



**GREAT LAKES RESEARCH CONSORTIUM**  
**19<sup>th</sup> Annual Student Faculty Conference 2009**

**March 13-14, 2009**

SUNY College of Environmental Science and Forestry  
Syracuse, NY



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# **19<sup>th</sup> Annual Student/Faculty Conference**

**March 13-14, 2009**

**Program & Abstracts**

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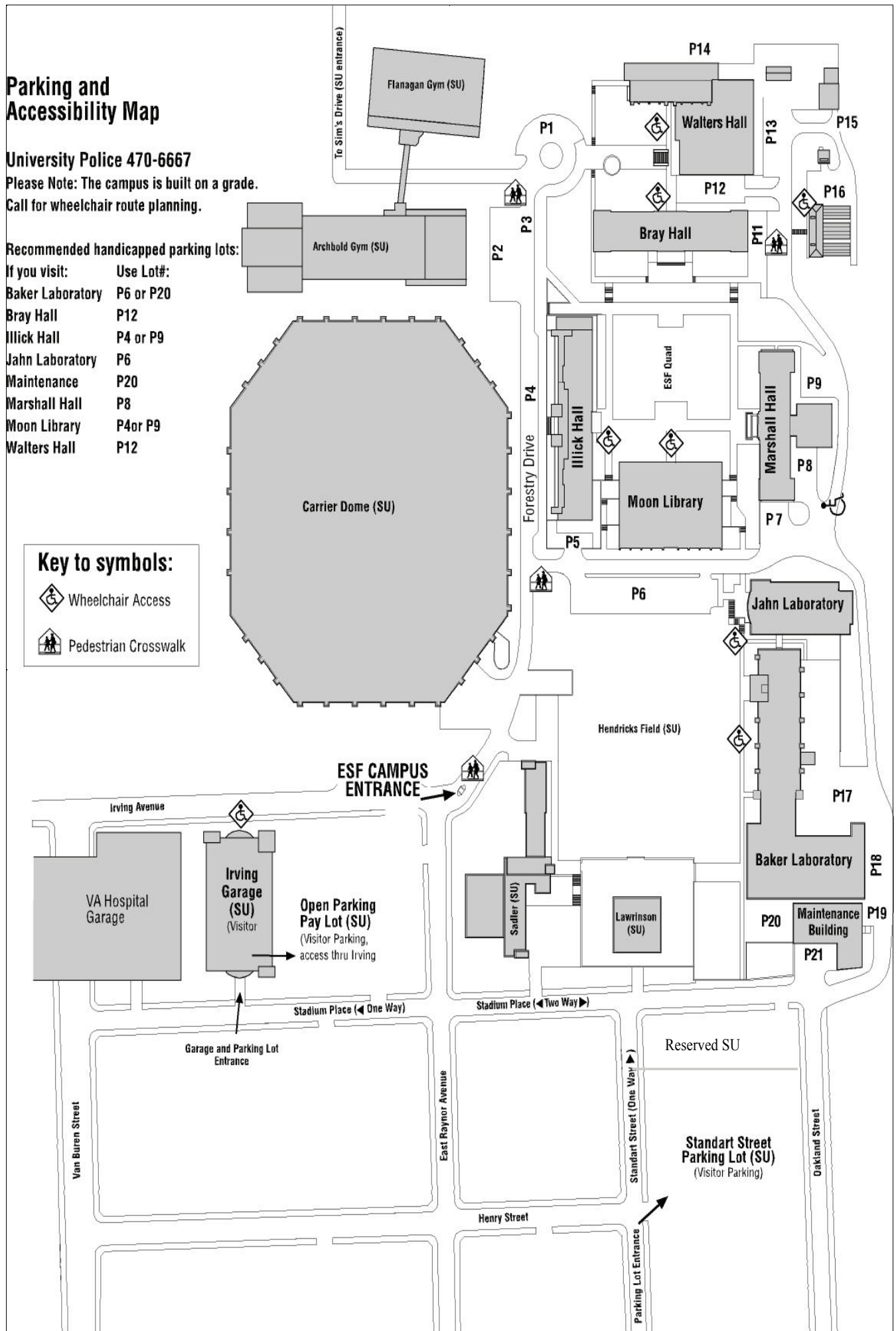
## Key to symbols:



Wheelchair Access



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## Wind Energy and the Great Lakes: Plenary Speakers



**Ken Visser** is an Associate Professor in the Department of Mechanical and Aeronautical Engineering at Clarkson University. He completed his Ph.D. at the University of Notre Dame in 1991. Post-doctoral work was performed under the auspices of the National Research Council at the NASA Langley Basic Aerodynamic Research Tunnel (BART). Ken was subsequently employed by the Boeing Aircraft Company for five years and was involved in development and design aspects of two aircraft: the High Speed Civil Transport and the 767-400ER, the latter resulting in a patent of a novel raked aerodynamic wingtip currently being flown on the Boeing 767-400ER. Other activities include helping in the design of the keel fin and

appendages for the America's Cup Team 2000, AmericaOne, and working with Fairchild Dornier Aircraft in Germany. In 2006-2007 Ken studied at DLR in Braunschweig, Germany. He has extensive experience in the development of wind tunnel data acquisition systems including hot-wire acquisition and flow visualization techniques.

His research interests are primarily experimental focusing on applied aerodynamics and renewable energy concepts. Current projects include wind turbine design optimization, passive reduction of drag on ground vehicles and design methodologies for aircraft wing tips.

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**Bruce Bailey, Ph.D.**, is the President of AWS Truewind, one of the world's leading meteorological and engineering consulting firms serving the renewable energy industry. Dr. Bailey has been active in wind and solar energy for over 30 years and has degrees in Meteorology and Engineering Management. Before forming AWS Truewind 25 years ago, Dr. Bailey was a tenured research associate with the Atmospheric Sciences Research Center at SUNY Albany. He leads a staff of approximately 100 professionals from the headquarters office in Albany, NY, with branch offices in Austin, TX and Barcelona, Spain (via a joint venture firm: Meteosim Truewind).



One of Dr. Bailey's specialty areas is offshore wind energy assessment, meteorology, mapping and siting. He has worked with several offshore wind project developers in North America and Europe and has led the mapping of the offshore wind resources for the United States on behalf of NREL, several states and the province of Ontario. Dr. Bailey is a member of the American Wind Energy Association (AWEA) and a former board director. He is a founding member of the AWEA Offshore Wind Working Group.

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**Dereth Glance** is the Executive Program Director for Citizens Campaign for the Environment (CCE) and has been part of the CCE team since 2002. She is an officer and a board member of the Clean Water Network and serves on the Governor's New York Clean Water Collaborative. Dereth serves on the board of directors for the Onondaga County Resource Recovery Agency (OCRRA) and chairs the agency's Recycling Committee. Dereth is active in a wide range of environmental issues including: the Great Lakes, air pollution, water quality, energy policy, conservation, waste and recycling, and wildlife protection. With a long-standing commitment to public education and activism, Dereth previously worked for Defenders of Wildlife; the utility-consumer watchdog, Citizen Action Coalition of Indiana; and the Michigan League for Human Services. Dereth attended Michigan State University where she earned her B.A. from the James Madison College of Public Affairs and resides in Syracuse, New York.



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**Keith Lott** holds a B.S. in Wildlife Biology and an M.S. degree in Conservation Biology and Applied Ecology from Frostburg State University. He became involved in wildlife/wind energy related issues while working for the University of Maryland Center for Environmental Studies Appalachian Laboratory conducting pre-construction bird surveys for a proposed wind turbine facility in Maryland. In 2003 and 2004 he help conduct mortality surveys at the Mountaineer wind turbine facility near Thomas, West Virginia. Keith is currently the wind energy wildlife biologist for the Ohio Department of Natural Resources Division of Wildlife.



## Plenary Presentation Overview

### Overview of Wind Energy Use, Benefits, Policy

**Dereth Glance**

My presentation will provide a brief introduction and overview of wind power, including its use in the US and globally. I will provide an overview of state and federal renewable energy policies, like the renewable portfolio standard and production tax credit. I will provide an overview of the environmental benefits of wind power and the importance of rigorous environmental and public review for utility-scale wind power projects for both on-shore and off shore.

### Industry Perspective on Offshore Wind Energy Development

**Dr. Bruce Bailey**

This talk will provide an overview of the wind industry's progress in offshore project development. The overview will include the European experience, which began over 15 years ago. While no offshore projects exist yet in North America, several have been proposed. Some of these will be highlighted, as will the barriers that have delayed development in North America to date.

Recent work on quantifying and mapping the available wind resources over the Great Lakes will be illustrated. Unique opportunities and challenges to development in the Great Lakes will be discussed. Recommended steps for defining the feasibility of a project in any one locale will be provided.

### An Introduction to Small Wind Turbine Technology

**Ken Visser**

Rising energy prices and concerns about global warming have significantly increased interest in alternative energy concepts and wind energy is estimated to be a major source of energy. In 2007 there was more than 5,000 MW of new wind capacity installed in the US, more than 27% of the newly added global wind capacity of 2007. Innovative and advanced technologies are major contributors to future wind turbine design. Technologies that address the opposing design requirements of weight, cost, reliability, and performance are essential to wind's continued growth. Clarkson University's efforts in small wind energy research over the past 10 years have recently led to several commercial technology transfer opportunities. Clarkson is also involved in developing turbine technology that will improve the cost-effectiveness and performance of large wind energy systems. An introduction of wind energy concepts and terminology will be given with particular emphasis on small wind turbines. Fundamental concepts, such as rotor solidity, power coefficient and blade geometry will be described followed by an overview of the projects and efforts at Clarkson University, including the Optiwind 300 kW turbine from Connecticut, a small turbine concept by Future Energy Solutions of Livonia, NY and a novel wind-driven home heating concept. Wind turbine systems and research tools developed at Clarkson including experimental facilities available for full scale testing will also be highlighted.

### Impacts of Wind Energy on Birds and Bats

**Keith Lott**

With the recent passage of renewable energy portfolio standard in the Northeast there is likely to be a dramatic increase in the number of proposed wind energy developments within this region. Some wind energy facilities within the United States have had significant environmental impacts, mostly focusing on birds, but more recently bats. This talk will outline the direct and indirect impacts that wind energy facilities may pose, and what steps are being taking to assess and minimize those impacts.

Date	Time	Marshall Hall Nifkin Lounge	Baker Hall Foyer	Baker Hall Room 145	Baker Hall Room 146	Baker Hall Room 148
Friday, March 13	12:00-1:00		Registration			
	1:00-3:20					Plenary Session: Wind Energy and the Great Lakes
	3:20-3:40		Break: Refreshments			
	3:40-5:20			Session 1A AOCs Sea Grant	Session 1B Limnology	
	5:30-6:00	Poster session				
	6:00-7:00	Poster session; cocktail reception				
	7:00	Dinner				
Saturday, March 14	8:30-9:00		Continental Breakfast			
	9:00-10:40			Session 2A Modeling	Session 2B Limnology	Session 2C Engineering
	10:40-11:00		Break			
	11:00-12:00			Session 3A Chemistry	Session 3B Limnology	
	12:00	Luncheon & Awards				

## Friday Program

12:00-1:00: Registration

1:00-3:20: Plenary Session: Wind Energy and the Great Lakes **Baker 148**

**Panelists:** Bruce Bailey, *President of AWS TrueWind*

Dereth Glance, *Citizens Campaign for the Environment*

Keith Lott, *Ohio Department of Natural Resources Division of Wildlife*

Ken Visser, *Associate Professor at Clarkson University*

3:30-3:40: Refreshment Break

3:40-5:20: Concurrent Sessions 1A, 1B

5:30-6:00: Special Sessions

6:00-7:00: Poster Session and Reception

7:00: Banquet and auction

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Session 1A, Areas of Concern Research **Baker 145**

3:40: Introduction to the Areas of Concern Special Session

Michael R. Twiss

4:00: Microbial Source Tracking of *Escherichia coli* in Lake Erie

Thomas, Marie & Sara Stark; Richard Boheen, Jonathan Sanford and W. Theodore Lee (Faculty Advisor)

4:20: Wild deer as potential vectors of manure pathogens and antibiotic resistance genes in the Northern Adirondack Region of New York State

Shaffer, Carrie and Shane Rogers

4:40: Eutrophication and Undesirable Algae in the Massena Area of Concern, St. Lawrence River: A study supporting New York State's Commitment to the Great Lakes Water Quality Agreement

Kring, Stefanie and Michael R. Twiss

5:00: Plankton Health in the Massena Area of Concern, St. Lawrence River

Lockwood, Hilary and Michael R. Twiss

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Session 1B, Limnology **Baker 146**

3:40: Barotrauma may be more common and more dangerous than you originally thought.

Gokey, J.J., Schreer, J.F., and Deghett, V.J

4:00: Genetic Divergence and Longitudinal Variation of Smallmouth Bass (*Micropterus dolomieu*) Populations in Lakes Erie and its Tributaries

Sard, Nick; Cassidy Hahn, Dr. Timothy Strakosh, Don Einhouse

4:20: Evaluation of the quality of landlocked Atlantic Salmon eggs

Snyder, Blake, Rinchar, J., Accardi, C. and E. Grant

**6:00-7:00 Poster Session *Nifkin Lounge***

**Great Lakes Diplomacy: A Case Study in the Evolution of Binational Environmental Diplomacy and Governance**

Nate Drag

**Influence of Biotic and Abiotic Factors on Walleye (*Sander vitreus*) Year Class Strength in Lake Erie.**

Hahn, Cassidy; Dr. Timothy Strakosh, Don Einhouse

**Unknown Threats: An Examination of Endosymbions in Non-Native Species**

Hajduk, Marissa, Lyubov Burlakova, Sergey Mastitsky, and Alexander Karatayev

**Impact of Garlic Mustard on Plant Diversity and Mycorrhizal Fungi**

Redlecki, Marie; Jessica Wooten and Chengwei Sun

**Self-Assembled Polypeptide Film Piezosensors for the Detection of Trace Concentrations of Toxic Heavy Metal Ions**

Stobiecka, Magdalena; Erica Sharpe, Jeffrey Debb, and Maria Hepel

**Food Web-Mediated Transport and Bioaccumulation of Flame Retardants (PBDE) in Eastern Lake Erie**

Tarasiewicz, Jon; Jessica Wuerstle & Alicia Pérez-Fuentetaja

**Developing a Land-based Monitoring Station on the Saint Lawrence River**

Thomas, Sean P., Pavlac, M.M., Boyer, Greg L.

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**Saturday Program**

**8:30-9:00: Continental Breakfast**

**9:00-10:40: Concurrent Sessions 2A, 2B, 2C**

**10:40-11:00: Break**

**11:00-12:00: Concurrent Sessions 3A, 3B**

**12:00: Luncheon and Awards Announcement**

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**Session 2A, Modeling *Baker 145***

**9:00: An Increased Potential For The Landsat Data Continuity Mission (Ldcm) To Contribute To Water Resource Assessment**

Gerace, Aaron; John Schott

**9:20: Modeling the Response of Hydrology and Water Quality to Climate Change at the Huntington Wildlife Forest (HWF) in the Adirondack Mountains, New York using a Biogeochemical Model (PnET-BGC)**

Pourmokhtarian, Afshin; Charles T. Driscoll, John L. Campbell

**9:40: Relating Small-Footprint Waveform Lidar Data to Plot-level Woody and Herbaceous Biomass for Improved Land Degradation Assessment.**

Wu, Jiaying, J.A.N. van Aardt, G.P. Asner, R. Mathieu, T. Kennedy-Bowdoin, D. Knapp, K. Wessels, B.F.N. Erasmus, I. Smit

Session 2B, Limnology ***Baker 146***

**9:00: Effects of alewife and round goby on yellow perch reproductive performance**

Accardi, Christina; Rinchard J., and Czesny S.

**9:20: Distribution, density and potential impacts of freshwater exotic mytilid *Limnoperna fortunei***

Karatayev, Vadim; Alexander Karatayev, Lyubov Burlakova, and Demetrio Boltovskoy

**9:40: Assessing the swimming performance of the round goby (*Neogobius melanostomus Pallas 1814*) and its implications for upstream migration in tributary streams and rivers**

Rupprecht, Shannon (Dr. Christopher Pennuto)

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Session 2C, Engineering ***Baker 148***

**9:00: Evaluation of Fresh Water Fouling Films Formed During Germicidal-Ultraviolet Water Purification**

Ayling, Katherine; Anne Meyer, Robert Baier

**9:20: Feasibility to reuse recycled bedding sand in dairy farm**

Zhang, Ying, Advisor: Stefan Grimberg

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Session 3A, Chemistry ***Baker 145***

**11:00: Application of Continuous Monitoring in the Lake Ontario Nearshore Nutrient Survey**

Pavlac, M.M.; T.T. Smith, S.P. Thomas, and G.L. Boyer

**11:20 The fate and persistence of cyanobacteria and cyanobacterial toxins in lake sediment**

Zastepa, Arthur and Frances Pick

**11:40 Analysis of PCDD/F and WHO Coplanar PCBs in Great Lakes Fish**

Valentin, Lori; Alexandra Orchard, Michael Milligan

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Session 3B, Limnology ***Baker 146***

**11:00 Effects of Experience on Predator Avoidance Behavior of Crayfish**

Dong, Nini (Advisor: Christopher Pennuto)

**11:20: Temperature and nutrients influence interannual variability of phytoplankton succession in Oneida Lake, NY**

Andrew Siefert and Edward Mills (advisor)

**11:40 Invasive European Frogbit: Its Distribution And Possible Control Strategies**

Bin Zhu, Meredith E. Eppers, Bryan P. Harris, and Lars G. Rudstam

# Presentation Abstracts

(Listed in alphabetical order by author)

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## Effects of alewife and round goby on yellow perch reproductive performance

Accardi, Christina; Rinchard J., and Czesny S.

### Session 2B

Yellow perch is a native species in Lake Michigan, historically supporting both commercial and recreational fisheries, but recently they are suffering from very erratic recruitment. Several factors including predation, zooplankton, water movement, and spawning stock characteristics have been proposed to potentially influence their recruitment. Recent studies demonstrated that fatty acid contents in both maternal and larval diets had significant effect on growth and survival of yellow perch offspring. Thus, we are currently conducting research to evaluate how alewife and round goby affect their reproductive performance (e.g., lipid and fatty acid composition of their eggs, embryo survival at eyed stage). Alewife and round goby are two available prey species for yellow perch in Lake Michigan and present distinct fatty acid signatures. In this presentation, I will give an overview of the research I am currently conducting for my MS thesis.

## Evaluation of Fresh Water Fouling Films Formed During Germicidal-Ultraviolet Water Purification

Ayling, Katherine; Anne Meyer, Robert Baier

### Session 2C

Research in progress concerns the assessment of biological fouling on quartz sleeves used to protect ultraviolet (UV) lamps in a water purification unit. The equipment is in use at the Great Lakes Center located in Buffalo, NY where it is provided with water from the Black Rock Canal entering into Lake Erie. Exposure to natural water systems causes fouling buildup of organic, mineral, and biological components on the sleeves hindering the throughput of the UV rays and decreasing the integrity of the purification system. Biological fouling of a surface is preceded by the adsorption of a proteinaceous layer and the formation of a "conditioning film", whose adhesive and retention properties are dictated by the critical surface tension (CST) of the material's surface and reduced when the CST is between 20-30 mN/m. Coatings, intended to modify the surface of the quartz sleeves to within this range, are being investigated for differences in fouling rate, composition, adhesion and retention strength and stability after UV exposure.

## Effects of Experience on Predator Avoidance Behavior of Crayfish

Dong, Nini (Advisor: Christopher Pennuto)

### Session 3B

Prey species must detect and respond appropriately to predators in order to survive. In aquatic environments, chemical cues released by the predators are important stimuli which can induce avoidance behaviors of prey animals. We assessed if predator avoidance was innate or learned in the Northern clearwater crayfish (*Orconectes propinquus*) as a preliminary step to assessing differences in learning behavior and memory formation in native and invasive crayfish. Predator-naïve (lab-reared) and experienced (wild-caught) crayfish were exposed to predator-scented water or filtered city water in a Y arena where their locations were recorded over a 10.5 minute period. Wild-caught (presumably predator-exposed) *Orconectes propinquus* showed a significant avoidance of water with predator odor, whereas the laboratory-reared (predator-naïve) conspecifics did not. Our result implies that avoidance of crayfish tends to be largely learned rather than innate. It also provided a baseline for the predator avoidance respond of *Orconectes propinquus*. Results of these studies could provide insights into how invasive crayfish species might respond to novel predators in new habitats. Adult invaders should be better able to succeed in the face of novel predators compared to juvenile or inexperienced crayfish. Further study will examine if prior learning experience will enhance the learning ability of crayfish and test acquisition of predator recognition and length memory retained for predator-naïve *Orconectes propinquus* (native species) and *Orconectes rusticus* (invasive species). This would be a new approach to explain the success of *Orconectes rusticus* in the Great Lakes regions.

## **Great Lakes Diplomacy: A Case Study in the Evolution of Binational Environmental Diplomacy and Governance**

**Nate Drag**

### **Poster Session**

As the scientific and public concerns over environmental issues changed in second half of the 20th century, the diplomatic and political methods, players, and tools evolved as well. The Great Lakes, as a system shared between Canada and the United States, present an excellent case study in the evolution of environmental policy that is inherently binational. How can these two neighboring countries overcome the cultural, political, and government structural differences facing the management of the Great Lakes? Beginning with IJC and the Great Lakes Water Quality Agreement, the federal governments were dominant in Great Lakes environmental policy during an era of Nation State Diplomacy that lasted until the 1980's. This decade marked the emergence of Subnational Actors, such as states, provinces, and nongovernmental organizations, on the binational scene. The success of these new players has led to the possibility of a more inclusive binational environmental policy community, perhaps extending to local and municipal levels. With a growing sense of civic environmentalism, a multi-level diplomacy appears to be occurring in the Great Lakes to more efficiently and effectively address the wide variety of ecological, social, and political challenges that face the restoration and protection of the world's largest freshwater system.

## **An Increased Potential For The Landsat Data Continuity Mission (Ldcm) To Contribute To Water Resource Assessment**

**Gerace, Aaron; John Schott**

### **Session 2A**

The ability to continuously monitor the global water supply from satellite imagery is an ongoing effort in the remote sensing community. Historically, sensors such as SeaWiFS and MODIS have been used over the open ocean to determine the constituents in the water. Poor spatial resolution precludes these satellites from being used to study inland lakes and ponds or very near-shore coastal regions. Alternatively, Landsat instruments have adequate spatial resolution but lack the radiometric fidelity necessary to study optically complex waters. A new sensor being developed by NASA has characteristics that indicate it will be both spectrally and spatially sufficient for monitoring inland and coastal waters.

This study presents the relevant sensor design parameters and results of an experiment to determine what impact LDCM's Operational Land Imager (OLI) will have on water resource assessment. Specifically, we investigate how the addition of a blue band, 12-bit quantization, and improved signal-to-noise affect our ability to retrieve water constituents. Preliminary results show that LDCM has the potential to reduce retrieval errors to less than 6% while its predecessor ETM+ would have expected errors of over 20%. This indicates that LDCM exhibits the potential to be a useful tool for the continuous monitoring of inland and coastal waters.

## **Barotrauma may be more common and more dangerous than you originally thought.**

**Gokey, J.J., Schreer, J.F., and Deghett, V.J.**

### **Session 1B**

Barotrauma is increasingly being recognized as a serious conservation and management issue in catch-and-release fisheries. Barotrauma results from decompression which can cause physiological and physical injuries. During the summers of 2007 and 2008 we angled for fish in the St. Lawrence River to determine the incidence of barotrauma injuries and the related mortality rates. An angler survey was also conducted in 2008. A total of 211 fish were caught at depths from 1-21m including perch (82), walleye (45), smallmouth bass (36), largemouth bass (14), goby (12), rock bass (10), northern pike (6), bluegill (5), and bullhead (1). Sixty-two (29%) showed signs of barotraumas, 99% of these being smallmouth bass, walleye, or perch. These fish, excluding gobies, represented 94% of the fish caught at depths >6m. Signs of barotrauma were bloating (89%), loss of equilibrium (66%), stomach eversion (62%), bulging eyes (18%), hemorrhaging in the eyes and fins (12%), and anal eversion (5%). Most fish had multiple signs with approximately 50% showing loss of equilibrium, bloating, and stomach eversion. The incidence of barotrauma increased with depth after first appearing at 6.4m. There was a threshold at ~10m where the incidence increased rapidly to 100% at 21m. Mortality occurred in 68% of the

fish with barotrauma, even in fish with less severe signs (e.g. bloating, loss of equilibrium), and showed a similar rate of increase starting at 9m. Although non-significant, there appeared to be interspecific differences in the susceptibility to barotrauma that should be considered when targeting different species and depths.

## **Influence of Biotic and Abiotic Factors on Walleye (*Sander vitreus*) Year Class Strength in Lake Erie.**

**Hahn, Cassidy; Dr. Timothy Strakosh, Don Einhouse**

### **Poster Session**

Annual fluctuation in recruitment has been well documented in the fisheries of Lake Erie. A suite of biotic and abiotic factors have been shown to dictate year class strength, however little work has been done on the influences these have on the variation in walleye, *Sander vitreus*, spawning run in Cattaraugus Creek. A long term data set recorded by the New York State Department of Environmental Conservation from 1979 - 2007 of was analyzed to uncover the effects of these factors on walleye year class strength in Lake Erie. The influence of Julian date of first and last ice cover, barometric pressure, wind speed, average day of first and last ice cover, Cattaraugus Creek discharge, wave period, maximum wind gusts, wind direction, average air temperature, and daily ice cover were compared against walleye year class strength. Preliminary results indicate that approximately 41% of walleye year class strength ( $R^2 = 0.407$ ,  $P = .001$ ) can be attributed to the tested variables. Further analysis will be conducted to create additional models and Akaike Information Criteria will be used to assess the goodness of fit of these models and rank them accordingly.

## **Unknown Threats: An Examination of Endosymbions in Non-Native Species**

**Hajduk, Marissa, Lyubov Burlakova, Sergey Mastitsky, and Alexander Karatayev**

### **Poster Session**

Since the early 1990s, non-native species have dominated the Great Lakes region, causing economic losses and changing ecosystems they invade. As the number of invasive species increases, new threats to wildlife and human may arise. Exotic species may serve as vectors of introduction for their specific parasites, including highly pathogenic ones, and may become hosts for aboriginal disease agents. This may result in catastrophic outbreaks of parasitic diseases that would otherwise not have existed in the introduced areas. Although many aspects of the negative impacts of aquatic invasive species have been well studied, the parasitological consequences of their spread have yet to receive adequate attention. In the fall 2008 we initiated a study of parasites of invasive molluscs known in the Great Lakes region. Preliminary data were collected for quagga mussel, *Dreissena rostriformis bugensis* ( $n = 76$ ), and New Zealand mud snail, *Potamopyrgus antipodarum* ( $n = 26$ ) from Lake Erie and a tributary of Lake Ontario. We found that 39.47% of the dissected *D. r. bugensis* harbored endosymbionts, mainly non-parasitic free-living nematodes and oligochaetes. The average number of nematodes per mussel was 2.03 ( $\pm 0.53$ , SE). No species-specific and/or pathogenic parasites were found in either *D. r. bugensis* or *P. antipodarum*. This however, does not denote the possibility of finding parasites in other populations of these or other non-native species. On-going work will examine larger populations of *D. r. bugensis*, *P. antipodarum* along with several other invasive aquatic species to determine species composition, distribution, and possible ecological impacts of their endosymbionts.

## **Distribution, density and potential impacts of freshwater exotic mytilid**

*Limnoperna fortunei*

**Karatayev, Vadim; Alexander Karatayev, Lyubov Burlakova, and Demetrio Boltovskoy**

### **Session 2B**

The freshwater golden mussel, *Limnoperna fortunei* (Mytilidea, Bivalvia) is considered to be the most aggressive invader in the southern hemisphere. In late 1980s – early 1990s, *Limnoperna* invaded South America, causing significant ecological and economical impacts, and in the near future may invade North America. *Limnoperna* is a suspension feeder and much of its ecosystem effects are due to shifting energy and matter from the water column to benthic communities (benthic pelagic coupling). Therefore, the overall ecosystem effects of *Limnoperna* will depend on their densities and biomass. However, to date there was no information available about population densities and distribution of *Limnoperna* in a waterbody. The focus of this study was to determine the density and distribution of *L. fortunei* across different substrates and depths in Rio Tercero

Reservoir in Cordoba, Argentina. We found that *Limnoperna* distribution is limited to hard substrates such as rocks and sand, with the highest densities found on rocks, and the lowest on mud. The general pattern of distribution of the golden mussel within a waterbody is thus very similar to that of the zebra mussels. However, we found that *Limnoperna* forms significantly higher densities and biomass than the zebra mussel across all substrates and especially on rocks. Therefore, the potential impacts of *Limnoperna* on the freshwater ecosystems they invade may be one of the strongest ever seen.

## **Eutrophication and Undesirable Algae in the Massena Area of Concern, St. Lawrence River: A study supporting New York State's Commitment to the Great Lakes Water Quality Agreement**

**Kring, Stefanie and Michael R. Twiss**

### **Session 1A**

According to the 2006 Remedial Action Plan (RAP) Status Report, the Beneficial Use Impairment (BUI) of Eutrophication and Undesirable Algae is unimpaired within the Massena Area of Concern (AOC). For two reasons, this BUI needs to be reassessed. A recent study, by Twiss et al. (2006), reveals that phosphorus concentrations within the Massena AOC were as high as 30 µg/L. Secondly, there is the lack of sufficient data to address this BUI. The only data available was from the Rotating Integrated Basin Studies program, which only has one data point at the center of the Moses-Saunders Power Dam. Clearly, there was not enough data to label the entire AOC as unimpaired regarding this BUI. It was hypothesized that total phosphorus would be low in the St. Lawrence River and elevated on the St. Regis River. From May 2008 to December 2008, surface grab samples were taken from eight locations on the St. Regis, Raquette, Grasse, and St. Lawrence River. It was found that levels were elevated on the St. Regis and Grasse Rivers. The St. Lawrence and Raquette Rivers were consistently below water quality guidelines of 20 µg/L. While the levels on the St. Regis and Grasse Rivers were above water quality guidelines, they were not grossly impaired, as evident from low phytoplankton biomass. We therefore conclude that this BUI is indeed unimpaired and, importantly provide substantial data to support this claim. This study provided a useful framework for approaching other Beneficial Use Impairments.

## **Plankton Health in the Massena Area of Concern, St. Lawrence River**

**Lockwood , Hilary and Michael R. Twiss**

### **Session 1A**

St. Lawrence River Area of Concern (AOC) at Massena requires further investigation to advance the status of the Beneficial Use Impairment (BUI) of Degradation of phytoplankton and zooplankton populations. This BUI requires further assessment as sufficient data lacks to support de-listing and past studies of phytoplankton communities downstream of the AOC indicate that shifts in both the phytoplankton and zooplankton communities are reflective of physical habitat changes due to the construction of the Moses-Saunders Power Dam, St. Lawrence Seaway, and pollution from upstream sources. A healthy plankton community is reflected in nutrient levels similar to reference populations and that when compared to non-impacted areas, the plankton community structure should be favorable (population, size and variability). It was hypothesized that nutrient levels, and therefore plankton populations, above the Power Dam would be different from those below the dam in the AOC. Sampling at twelve stations above the dam was completed in July 2007. In September 2008, twenty-three stations in total were sampled above and below the dam in the St. Lawrence, St. Regis, Raquette, and Grasse Rivers. It was found that nutrient levels of phosphorus, nitrate, and silicate below the dam were slightly different from above the dam. Phytoplankton populations, as evident from FluoroProbe data, varied from station to station, typical of a mixed river system. Zooplankton also showed variability, but with substantial data, we concluded that plankton populations are not impaired and that tributaries downstream cause fluctuations in nutrient levels, therefore affecting the plankton present in the area.

## **Application of Continuous Monitoring in the Lake Ontario Nearshore Nutrient Survey**

**Pavlac, M.M.; T.T. Smith, S.P. Thomas, and G.L. Boyer**

### **Session 3A**

The Lake Ontario Nearshore Nutrient Survey (LONNS) conducted in the summer of 2008 was designed to assess

the effect of *Cladophora*, dreissenid mussels, and physical forces on the movement of nutrients entering the lake. As part of that survey, continuous real-time monitoring was employed in the nearshore areas of Oak Orchard, Rochester, and Mexico Bay in New York. The ferry box was equipped with sensors for chlorophyll, phycocyanin, CDOM, temperature, conductivity, turbidity, dissolved oxygen, and pH. Phytoplankton class abundance was estimated using the BBE FluoroProbe operated in continuous-flow mode. These data streams were geo-referenced and used to examine the spatial and temporal change of the different parameters relative to the riverine inputs. Initial results showing the variations in the distribution and composition of algal growth, as well as the physical data, will be presented.

## **Modeling the Response of Hydrology and Water Quality to Climate Change at the Huntington Wildlife Forest (HWF) in the Adirondack Mountains, New York using a Biogeochemical Model (PnET-BGC)**

**Pourmokhtarian , Afshin; Charles T. Driscoll, John L. Campbell**

### **Session 2A**

Changing climate has complex direct and indirect affects on forest ecosystems. Biogeochemical watershed models can be used to help understand the long-term effects of climate change on ecosystems. We used a biogeochemical model (PnET-BGC) to evaluate the effects of potential future changes in temperature, precipitation, solar radiation and atmospheric CO<sub>2</sub> on the hydrology and biogeochemistry at the Huntington Wildlife Forest (HWF) in the Adirondack Mountains, New York. Future emissions scenarios are monthly output from three atmosphere-ocean general circulation models (AOGCMs; HadCM3, PCM, GFDL) in conjunction with lower and upper bounds of projected atmospheric CO<sub>2</sub> (550 and 970 ppm by 2099, respectively). AOGCM results over the 21st century indicate an average increase in temperature ranging from 1.9 to 7.0°C with simultaneous increase in precipitation ranging from 11.9 to 12.2% above the long term mean (1970-1999). Watershed modeling showed a significant shift in hydrology with earlier spring discharge (snowmelt), greater evapotranspiration, and later snowpack development. Model results indicated an increase in NO<sub>3</sub>- leaching due to increases in net mineralization and nitrification. Sensitivity analysis showed that the temperature is the key driver of watershed responses to future climate change.

## **Impact of Garlic Mustard on Plant Diversity and Mycorrhizal Fungi**

**Redlecki, Marie; Jessica Wooten and Chengwei Sun**

### **Poster Session**

Garlic mustard (*Alliaria petiolata*) is a non-native biennial herb that establishes monospecific stands in forest understories and is a threat to forested watersheds throughout the Great Lakes basin. Garlic Mustard may be a successful invader of mature forest understories by inhibiting mutualistic interactions between native plants and arbuscular mycorrhizal fungi. In early 2007 36 1-m<sup>2</sup> plots were set up in a moist deciduous forest with three treatments. These treatments were as follows: areas of high garlic mustard density with the garlic mustard left intact, areas of high garlic mustard density with the garlic mustard removed several times each season, and areas where there was little to no garlic mustard established. The biomass of removed garlic mustard was measured, species response to garlic mustard removal was assessed, and % mycorrhizal inoculum potential (MIP) measured. The amount of removed garlic mustard biomass decreased from 2007–2008. No significant richness differences have been detected yet between the three treatments. Plots with high garlic mustard density had the lowest MIP, which indicates that garlic mustard may be inhibiting this critical mutualist. Garlic mustard removal and plot monitoring will continue for three more years.

## **Assessing the swimming performance of the round goby (*Neogobius melanostomus* Pallas 1814) and its implications for upstream migration in tributary streams and rivers**

**Rupprecht ,Shannon (Dr. Christopher Pennuto)**

### **Session 2B**

Non-indigenous species have had enormous effects on the environments they invade. Round gobies invaded

the Great Lakes in 1990 and have had negative effects on benthic macroinvertebrate and fish communities. Recently, tributary streams have begun to be invaded, but little is known about the physical characteristics of streams or the swimming performance of gobies which might determine invasion success. Several species of Hawaiian Gobiidae can scale 350-m waterfalls using various combinations of swimming, fused pelvic fins, and in one species, the mouth as a ventral sucker. Since round gobies also have fused pelvic fins, we examined the effect of water velocity, substrate size, and body size on scaling ability and swimming performance to estimate which conditions might limit upstream migration. A Vogel flume was used to test 6 velocities, 3 substrates, and 2 body sizes. Additionally, we determined whether fin morphometrics scaled allometrically or isometrically with body weight. Preliminary results showed that adult gobies spent equal amounts of time swimming when tested over smooth or pebble substrates, but time spent swimming decreased at higher velocities. Pectorals were used in lower velocities; whereas caudal fins were used in higher velocities for the pebble substrate. There was an isometric relationship between the fused pelvic fin area and body weight for both juveniles and adults, indicating waterfall scaling would not be possible. Combined, these data suggest that streams with water velocities as high as 85 cm/s would be susceptible to goby invasion, but that dams or waterfalls should be effective barriers.

## **Genetic Divergence and Longitudinal Variation of Smallmouth Bass (*Micropterus dolomieu*) Populations in Lakes Erie and its Tributaries**

Sard, Nick; Cassidy Hahn, Dr. Timothy Strakosh, Don Einhouse

### **Session 1B**

The smallmouth bass (*Micropterus dolomieu*) is a native fish to the Great Lakes and eastern central North America. Despite the species ecological importance little is known about the genetic composition of its populations. The purpose of this study was to assess the genetic variation and relatedness of spawning smallmouth bass in Lake Erie and its tributaries and the contribution of each sampling site to the overall adult population. Additionally, the longitudinal genetic variation within one of Lake Erie's tributaries, Cattaraugus Creek, will be evaluated. In the summers 2007 and 2008 tissue samples from spawning adults were collected. DNA from these samples was extracted, amplified and genotyped using the Li-Cor 4300 DNA analyzer at seven microsatellite loci. Statistical analysis was then performed using POPgene. Preliminary results suggest significant genetic variation between sites despite geographic location. The results alluded to a possible resident population in Cattaraugus Creek that may not be interbreeding with potadromous smallmouth bass from Lake Erie. Future research will expand the study to include two additional lake and tributary sites and will attempt to identify the contribution of each of the spawning sites to the general lake population.

## **Wild deer as potential vectors of manure pathogens and antibiotic resistance genes in the Northern Adirondack Region of New York State**

Shaffer, Carrie and Shane Rogers

### **Session 1A**

Livestock manures on agricultural lands present a route of exposure for wildlife that transit or forage upon the land. Once ingested, zoonotic enteric pathogens may colonize infected animals where they proliferate to be later deposited elsewhere upon the landscape. This may negate the benefits of management practices designed to reduce pathogens prior to release of manures into the environment (eg. manure storage, composting, and anaerobic digestion), or practices such as grassed and riparian buffers designed to physically impede movement of pathogens from manure-amended fields to nearby surface waters. Management practices designed to reduce erosion and manure losses such as maintenance of crop residues may encourage use of manure-amended lands by foraging wildlife.

This study investigates the distribution of pathogens in feces of wild deer in agricultural and pristine land use areas in northern New York. Our preliminary work suggests that wild deer serve as reservoirs of pathogenic organisms and antibiotic-resistant bacteria following exposure to livestock manures on the agricultural landscape. We have observed a significantly greater frequency of detection of molecular indicators of enterohemorrhagic *E. coli* and *Campylobacter spp.* as well as tetracycline-, sulfonamide-, and vancomycin-resistance genes in deer feces collected near fields onto which livestock manures have been applied as compared to deer feces collected nearby in the Adirondack State Park. This suggests a threat to produce fields proximate to manured fields that these deer also inhabit, as well as to individuals that consume game meat originating near manure-amended lands. Potential water quality impacts have yet to be determined.

## **Temperature and nutrients influence interannual variability of phytoplankton succession in Oneida Lake, NY**

Andrew Siefert and Edward Mills (advisor)

### **Session 3B**

Phytoplankton communities in temperate lakes often follow consistent patterns of seasonal succession, but considerable interannual variation exists in the timing, magnitude, and composition of the successional stages. I used a long-term dataset (1996-2007) from shallow, polymictic Oneida Lake to explore interannual variability of phytoplankton succession and its relationship to temperature and nutrient variability. A clear sequence of phytoplankton succession was observed in Oneida Lake in all years: a diatom-dominated spring bloom, followed by a period of low phytoplankton biomass in early summer (clear water phase), and a second bloom in late summer dominated by cyanophytes, transitioning to diatom dominance in the fall. Timing of the spring diatom bloom was directly related to spring ice-out date, while phosphorus concentration controlled the magnitude of the spring peak. The spring bloom ended earlier in years with low silica concentration, indicating silica limitation contributes to the onset of the clear water phase. Warm water temperatures during early summer were associated with earlier but weaker cyanophyte blooms. The negative relationship between temperature and cyanophyte growth may have been mediated by nitrate concentration, which was lower during warm summers. The magnitude of the fall diatom peak varied greatly from year to year and was weakly correlated with silica concentration. These results demonstrate how the effects of temperature and nutrients on phytoplankton dynamics are complex and often season-specific, and understanding this complexity is necessary to predict the responses of phytoplankton communities to natural and anthropogenic changes in nutrients and temperature.

## **Evaluation of the quality of landlocked Atlantic Salmon eggs**

Snyder, Blake, Rinchard, J., Accardi, C. and E. Grant

### **Session 1B**

The Adirondack Fish Hatchery, owned and operated by the New York State Department of Conservation (NYSDEC), is collecting yearly 1.1 million eggs of landlocked Atlantic salmon to meet its program goal. These eggs are collected from Little Clear Pond and from a domestic broodstock fed a Ziegler diet. For several years, eyed up rate was higher for wild fish than for the domestic broodstock. To evaluate nutritional problems potentially affecting egg quality, the domestic broodstock was divided in two groups and fed either a Zeigler diet or a Corey diet. In 2008, eggs were collected from the three groups of fish (Zeigler, Corey and Wild) and their quality was evaluated using the eyed up and hatching rates, as well as the lipid and fatty acid compositions of the eggs. The results presented in this study will be used by NYSDEC to improve survival of Atlantic salmon alevins.

## **Self-Assembled Polypeptide Film Piezosensors for the Detection of Trace Concentrations of Toxic Heavy Metal Ions**

Stobiecka, Magdalena; Erica Sharpe, Jeffrey Debb, and Maria Hepel

### **Poster Session**

The low concentrations of heavy metal ions such as cadmium, mercury and lead in the environment have a profound effect on living organisms and pose serious health concerns. Recent studies indicate that even the trace concentrations of these toxic metals may cause long term effects leading to autism, diabetes and other deceases in people with increased susceptibility which has been correlated with decreased glutathione (GSH) levels in cells and body fluids. The GSH/GSSG system is the main redox regulation system in living organisms and acts as to reduce the oxidative stress. We have been interested in the interactions of GSH with toxic heavy metals (Cd, Hg, Pb) to evaluate the protective role of GSH in reducing susceptibility to autism and to design GSH based sensors for heavy metals. We have found that the self-assembling monolayer of GSH on Au-piezoelectrodes show remarkable sensitivity to cadmium, mercury and lead. These interactions are due to the coordination to carboxylic groups present in the monolayer of the polypeptide and to the sulfhydryl group in GSH when it is covalently bound to the gold substrate through a basal layer of mercaptopropionic acid.

## **Food Web-Mediated Transport and Bioaccumulation of Flame Retardants (PBDE) in Eastern Lake Erie**

**Tarasiewicz, Jon; Jessica Wuerstle & Alicia Pérez-Fuentetaja**

### **Poster Session**

Many contaminants found in Lake Erie bioaccumulate in fish, posing a risk to aquatic populations and their consumers. Polybrominated diphenyl ethers (PBDEs) are contaminants highly persistent in the environment that have similar structure to the banned polychlorinated biphenyls (PCBs). The United States is the world's largest consumer of PBDEs, which are used as flame retardants in many items such as building materials, plastics and textiles. These chemicals leach into aquatic systems through waste disposal and breakdown of materials. PBDEs have been shown to alter the endocrine system and can disrupt thyroid activity and affect reproduction. Many aquatic invasive species have become established in Lake Erie and have modified the food web. These exotic species have the potential to increase the concentration of contaminants in top predators while reducing the amount of energy reaching them. Our research will look at the concentration of PBDEs in different levels of the food chain including predatory (sport) fish, forage fish, zooplankton, benthos, water and sediment. We will use stable isotopes ( $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ ) to determine trophic levels and interactions among organisms. This research will provide insight into PBDE bioaccumulation and energy pathways in food webs dominated by exotic species in Lake Erie.

### **Microbial Source Tracking of *Escherichia coli* in Lake Erie**

**Thomas, Marie & Sara Stark; Richard Boheen, Jonathan Sanford and W. Theodore Lee**  
(Faculty Advisor)

#### **Session 1A**

High bacteria levels in beach waters have an important impact on both the health of beach users and on local economies when the beaches are closed. Over the past several years, Lake Erie beaches in Dunkirk, NY have been frequently closed due to high levels of *Escherichia coli* in the water. Although the levels of *E. coli* in the lake are measured on a routine basis by the Chautauqua County Health Department, they lack the resources to identify the sources of the bacteria. *E. coli* is frequently used as an indicator organism for fecal pollution when assessing the quality of recreational water. To identify the source(s) of the bacteria in the lake, *E. coli* were isolated from the beach waters and sands in Dunkirk on Lake Erie, as well as from nearby tributaries flowing into the lake. Genomic DNA from the *E. coli* isolates was purified, and genetic fingerprints were then generated. Genetic fingerprints were also generated from *E. coli* isolated from cattle, dogs, humans, cats, deer, geese and gulls. These genetic fingerprints were then compared to the Lake Erie and tributary samples in order to determine a possible source for fecal pollution. The preliminary data indicate that the *E. coli* obtained from Lake Erie and nearby tributaries are naturalized strains and are not fecal in origin. The data indicate that *E. coli* can survive for extended periods in the environment, and that other bacteria such as *Bacteriodes* strains may be better indicators of fecal pollution in beach waters.

### **Developing a Land-based Monitoring Station on the Saint Lawrence River**

**Thomas, Sean P., Pavlac, M.M., Boyer, Greg L.**

#### **Poster Session**

Algal blooms in the Great Lakes have been a topic of study for the past 25 years. As the movement of these blooms is better understood, the need to develop a system that will accurately monitor them has developed. In this study, we focused on the development of a land-based system located approximately 16 miles down stream of the outlet of Lake Ontario on the St. Lawrence River. The system was installed on Governor's Island, one of SUNY ESF's field stations, in Clayton, NY. For the 2008 field year, we focused on the development of the system and troubleshooting problems as they arose. A Hach Hydrolab was used to collect basic water quality data (i.e. pH, temperature). This data assisted in determining the efficiency of the system. For 2009, we will be focusing more on data collection and making the information publicly available through the use of a web site which will be updated in real-time.

### **Introduction to the Areas of Concern Special Session**

**Twiss, Michael R.**

#### **Session 1A**

New York State and the Province of Ontario have fifteen of forty-three Areas of Concern (AOCs), as defined by

the Canada-United States Great Lakes Water Quality Agreement (GLWQA). Most GLRC universities and colleges are within 100 km of an AOC. Successful delisting has occurred so far only in NY (Oswego Harbor) and ON (Collingwood Harbour, Severn Sound). This special session at this year's GLRC meeting serves to highlight student involvement with research associated with AOCs. Examples of this research provided in this session will deal with bacterial contamination and sophisticated methods of source tracking, issues of Eutrophication, and plankton community health. Each GLWQA-defined AOC has a Remedial Action Plan (RAP). De-listing an AOC means it is no longer an AOC. De-listing requires scientific proof that all Beneficial Use Impairments (BUIs) no longer exist. In addition, the local community must agree that the BUI is no longer impaired. RAPs are a prescribed technology that can be difficult to carry out in naturally complex ecosystems.

## **Analysis of PCDD/F and WHO Coplanar PCBs in Great Lakes Fish**

**Valentin, Lori; Alexandra Orchard, Michael Milligan**

### **Session 3A**

As part of the Great Lakes Fish Monitoring Program, we are analyzing whole fish composites and fish fillets collected at different sites from all five of the Great Lakes for a suite of contaminants such as Hg, PCBs, organochlorine pesticides, PBDEs, and PCDD/Fs. In this contribution, we will report on fish concentrations of PCDD/F homologues, 2,3,7,8-PCDD/F substituted congeners, twelve coplanar PCBs designated by the World Health Organization (WHO), and polychlorinated diphenyl ethers (PCDEs). In addition, we will compare TCDD-TBQs contributions from PCDD/F and coplanar PCBs. Five gram fish homogenates are extracted using Accelerated Solvent Extraction (ASE), followed by preliminary clean-up using automated gel permeation chromatography. After multi-layer silica column clean-up, PCDD/Fs and coplanar PCBs are isolated using dual-layer carbon column fractionation. The final extracts are then analyzed using gas chromatography/mass spectrometry.

## **Relating Small-Footprint Waveform Lidar Data to Plot-level Woody and Herbaceous Biomass for Improved Land Degradation Assessment.**

**Wu, Jiaying, J.A.N. van Aardt, G.P. Asner, R. Mathieu, T. Kennedy-Bowdoin, D. Knapp, K. Wessels, B.F.N. Erasmus, I. Smit**

### **Session 2A**

Land degradation, which characterizes the reduction in the capacity of an ecosystem to deliver services such as grazing, fuelwood or wildlife habitat, is regarded as one of the most important environmental issues facing sub-Saharan Africa. However, remote assessment of land degradation has reached its limits in terms of spatial and temporal resolution, accuracy, and ecological understanding from a traditional remote sensing perspective (e.g., 500m/pixel MODIS 36 bands). Such spectrally and spatially coarse resolution data limit our ability to unravel changes in the land surface at the scale at which processes occur (a few meters). We therefore propose to develop processing approaches and applications for land degradation assessment using a new generation of airborne laser scanners, namely full-waveform light detection and ranging (lidar). These sensors are capable of recording the signal of the entire backscattered laser pulse, thus providing an order of magnitude increase in vertical resolution over conventional discrete return lidar sensors.

Our research focuses on application of per-pixel (0.56m) waveform data at the plot-level ( $\pm 5$  m radius) for the assessment of variation in woody and herbaceous biomass measurements. These biomass properties are directly influenced by changes in land degradation status. Pre-processing steps will include advanced deconvolution and signal decomposition approaches, while field-measured structural metrics will be related to waveform properties.

We believe that lidar waveform technology has the potential to improve our ability to quantify global land cover change and terrestrial productivity, thereby leading to improved carbon cycle and ecosystem modeling.

## **The fate and persistence of cyanobacteria and cyanobacterial toxins in lake sediment**

**Zastepa, Arthur and Frances Pick**

### **Session 3A**

Microcystins are a group of hepatotoxins commonly produced during cyanobacterial blooms occurring in warm, stable, and nutrient-rich conditions. They are cyclic, non-ribosomal heptapeptides consisting of 80+ congeners, varying usually at 1 or 2 amino acid locations. Microcystins are the most widely studied and monitored cyanobacterial toxin, however their fate in the aquatic environment remains poorly understood. The dynamics of microcystins in the water column has been well studied and the major pathways of disappearance are thought to be dilution, degradation (microbial), and sedimentation. In contrast, only a few studies have addressed the presence and persistence of microcystins in the sediment. The literature suggests three potentially significant routes of deposition: 1) Sedimentation of intact decaying cells, 2) adsorption to suspended sediment and subsequent settling, and 3) production within the sediment. The proposed thesis will address the following: 1) The extent and depth of microcystins and microcystin-producers *present* in the natural sediment (survey), 2) the extent to which microcystins and microcystin-producers *persist* over winter in the sediment, and 3) quantify the degree of *resuspension* of sedimentary microcystin into the water column. A new approach utilizing automation and limiting hazardous solvents will be applied to sediment in order to evaluate the effectiveness of microcystin analysis in this matrix and accomplish the above objectives.

## **Feasibility to reuse recycled bedding sand in dairy farm**

Zhang, Ying, Advisor: Stefan Grimberg

### **Session 2C**

Sand is the bedding of choice for a large number of dairy farms due to its perceived low pathogen content, its high cow comfort and in part due to increased cost of organic bedding now used for bio-fuel processing. Bedding sand samples from Old McDonald farm and Mark's farm, as well as manure solids bedding from Sheland farm were collected on Jan 23rd, 2009. There are virgin sand, recycled sand, used bedding sand, used manure solids, and recycled manure solids. All of them have been analyzed through Live Dead stain test using Bac Light kits. Results of bacteria population in various bedding are compared to see how clean recycled sand and manure is and whether further cleaning are needed. Also, sand bedding will be compared with organic bedding in terms of bacteria content. From previous data, recovered sand from McLanahan manure sand separator is not clean based on generally accepted threshold number thought to cause mastitis. Therefore, recycled sand will be dried under certain constant temperature to reduce moisture content in order to reduce live bacteria concentration further. Correlation between moisture content and bacteria population will be found so that farmers can have the knowledge of how long they should wait before reusing recovered bedding sand.

## **Invasive European Frogbit: Its Distribution And Possible Control Strategies**

Bin Zhu, Meredith E. Eppers, Bryan P. Harris, and Lars G. Rudstam

### **Session 3B**

The floating invasive plant – European frogbit (*Hydrocharis morsus-ranae*) was first introduced in Ottawa in 1932. It escaped to the Rideau Canal system in 1939 and invaded in the St. Lawrence River in New York in 1974. Since then it invaded other water bodies rapidly. European frogbit can form dense floating mats and has detrimental effects on native aquatic vegetation, animals, and human commercial and recreational activities. Therefore European frogbit invasion may be an imminent threat to our lakes. An experiment was set up to investigate European frogbit growth in waters with different trophic levels under global warming. The results suggested the plants would keep spreading southward with warmer temperature regardless of nutrient levels in water. A field survey was also conducted in 2008 and showed the current distribution of this plant in New York. Some environmental factors including altitude, distance from major routes, water openness, temperature, total suspended solids, nitrogen, phosphorus, dissolved oxygen, and pH were measured in water bodies with and without this plant during the survey. Wind exposure, nitrate concentration and dissolved oxygen were identified to be closely linked to European frogbit's invasion. Additionally, a number of methods are proposed to control European frogbit including hand pulling, shading, biological control, and education.