert, and DePaul Assistant Professor Beth Lawrence. They have been investigating the invasion dynamics and ecological impacts of invasive Typha on upper Great Lakes coastal wetlands since 2002. Through controlled and field studies they have documented Typha’s insidious attributes. They have also observed that Typha’s dominance diminishes biodiversity.

Because humans tend not to spend time in wetlands, it is easy to dismiss them as inconsequential. Albert, a wetlands ecologist, counters that view. “Great Lakes marshes may be relatively small ecosystems in terms of size, but...”

2011 REU Student Published in Ornithology Journal

“I spent a lot of early mornings alone in the woods with a microphone the size of my arm,” is how Christopher Crawford describes the less (or more?) glamorous side of his UMBS Research Experiences for Undergraduates (REU) work. He and his REU mentor, St. Mary’s College of Maryland professor Jordan Price, had their research published in the Wilson Journal of Ornithology this fall.

Crawford studied the singing behavior of the pine warbler (Setophaga pinus) during the

see REU p. 7
As you know, the Biological Station hosts research conducted by scientists from institutions world-wide (nearly 50 institutions during the past two summer field seasons), as well as the University of Michigan. Reasons are many, including 1) excellent laboratories and valuable field experiments, 2) access to diverse habitats, 3) valuable long-term data sets and information collected from across the Upper Great Lakes region, and 4) unique opportunities for collaborating that cut across traditional scientific disciplines. These combine to create a unique living and learning environment focused on improving understanding of healthy biological systems.

As sustainability emerges as a framework for planning a viable future for humans and life on our planet, it is critical to keep in mind that the sustaining of human well-being has ecological and scientific, as well as economic, political and cultural components. Our focus at the Biological Station has always been and will continue to be on science. However, recognition that improved scientific understanding of environmental systems is required for advancing other dimensions of sustainability elevates the importance of past, present and future work at our field station.

What can we do to ensure that the important science and training programs at the Biological Station continue to enrich our understanding of environmental systems? The most obvious answer is to continue finding ways to develop our facilities and infrastructure, ensure access to important habitats, provide data resources, and, most importantly, provide students opportunities to study and conduct on-site research with world-class teaching faculty and researchers.

All of this requires funding from diverse sources. The University of Michigan, government science agencies (such as the National Science Foundation, the US Department of Energy, the US Forest Service, and many others), foundations and many individual donors have demonstrated that they appreciate the importance of bringing students and experienced researchers together to focus on field studies and the interactions of humans, land, air and water that underlie environmental sustainability.

As we enter into the next University of Michigan-wide development campaign, it is important that those of us with interests in the Biological Station be engaged in this important effort. Donor support has implications and benefits that extend far beyond individual or group contributions. Past donor support has been critical in providing resources described above that benefit our students, faculty, and researchers. Importantly, past donations have provided important leveraging opportunities that have led to major research awards from science funding agencies and foundations.

There is no question that donor support will continue to increase opportunities for obtaining external support to develop programs enabling teams of students and researchers to conduct the field-based environmental research focused on science needed for moving our Great Lakes region and our world in a sustainable direction. We invite you all to participate in this important effort.

Thank you!
Facilities Updates

- **Burial of camp power lines** continues. This fall, U-M electricians are rerouting East State Street and A Street lines underground. This is the third phase of a long-term LSA Dean’s Office-funded project to free camp of overhead electrical wires. The Station is especially grateful to LSA Facilities Manager Bill Weber for his support on this project.
- **Bob Vande Kopple installed a fiber optic line to Hilltop housing.** Previously, Hilltop was connected to the campus network via point-to-point radios.

**Station News**

**Summer Science Structures in South Fishtail Bay**

A second structure joined our monitoring buoy in South Fishtail Bay this summer. It was a tower, albeit a short one, that held equipment to monitor energy, water vapor and CO₂ exchange at the lake’s surface.

The Ohio State University professor Gil Bohrer, who is one of the UMBS FASET* project researchers, says they installed the lake tower to see whether Douglas Lake provides an important contribution to the carbon uptake of the region.

The FASET gas tower monitors the solar radiation and heat budgets of the forest, as well as CO₂ and water vapor respired by the forest. The FASET experiment focuses on understanding the CO₂ uptake by the ecosystem in Northern Michigan, and because small inland lakes such as Douglas Lake are an important component of the ecosystem, the researchers wanted to evaluate the contribution of such lakes to the total ecosystem CO₂ and water vapor exchange.

The tower deployment was seasonal and it was removed before the winter. Bohrer has not finished analyzing the summer’s data yet, but does expect to find Douglas Lake an important carbon sink.

*Forest Accellerated Succession Experiment

**VOSS BEQUEST**

In early October the Station received notice that Dr. Edward G. Voss, who died in February, 2012, left a major estate gift to UMBS. Director Nadelhoffer said, “Dr. Voss’ legacy was enormous: his teaching at our field station, the students he mentored and inspired, his classic three-volume work describing Michigan flora, and his entomological work. We were truly fortunate that he chose to do much of his work at the Biological Station, first as a student, then, while a professor at the U-M, as a researcher and course instructor. Clearly the Station was as important to him as he was to us.”

Voss specified that his gift should be placed in an endowment, the proceeds of which can be spent at the discretion of the Director in support of Biological Station programs. “Dr. Voss’ generous and unrestricted bequest is the type of gift that is extremely beneficial,” said Nadelhoffer. “Its flexibility ensures that we will be able to use it efficiently and effectively, even as circumstances change into the future.”
Ninety-two years after the first bathymetric survey of Douglas Lake, very little has changed under its surface. We know this because of the University of Michigan’s Department of Surveying and Geodesy’s 1921-1922 survey of Douglas Lake, and a more recent survey by UMBS researcher, Dr. Guy Meadows.

Over the course of two summers, Camp Davis surveying crews mapped the bathymetry of Douglas Lake in great detail. Using little more than a weighted rope, a boat and a desire to leave the bugs at the shoreline, students sounded and recorded the lake’s depths.

Minor alterations were made in 1934 to correct and supplement the original survey. For the next 74 years, this survey of the lake’s depth served as a valuable resource for the Biological Station and the surrounding community.

In 2008, Meadows, then faculty in Atmospheric, Oceanic, and Space Sciences at the University of Michigan’s College of Engineering, revisited the task. Using a small coastal survey vessel with on-board precision acoustic depth sounding and differential Global Positioning System (GPS) instrumentation, Meadows remapped Douglas Lake’s bathymetry.

With such sophisticated equipment and techniques one would assume a significantly superior product. In many ways it is. There is fine-grain detail with respect to the specific shape of the kettle depressions. And the data is stored in digital format that allows for additional analysis, like the calculation of lake volume.

Yet it is amazing how similar the two bathymetry maps are. With a row boat and a long piece of rope, one could replicate the product of 21st century technology and years of expertise in its use.

Visit the UMBS Research Gateway to see a comparison between the two data sets and analysis of what changed between the two surveys: http://umbs.lsa.umich.edu/research/

Douglas Lake Bathymetric Map

Top view

Side view

DEPTH (in feet)

- 0-13
- 13-26
- 26-43
- 43-59
- 59-83

GIS image by Jason Tallant
Data source: Meadows 2008 Bathymetric Survey
After a several-year hiatus, late summer mini-courses are back, August 20-24. We are offering two old favorites, Art in Nature and Fungi, and one new course, Great Lakes Oceanography.

Retired NOAA scientist Gary Fahnenstiel will teach Oceanography. The class will combine time on Douglas Lake to learn techniques, and time on Lake Huron and a NOAA Research Vessel.

We heard the clamor for Marilynn Smith to reprise her Fungi course. Fortunately, she was game to employ her rain dance again next summer to coax forth all the basidiocarps northern Michigan has to offer. Whether the weather’s wet or dry, students in this class will be fascinated by the variety of forms our dear decomposers take.

Ann Singsaas’s Art in Nature class will again offer beginners and advanced amateurs alike the opportunity to learn new techniques and refine old ones. A late summer’s pallet of colors and field sites around the Station property are guaranteed to provide inspiration.

Birds of Northern Michigan fans, fear not. We will still offer this popular class in the spring (May 28-June 1), with Mary Whitmore and Bob Hess leading the field trips.

Mini-course registration will open in late February.

### 2014 Mini-Courses

**Spring: May 28-June 1**

Birds of Northern Michigan

**Late Summer: August 20-24**

Art in Nature

Fungi

Great Lakes Oceanography
In Memorium
Camp Nurse Marie Boda
by Mark Paddock

Marie Boda left this life on October 7, 2013 at age 88. She was the Biological Station nurse from the mid-1970s to the mid-1980s. We knew her as a quiet, professional, caring, and utterly dependable person who greeted you with a warm smile and great empathy. She did her job well and was important to those who were ill, hurt, or needed her counsel.

She was an extraordinarily good person considered by her community as a “Saint,” an “Angel,” and full of “Grace.” I do not exaggerate; these are just some of the descriptions I have read and heard about Marie when she was alive and since her death.

Marie was 100% Odawa, an active member of the Little Traverse Tribe, and deeply involved with the Indian Education Program, especially with young people. Marie had a deep Catholic faith and played organ for years in her nearby St. Clements Church. This church was the scene of a Funeral Mass and Odawa Funeral ceremony held for Marie on October 12.

Mark Paddock was UMBS Associate Director from 1972-1991.

Cattails, from front page

their importance to fish, migratory birds and our water quality is enormous.”

There is no silver bullet to address Typha invasion. However, Team Typha has found immediate and potential long-term ecosystem improvement possible by simple removal of the invasive Typha. Perhaps “simple” isn’t the best word to use. Removing Typha is hard work.

On a steamy July morning this past summer, Lishawa was searching for motivation to take the team into the marsh. “It’s always more humid in the marsh, and the [tall] plants deaden any breeze we might get.”

When removing invasive Typha the team uses several different treatments. The most labor-intensive involves digging down below the water level to the plant’s roots and removing not only the plant, but also the underground rhizomes by which it spreads. These rhizomes can be meters long. Other removal methods the researchers have used include mowing (cutting and leaving biomass on marsh surface), and aboveground harvest (cutting stems below standing water levels, but leaving the rhizomes). In every case, the treatments dramatically reduced (54-88%) Typha coverage in the following summer. Belowground harvest was
particularly effective, reducing cover by 82-99% of pre-treatment values one year later.

Team *Typha*’s first summer of manual cattail removal was in 2011. Lishawa says that preliminary analysis of 2013 data indicates there is “greater diversity and dominance of native plants at all sites two years later.” The team suspects that the increase in species diversity comes from deeper penetration of sunlight into the soil surface, triggering native seed germination.

Other factors influence how easy or hard it is to reverse a *Typha* invasion. Younger (<20 years since *Typha* establishment) stands have more robust native plant populations and seed banks from which to regrow plants. Also sites with lower water levels – a condition predicted to be increasingly common in the Great Lakes – are easier for native seedstock to recolonize.

The idea to explore bioenergy came from a series of conversations within the group. “It has the potential to address our loss of biodiversity in these important ecosystems, while simultaneously providing a renewable energy fuel source,” says Tuchman.

The team has explored two mechanisms for bioenergy production. Anaerobic digestion decomposes the harvested *Typha* without oxygen present. The reaction produces methane, which can be burned to produce electricity and heat. In pelletizing, dead plant matter is ground and compressed into small, combustible pellets for home or power plant use.

Although both processes were promising in preliminary testing, anaerobic digestion worked better with some of the other invasive wetland plants than with *Typha*. And not many digestion units presently exist in the U.S. These factors may point to pelletizing as the way to ultimately dispose of harvested cattails.

Team *Typha* is poised to apply its cattail removal and bioenergy research on a large scale. They are waiting to hear on a funding proposal that would support restoration efforts in 300 acres of Great Lakes coastal wetlands, including Cheboygan Marsh.

Look for updates on this project on the UMBS website.
The University of Michigan will officially launch its next fundraising campaign, “Victors for Michigan,” on November 8, 2013. The previous “Michigan Difference” campaign ended in 2008. It raised $3.2 billion and was the largest ever by a public university at that time. University officials are promising the new campaign goal will ambitiously exceed the last one. We hope you will campaign partner and help the Biological Station engage more students in environmental field studies focused on advancing understanding of natural systems.

The campaign has three major priorities: Student Support, Experiential Learning, and Global Problem Solving. These translate to UMBS as follows:

Student Financial Support

The Biological Station has long made student support a top goal. The alumni, faculty and friends who have created endowed funds are already changing students’ lives by helping them attend the Biological Station. We look forward to additional leadership in this area, especially as we address the often prohibitive costs to out-of-state students who want to attend UMBS.

Engagement Beyond the Classroom

The University, and higher education in general, are noticing the value of field-based education. The Biological Station has been offering this opportunity for over a hundred years. We now need to bring the best of the Station’s educational framework — exemplary teaching faculty, state-of-the art research facilities, and access to both representative and unique habitats of the Great Lakes region — into the 21st Century. This includes updating and creating infrastructure that is environmentally sustainable, and protecting sensitive lands and habitats.

Collaborating on the World’s Most Challenging Problems

UMBS researchers are already documenting species and ecological change in the Great Lakes as our climate changes around us. U-M wants to harness the talent and diversity of its researchers to create bold new ideas. At the Biological Station, this means even more support for projects that cross disciplinary boundaries and help address the climate crisis.

We invite you to become a Victor for Michigan with us.