ABSTRACTS AND BIOGRAPHIES FOR PRESENTATIONS

AT THE

8TH ANNUAL CONFERENCE

OF THE

NORTHEAST AQUATIC PLANT MANAGEMENT SOCIETY

16-17 JANUARY 2006

GRAND SUMMIT RESORT AT MOUNT SNOW

WEST DOVER, VERMONT

abstracts and biographies are listed in order of presentation at the conference

KEYNOTE ADDRESS

Carlton Layne, Executive Director
Aquatic Ecosystem Research Foundation
3272 Sherman Ridge Dr.
Marietta, GA 30064
clayne@aquatics.org

Carlton R. Layne received his BA Degree in Biology from Clarion State University, Clarion, PA and an MS Degree in Criminal Justice from Rollins College in Winter Park, FL. Carlton spent 5 years with the USDA, Agricultural Marketing Service, and 30 years with the US EPA in the Pesticides & Toxic Substances Branch. While with US EPA, Carlton was an Inspector, Grant Monitor, and Regional and National Training Officer (1973-1990), Chief of the Region 4 Pesticides Section (1990-1999), and a National Pesticides Expert (2000-2003). Currently, Carlton is the Executive Director of the Aquatic Ecosystem Research Foundation. Carlton is Past President of the Florida Aquatic Plant Management Society and Past Director Aquatic Plant Management Society.

Formulation Technology: Why All Aquatic Herbicides are not the Same.

Jim Petta and Randy Cush

Jim Petta
Syngenta Professional Products
5221 River Oaks Drive
Corpus Christi, TX 78413
jim.petta@syngenta.com

This paper reviews the various formulations used in aquatics. Details are provided as to the "why" different formulations are used; why the active ingredient plays a significant role in the formulation type; and what inert ingredients are added and for what purpose. These various components make up the products we use in aquatics, and understanding their purpose and composition will assist aquatic plant managers with herbicide decisions.

Jim Petta received his BS Degree in Entomology from Texas A&M University and an MS Degree in Agriculture from California State University. Jim has spent over 22 years in research and development for Syngenta working in the US and overseas including a one year assignment to Indonesia in 2000. Jim is the current president of the Aquatic Ecosystem Restoration Foundation and is the President-elect of the Aquatic Plant Management Society.

Evaluations of Imazamox, Penoxsulam, and Other Herbicides for Aquatic Plant Management

R.J. Richardson* and A.P. Gardner. North Carolina State Univ., Raleigh, NC.

Dr. Robert J. Richardson – presenter
Assistant Professor and Extension Specialist
Aquatic and Non-Cropland Weed Management
North Carolina State University
Box 7620
Raleigh, NC 27695
rob_richardson@ncsu.edu

Field and greenhouse trials were conducted in 2006 to evaluate control of various problematic aquatic plant species with imazamox (Clearcast from BASF), penoxsulam (Galleon from SePRO), carfentrazone (Stingray from FMC) and other herbicides. These herbicides were evaluated as foliar applications or in-water treatments. Efficacy was evaluated on hydrilla, Eurasian watermilfoil, variable leaf milfoil, parrotfeather, watermeal, water lettuce, water hyacinth, alligatorweed, and other species. Weed control was visually rated on a 0 to 100% scale with 0% equal to no control and 100% equal to complete plant death. In field trials, watermeal was not controlled with diquat or carfentrazone, but was controlled with fluridone. Variable leaf milfoil was controlled with triclopyr, imazamox, and carfentrazone and water hyacinth was controlled with imazamox. In greenhouse trials, water hyacinth, water lettuce, and giant salvinia were controlled with penoxsulam. Water lettuce was controlled with imazamox, but giant salvinia was not. Details from these studies and results from additional trials will be presented.

Rob Richardson is an Assistant Professor and Extension Specialist at North Carolina State University with responsibilities in aquatic and non-cropland weed management. He currently oversees a research technician, two graduate students, and an undergraduate employee at NCSU. Rob received a Ph.D. in Weed Science from Virginia Tech and worked as a Research Associate at Michigan State University for three years before moving to North Carolina.

Early Spring Application of Low Rates of Endothall Combined with 2,4-D for Selective Control of Eurasian Watermilfoil and Curlyleaf Pondweed

John G. Skogerboe*
[*]Research Physical Scientist
U.S. Army Engineer Research and Development Center
Eau Galle Aquatic Ecology Laboratory
W500 Eau Galle Dam Rd
Spring Valley, WI 54767
skoger@gte.net

Curlyleaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) have become wide spread problems in many northern lakes. Both plants begin growing in very early spring when ice first disappears from lakes, forming dense canopies before many native aquatic plants begin to grow later in spring. Outdoor mesocosm and small scale greenhouse studies conducted by the US Army Engineer Research and Development Center demonstrated that applying endothall (1 mg/L active ingredient [ai] applied as Aquathol K) combined with 2,4-D (0.5 mg/L ai applied as DMA 4) to curlyleaf pondweed and Eurasian watermilfoil in early spring resulted in better control with significantly less recovery. Based on these small-scale results, a field study was initiated to demonstrate improved, selective, long-term control of curlyleaf pondweed and Eurasian watermilfoil using early spring applications of endothall combined with 2,4-D. Four lakes infested with curlyleaf pondweed and Eurasian watermilfoil were selected in the Minneapolis/St. Paul, MN area. Pretreatment plant surveys were conducted in June and August of 2003, and two lakes were treated with the combination of endothall (1 mg/L ai) and 2,4-D (0.5 mg/L ai) in April 2004, 2005, and 2006. The two untreated lakes served as reference lakes. Post treatment plant evaluations were conducted in June and August, 2004 through 2006. Herbicide treatments were successful at reducing curlyleaf pondweed and Eurasian watermilfoil densities by more than 95% throughout the lakes. Herbicide treatments resulted in no significant changes in native plant abundance or diversity during the first year post treatment, but native plant diversity and abundance did increase in treated lakes during the second and third year post treatment. Water clarity was not reduced following removal of Eurasian watermilfoil and curlyleaf pondweed.

Mr. Skogerboe has been involved in studying the management of aquatic plants since 1994. He is currently stationed at the US Army Engineer Research and Development Center, Eau Galle Aquatic Ecology Laboratory, Spring Valley, WI where his research interests have focused on the selective chemical control of submersed, floating and emergent exotic plant species. He began his Federal career with the Environmental Laboratory at the US Army Engineer Research and Development Center (ERDC), Waterways Experiment Station, Vicksburg, MS, in 1977.

Mr. Skogerboe has a BA degree in Environmental Science from the University of Virginia, and an MS degree in Civil Engineering from Louisiana Tech University. He also serves as a technical reviewer and advisor pertaining to aquatic herbicide issues for various Federal and state agencies. He has authored or co-authored numerous articles on chemical control of aquatic and wetland vegetation.

Combinations of Endothall with 2,4-D and Triclopyr for Control of Eurasian Watermilfoil

John D. Madsen[1], Kurt D. Getsinger[2], and Ryan M. Wersal[1], [1]GeoResources Institute, Mississippi State University, Mississippi State, MS 39762-9652 and [2]US Army Engineer Research and Development Center, Vicksburg, MS 36180-6199.

Dr. John D. Madsen
Extension / Research Assistant Professor
GeoResources Institute
Mississippi State University
Mississippi State, MS 39762-9652
jmadsen@gri.msstate.edu

Eurasian watermilfoil (*Myriophyllum spicatum* L.) is a widespread submersed aquatic plant that causes nuisance problems in the continental United States. While both contact and systemic herbicides are available to control Eurasian watermilfoil, each class of herbicide has its drawbacks. Contact herbicides are fast acting, relieving nuisance problems quickly, but may allow regrowth of nuisance plants by not killing the entire plant. Systemic herbicides will often kill the entire plant, but are slower acting and limited by short contact times. We examined whether combinations of contact (endothall) and systemic (2,4-D and triclopyr) herbicides might exploit the strengths of each herbicide class, and minimize their weaknesses. Eurasian watermilfoil was treated with combinations of endothall (Aquathol-K) with either 2,4-D (DMA-4 IVM) or triclopyr (Renovate 3). Our goal was to determine if there is a potential additive or synergistic effect with these two compounds, or screen for potential interference. The liquid formulation of endothall was evaluated alone (at either 1.5 or 1 ppm with a 24-hour exposure) and in combination with 2,4-D or triclopyr at a rate of 1 ppm endothall with 0.5 ppm of 2,4-D or triclopyr at both 12 and 24 hours of exposure. Each treatment, and a reference were replicated in four tanks, for a total of 36 -

100 gallon tanks. Each tank had seven 1-gallon pots containing “supersoil” growth medium and planted with two sprigs of Eurasian watermilfoil. Plants were allowed to grow for four weeks prior to treatment. One pot per tank was harvested for pretreatment biomass values. Each week, tanks were rated for percent control on a 0-100% scale. Four weeks after treatment, plants were harvested and sorted to shoot biomass. Plants were dried at 70C and weighed for biomass determination. After four weeks, all treatments showed equal control of plant shoot mass, based on a one-way analysis of variance. Analysis of visual ratings indicated that endothall alone provided control the first week after treatment, but percent control was rated at 60%. Triclopyr and 2,4-D alone provided 100% control after two to three weeks, but initial control was less than 20%. All treatments with endothall and a systemic herbicide provided at least 50% control in the first week of treatment, and 100% control after four weeks. Combinations of endothall with either 2,4-D or triclopyr provided the benefits of immediate action in and complete control within four weeks.

Dr. John D. Madsen is Assistant Extension/Research Professor in the GeoResources Institute and the Department of Plant and Soil Sciences, Mississippi State University since 2003. Previously, he was an Assistant Professor of Biology at the Minnesota State University, Mankato from 2000 to 2003; and a Research Biologist in the Environmental Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, MS from 1991 to 2000.

Dr. Madsen has a Bachelor of Science (1980) degree from Wheaton College, Wheaton, IL, and Master of Science (1982) and Doctor of Philosophy (1986) degrees in Botany from the University of Wisconsin-Madison.

Evaluation of Aquatic Herbicides for Control of Variable Milfoil

Dr. Michael D. Netherland
Research Biologist
US Army Engineer Research and Development Center
University of Florida Center for Aquatic and Invasive Plants
7922 NW 71st Street
Gainesville, FL 32653
mdnether@ufl.edu

Variable milfoil (*Myriophyllum heterophyllum* Michx.) is invasive in waters of the Northeast United States. Anecdotal reports suggest that it is difficult to control, but exposure time relationships for available aquatic herbicides have not been systemically investigated against variable milfoil. We completed laboratory and mesocosm evaluations to compare efficacy of 11 active ingredients (2,4-D, bispyribac, carfentrazone, copper, diquat, endothall, flumioxazin, fluridone, imazamox, penoxsulam, triclopyr) that are either currently registered for aquatic use or those that are being evaluated under an experimental use permit (EUP). Products were separated by mode-of-action, with the most effective systemic auxin analog, systemic enzyme inhibitor and contact herbicides identified. The butoxyethylester (BEE) formulation of 2,4-D was proven to be the most effective systemic auxin analog, and was consistently more effective than either the liquid 2,4-D or triclopyr amines when evaluated at similar use rates and exposures. Treatment with low doses (100 to 400 ppb) and extended exposures (7 to 14 days) of 2,4-D and triclopyr can be highly effective for control of variable milfoil. These treatments proved more effective than high dose (2 to 4 ppm) and shorter-term exposures (6 to 18 hours). Increasing pellet density can improve efficacy of 2,4-D and triclopyr treatments in areas where high rates of water exchange are likely to result in short exposure times (spot applications, flowing systems). Carfentrazone was the most effective contact herbicide, providing excellent control (>85%) with rates ranging from 100 to 400 ppb and exposure periods of greater than 2 hours. While diquat was also effective on variable milfoil at rates of 180 and 375 ppb, it required a significantly longer exposure period (>20 hrs) to give comparable efficacy to carfentrazone. The addition of copper to diquat did not significantly increase efficacy or reduce the exposure requirements. Fluridone and penoxsulam were the most effective systemic enzyme inhibitors and controlled variable milfoil at rates ranging from 5 to 20 ppb while imazamox and bispyribac showed weak herbicidal activity at rates up to 50 ppb. All acetolactate synthesis (ALS) inhibitors will require extended exposure periods (>90 days) to provide adequate control. Studies to develop herbicide application strategies are underway. Initial studies on the impact of water temperature on carfentrazone and 2,4-D BEE efficacy showed no significant response differences at water temperatures of 61 F (16 C) and 75 F (24 C), signifying that both products could be applied throughout the spring and summer months.

Mike Netherland is a Research Biologist for the US Army Engineer Research and Development Center. He is located at the University of Florida Center for Aquatic and Invasive Plants and is a courtesy Associate Professor in the Department of Agronomy. Dr. Netherland received an M.S. in Botany and Plant Pathology from Purdue University and his Ph.D in Agronomy from the University of Florida. His dissertation topic evaluated the response of hydrilla tubers to various forms of management. From 1998 to 2003 Mike was employed by the SePRO Corporation as the Research Director for Aquatics. Both public and private sector research has focused on the response of exotic and native submersed plants to experimental and EPA registered herbicides. Dr. Netherland has worked with *Myriophyllum* spp. since 1988, and has conducted extensive research at the laboratory, mesocosm, and field-scale evaluating various control methods.

Replacing Variable Water Milfoil with Native Species in Lake Massasecum: Plant Data and Analysis of Results

Wendy Gendron and Kenneth J. Wagner (ENSR Corporation, 11 Phelps Way, P.O. Box 506, Willington, CT 06279. kwagner@ensr.aecom.com) and Amy Smagula (NHDES, 29 Hazen Drive, Concord, NH 03301. asmagula@des.state.nh.us),

Wendy Gendron
ENSR Corporation
2 Technology Park Drive
Westford, MA 01886
wgendron@ensr.aecom.com

The north end of Lake Massasecum has a substantial infestation of variable water milfoil, *Myriophyllum heterophyllum*, that has been largely contained by fragment barriers and mechanically harvested over several years without elimination. As part of an experimental program to evaluate the efficacy of milfoil replacement by suction harvesting and replanting of native vegetation, two acres of this six acre cove were treated in August of 2005, leaving about an acre of milfoil unaddressed. Suction harvesting and planting efforts were documented in video form, and will be presented as a video. Methods development and procedural tips for maximizing effectiveness of the suction harvesting and planting programs are offered and presented visually, giving viewers a clear understanding of the process and both its limitations and potential.

Suction harvesting of variable water milfoil and planting of native vegetation from elsewhere in Lake Massasecum in 2005 was monitored by video transects through 16 treatment plots and 3 control plots, as well as two plots from which the native plants were collected. Video frames were analyzed for plant types, cover and four general density categories, facilitating an analysis of the success of suction harvesting and the resulting plant community. A number of quality control checks were performed, indicating good agreement between observers but a potential for somewhat different results from different transects through the same plot, although at the level of change sought through harvesting and planting, these sources of error were minor. Suction harvesting removed approximately 87% of the milfoil, while reducing native species by about 42%. Planting increased native density by 3 to 10%. Regrowth of milfoil by June of 2006 was minimal, but so was expansion of planted vegetation. Milfoil had not colonized areas from which native plants were collected for planting in the target plots. Control areas still exhibited substantial milfoil growths. Results from the remainder of the 2006 growing season will be presented as well.

Ms. Gendron is an Aquatic Ecologist at ENSR and a Certified Lake Manager through the North American Lake Management Society. She has over 10 years experience in water resources management. Ms Gendron is active in organizations dedicated to the health and welfare of lakes and other water resources. She is the Secretary of the North East Chapter of NALMs and the Membership Committee Chairperson for NALMS. Ms. Gendron has performed and designed numerous diagnostic feasibility studies, nutrient and bacteria TMDLs, watershed restoration studies throughout her career. Recently, she has been involved with two milfoil research projects with the NHDES. She will be presenting the results of one of these projects for us today.

Understanding Eurasian Watermilfoil: Nutrients, Growth and Invasion

Swinton, M. * & C.W. Boylen

Mark Swinton
Darrin Fresh Water Institute and Department of Biology
Rensselaer Polytechnic Institute
Troy, NY 12180
swintm@rpi.edu

Although Eurasian watermilfoil, *Myriophyllum spicatum*, continues to invade new lakes yearly throughout North America, little research has been focused on the nutrient requirements of this exotic species and why some lakes are more susceptible to infestation than others. Eurasian watermilfoil was discovered in 1985 in Lake George, a large oligotrophic lake in upstate New York. While it has continued to spread to new locations around the lake, we have seen bed boundaries ebb and flow at several sites. In 2003 we initiated a project to look at milfoil bed development and biomass production relative to nutrient requirements and acquisition. Two sites have received particular attention. Within these beds, milfoil dominance approached 100% while the natives consisted of 5-6 species. Plant height and density were 3 to 4 times that of the natives, respectively. Bed density has been measured by traditional methods as well as with new sonar technologies providing greater detail in bathymetry, plant growth and sediment composition within the respective communities. A consistent sampling protocol has shown growth differences between milfoil and native plant communities. Sediment nutrient chemistry appears important to the outward expansion of the beds. While porewater chemistry has shown that milfoil is able to pull nitrogen from a greater depth than that of native plants, a similar correlation with phosphorus has not been detected. Also, the percent of organic content is consistently lower in the milfoil beds than in the native communities. The control of milfoil bed development is presented here in terms of nutrient acquisition.

\Mark Swinton is currently a graduate student at Rensselaer Polytechnic Institute in Troy, NY. After receiving his BS in Marine Biology from Roger Williams University in RI, he moved to FL where he designed, built and ran a fish farm and hatchery. When the company was bought out he decided to return to school and completed his MS at SUNY Albany dealing with behavioral toxicology. Mark returned to his love for the aquatic environment when he began work with Dr. Charles Boylen attempting to better understand Eurasian Watermilfoil's ability to out-compete native macrophytes and determine the nutrient and trophic changes associated with these invasions in an oligotrophic lake.

Hydrocharitaceae the Frogbit Family, Friend or Foe?

C. Barre Helllquist, Ph.D.
Professor Emeritus
Massachusetts College of Liberal Arts
North Adams, Massachusetts 01247
bhellqui@mcla.edu

Hydrocharitaceae, the frogbit family, is the source of numerous invasive species in North America and the northeast. This family has a diverse group of genera including the common *Vallisneria* and *Elodea*. Invasive species in the northeast including *Egeria densa, Hydrilla verticillata*, and *Hydrocharis morsus-ranae*, The native *Elodea canadensis* and *E. nuttallii* are weedy in various locations. Most Hydrocharitaceae genera and species have the potential to become invasive in North America, including the Federally-listed *Ottellia alismoides*. This and other species readily available on the internet pose a threat to water bodies in the United States and Canada

----

Barre Hellquist received his Ph.D. from the University of New Hampshire, working on the distribution of the *Potamogeton* as influenced by water chemistry. He taught Biology at Massachusetts College of Liberal Arts, North Adams, Massachusetts and retired two years ago. He continues his writing and research on aquatic plants. He is coauthor of "Aquatic and Wetland Plants of Northeastern North America", has contributed to the treatments of various aquatic families in the "Flora of North America", "Flora of Australia", Flora of the San Juan River Basin (four corners area), and the Flora of China. His present research interest is the waterlilies of tropical Australia, and the taxonomy of the *Potamogeton* of the world.

PANEL DISCUSSION

Fish Eye View: Plant Management from the Fisheries Perspective

Panel Participants

Shawn P. Good
Fisheries Biologist
Vermont Dept. Fish & Wildlife
271 North Main St., Suite 215
Rutland, Vermont 05701-2423
shawn.good@state.vt.us

Stephen G. Perry, Chief
Inland Fisheries Division
NH Fish and Game Department
11 Hazen Drive
Concord, NH 03301
sperry@wildlife.state.nh.us

Peter Aarrestad
Supervising Fisheries Biologist
Habitat Conservation and Enhancement Program
CT DEP Inland Fisheries Division
Hartford, CT 06106
peter.aarrestad@po.state.ct.us

Timothy J. Sinnott
Biologist 2 (Ecology)
Ecotoxicology and Standards Unit
Division of Fish, Wildlife & Marine Resources
New York State Dept of Environmental Conservation
625 Broadway
Albany, New York 12233-4756
txsinnot@gw.dec.state.ny.us

Matt Sanderson
Sr. Aquatic Biologist
NYSDEC
Region 8 Bureau of Fisheries
mjsander@gw.dec.state.ny.us

Water Chestnut Control and A Caged Fish Study of the Aquatic Herbicide Glyphosate.

Co-Presenters: Eric A. Paul and Robert Fahy

Eric A. Paul, Biologist 1 (Ecology)
NYSDEC
Aquatic Toxicant Research Unit
NYSDEC - Rome Field Station
8314 Fish Hatchery Road
Rome, NY 13440
eapaul@gw.dec.state.ny.us

Robert Fahy
Certified Aquatic Herbicide Applicator
Upstate Applications, Inc
PO Box 486
Wayland, NY 14572
UpstateApplications@frontiernet.com

Water chestnut (Trapa natans) is an invasive aquatic plant in several lakes in NYS. Previously only one 2,4-D granular formulation was specifically labeled for water chestnut control (the BEE formulation in Aqua-Kleen® and Navigate®). While other problem aquatic plants have a number of options using registered aquatic herbicides, the choices for water chestnut were very limited. Recently, two liquid herbicides have been approved for topical application to water chestnut with a FIFRA 2(ee) recommendation for an unlabeled pest (water chestnut). The herbicides are a 2,4-D Dimethylamine formulation (Weedar 64®) and a formulation of glyphosate (Rodeo®).

In our study, Rodeo® was applied to a 10-acre plot of water chestnut in the Second Creek Bay of Sodus Bay, Wayne County, New York. Applications were made to a dense mat of water chestnut, as well as the sprayings of isolated, small groups of plants. We achieved our goal of 80% control in the dense mat, but the small groups of plants were not controlled to any appreciable degree. While seeds were produced, past studies have shown that these seeds are not viable. The results of additional sites that were treated in this fashion as well as "lessons learned" from these applications will be presented.

In addition, we conducted a caged fish study examine the potential non-target toxicity from this operational glyphosate treatment. Cages with fish were placed in treated and untreated sites in the lake 24 hours prior to treatment. All cages were checked immediately before treatment, and following treatment at 4 hours, 24 hours, and daily after that for a period of 7 days. Water samples were also taken at each time period for glyphosate analysis. While some mortality occurred in the treated sites when compared to untreated reference sites, it seems unlikely to be due to the application of the herbicide. The results of laboratory toxicity tests, which we conducted with Rodeo®, when compared to the chemical analysis from the water samples confirm this supposition. It appears that the mortality observed was due to poor water quality, specifically dissolved oxygen in the treated sites. Additional research is planned.

Eric A. Paul is a Biologist 1 (Ecology) for the New York State Department of Environmental Conservation at the Aquatic Toxicant Research Unit. He has served in that position for the past 16 years. His responsibilities currently include planning and conducting toxicity studies of pesticides to fish, amphibians, and other aquatic life. He has conducted toxicity studies of several aquatic herbicides to fish and other aquatic life. He has conducted several Fish and Wildlife reviews of pesticides which have been submitted for registration to New York State. He prepares reports for publication in scientific literature. He has a BS in Biology and a MS in Ecology from The Pennsylvania State University. He has published the results of several of his studies in several scientific journals. Some of these articles include: The toxicity of diquat, endothall, and fluridone to the early life stages of fish; A Comparison of the Toxicity of Synergized and Technical Formulations of Permethrin, Sumithrin, and Resmethrin to Trout; Fish and wildlife related impacts of pesticides used for the control of mosquitoes and blackflies; Fish and Invertebrate Sensitivity to the Aquatic Herbicide AquaKleen®

Bob Fay received a degree from Ithaca College in 1975. He has been involved with small business his whole career and has been working in aquatics since 1996. He also performs chemical applications to apple and potato crops every fall. Bob is married and has two children.

Comparison of Fish Community Characteristics in Waneta And Lamoka Lakes After a Whole Lake Fluridone Treatment in Waneta Lake

Matthew J. Sanderson
NYS Department of Environmental Conservation
6274 East Avon-Lima Road
Avon, NY 14414
mjsander@gw.dec.state.ny.us

James M. Haynes
Dept. of Environmental Science and Biology
SUNY College at Brockport
350 New Campus Drive
Brockport, NY 14420
jhaynes@brockport.edu

Fisheries surveys in Waneta and Lamoka Lakes from 2003 to 2006 were conducted to assess potential changes in the fish community of Waneta Lake after an April 2003 whole-lake treatment with the herbicide fluridone. A variety of standard fishery statistics were used to compare and evaluate potential differences in the status of fish populations between lakes, years, and seasons. Very few significant differences were detected. Abundance of chain pickerel and yellow perch was higher in Lamoka, and smallmouth bass abundance was higher in Waneta. Pumpkinseed, bluegill and yellow perch were longer and heavier in Waneta than in Lamoka Lake, largemouth bass were longer and heavier in Lamoka than in Waneta Lake. However, there were no significant interaction effects among lakes and years suggesting that something unusual happened in 2003 in Waneta Lake. Longer and heavier pumpkinseed and bluegill in 2003 may suggest that the fluridone treatment had a short-term effect on reproduction and recruitment, but because their ages did not differ among years this hypothesis is weak. Smallmouth bass in Waneta Lake were longer, heavier and older in 2003 than in 2004 and 2005; therefore, reproduction or recruitment may have been impaired as a result of the fluridone treatment in 2003. Although it was not detected clearly by the statistical analyses of catch per unit effort, the number of yellow perch caught in October 2004 and May 2005 declined sharply in Waneta Lake and rose exponentially in Lamoka Lake. This may have occurred due to loss of aquatic macrophyte habitat after the fluridone treatment that lead to increased natural mortality or poor year classes in Waneta but not Lamoka Lake. Overall, the four years of data examined do not appear to show that the fluridone treatment of Waneta Lake adversely affected the fish community. If loss of cover for juvenile fish or loss of food and cover for invertebrate prey of juvenile fish exists in Waneta Lake, it has yet to manifest itself in a detectable way.

Matt is a Senior Aquatic Biologist with the Region 8 Fisheries Unit of the New York State Department of Environmental Conservation in Avon, New York. He began his career with the DEC in 1988 at the New York City regional office as a regional Habitat Protection Biologist. In 1989, he transferred to Avon to become Region 8's Habitat Protection Biologist and moved over to the Fisheries Unit in 1998. Matt is responsible for fisheries management activities in Monroe, Wayne, and Orleans counties. Resources include Lake Ontario and it's tributaries, Conesus Lake (one of the western finger lakes), and two blue ribbon trout streams. He provided fisheries oversight of three major rainbow trout stream restoration. On a region-wide level, he coordinates with other Department programs to provide fisheries input into aquatic vegetation management programs. From July, 1986 to July, 1988, he worked for the Natural Resources Group of the New York City Department of Parks & Recreation, where he coordinated wetland restoration grant applications, devised a park water body analysis and management program, and conducted limnological studies of several park lakes, which resulted in management and restoration recommendations. Matt obtained his MA degree in Ecology (1981) and BS degree in Biology with a minor in Environmental Science (1979) from the State University College at Geneseo, New York.

Responses of Sentinel Non-Target Species to Copper-Containing Algaecides

Brenda M. Johnson, O'Niell R. Tedrow, Charles R. Sisson, Jr., Andrew D. McQueen, Matthew M. Chao, and John H. Rodgers, Jr.
Clemson University, Department of Forestry and Natural Resources

Brenda Johnson
Department of Forestry and Natural Resources
Clemson University
261 Lehotsky Hall
P O Box 340317
Clemson, SC 29634-0317
bjohns5@clemson.edu

Comprehensive risk assessment requires accurate estimates of potential adverse effects of algaecides applied to aquatic systems for the control of algal species. In this research, responses of freshwater fish (fathead minnow-*Pimephales promelas* Rafinesque and bluegill-*Lepomis macrochirus* Rafinesque) and invertebrates (water flea-*Daphnia magna* Straus and scud-*Hyalella azteca* Saussure) to aqueous exposures of Algimycin®PWF and copper sulfate were measured using US EPA protocols. These laboratory experiments were conducted in moderately hard water (pH 7±1.5, D.O. 8±2 mg O_2 / L, temperature 23±1°C, conductivity 130-350 µS / cm^2, alkalinity 40-80 mg $CaCO^3$ / L, hardness 40-80 mg $CaCO^3$ / L) with exposures ranging from 48 to 96 hours. Invertebrates were more sensitive than fish to both forms of copper. Copper sulfate was more toxic to non-target species than Algimycin®PWF. For "typical" applications, margins of safety are clear for fish but not for invertebrates. Other considerations for risk assessment include residence time in the water column after applications and copper's lithic biogeochemical cycle (affinity for sediments).

Brenda Johnson is a graduate research assistant in the Ph.D program at Clemson University, SC working with Dr. John Rodgers. She received a B.S. (2000) in environmental science from the University of Wisconsin-River Falls, and a M.S. (2006) in environmental toxicology from Clemson University. Her thesis involved design of constructed wetland treatment systems for produced water. Her dissertation research will focus on mitigating impacts of invasive *Lyngbya* on manatees and other endangered species in Crystal River, FL.

Do Algae Spill Their Guts After Treatment with Algaecides?: A Test of the "Leaky Cell" Hypothesis.

John H. Rodgers, Jr., O'Niell Tedrow and Maurice Duke
Clemson University, Department of Forestry and Natural Resources

Dr. John Rodgers
Department of Forestry and Natural Resources
Clemson University
261 Lehotsky Hall
P O Box 340317
Clemson, SC 29634-0317
jrodger@clemson.edu

Microcystis aeruginosa, a planktonic cyanobacterium, produces microcystin which is a potent toxin affecting mammals and fish at relatively low concentrations (≥1µg/L). In order to mitigate risks from this harmful alga in

water resources, copper-containing algaecides and other materials are applied as treatments in critical situations such as potable water supplies, recreational areas, and livestock watering. These treatments reportedly cause the treated *Microcystis* to "leak" toxin to the surrounding water resulting in a local increase in microcystin concentration. We investigated the "leaky cell" hypothesis under controlled conditions in the laboratory. Water from Pawnee Reservoir (Lancaster County, Nebraska) containing a "bloom" of *Microcystis* was exposed to a series of concentrations (0.1 – 1.0 mg/L) of Cutrine Ultra, Clearigate and Algimycin PWF and copper sulfate. Concentrations of microcystin in post-treatment samples were compared with concentrations in pre-treatment samples and untreated controls. No statistically significant increase in toxin production was observed in post-treatment samples after a 96h exposure period. Observation of toxin release which is widely cited in instances where algaecides are considered as temporary solutions for mitigating risks of toxin production may be limited to situations where excessive applications of algaecides are used or unusual strains of *Mycrocystis* are present. In this case, growth of *Microcystis* in Pawnee Reservoir water was controlled with an application of 200 µg Cu/L as Cutrine-Ultra.

John Rodgers is a professor of environmental toxicology in the department of forestry and natural resources at Clemson University, SC and he is co-director of the Clemson Environmental Institute. He has worked on water resources for thirty years.

Cyanobacteria: Can They Make You Blue, or Green, or Dead?

Kenneth J. Wagner, Ph.D, CLM
ENSR
11 Phelps Way, P.O. Box 506
Willington, CT 06279-0506
KWagner@ensr.aecom.com

Cyanobacteria, or blue-green algae, are photosynthetically pigmented bacteria that include a variety of sub-groups, some of which are known for taste/odor and/or toxicity. Many have buoyancy mechanisms that can result in surficial scum formation, and most planktonic forms can become abundant enough to affect water appearance and quality. Increased phosphorus levels and decreased nitrogen:phosphorus ratios tend to favor b Cyanobacteria. Some forms are associated with "clean" conditions, and the presence of low levels of Cyanobacteria represent a minimal threat to ecological or human health. However, the potential for elevated abundance, concentration at the surface of the water column, and production of taste/odor and toxic compounds cause Cyanobacteria to be considered nuisance organisms.

Unfortunately, the taxonomy of Cyanobacteria is complicated, and production of taste, odor and toxicity is not consistent or correlated with each other. Management to be safe may be overly restrictive, but failure to recognize risks can be fatal. While human deaths due to toxic Cyanobacteria are relatively rare, they have occurred, and deaths of livestock and pets are more common. Testing for the most common toxin, microcystin, is now inexpensive in bulk quantities, but testing for other toxins remains expensive. Declining water clarity has some value as an early warning sign, supported by identification and cell counts, and possibly with toxicity testing where warranted. However, this approach requires considerably more resources than traditionally applied. Development of inexpensive toxicity tests is needed.

Management in response to Cyanobacteria blooms should focus on bloom prevention, usually through nutrient controls, but potentially through mixing. Where algaecides are applied they should be applied early in the bloom formation process for maximum effectiveness and minimum potential impact to ecological and human health.

Dr. Wagner holds a B.A. in Environmental Biology from Dartmouth College and M.S. and Ph.D. degrees in Natural Resource Management from Cornell University. He had four years of experience with the New Jersey Department of Environmental Protection between his undergraduate and graduate degree programs, working primarily with the Division of Water Resources in lake and stream assessment and management. He has since gained over 20 years of experience with northeastern US consulting firms, working on a variety of water resources assessment and management projects. Projects have included a range of algal assessment and management efforts, many involving Cyanobacteria. Remedial actions have included nutrient controls in the watershed and lake, mixing strategies, biomanipuation, and algaecide applications. He has been involved in several state working groups considering appropriate monitoring requirements and responses to Cyanobacterial problems.

Using GIS to Map Invasive Aquatic Plants in Connecticut Lakes

Roslyn Selsky, Gregory J. Bugbee and Jason C. White, Invasive Aquatic Plant Program, Connecticut Agricultural Experiment Station, 123 Huntington Street, P.O. Box 1106, New Haven, CT 06504

Roslyn Selsky
Roslyn.Selsky@po.state.ct.us

The Connecticut Agricultural Experiment Station's (CAES) Invasive Aquatic Plant Program (IAPP) is using GIS to determine the distribution of invasive aquatic plants in Connecticut lakes and ponds. In a first-of-its-kind survey in Connecticut, locations of plant species were recorded using a Trimble GeoXT and then downloaded to ArcGIS 9. Observed plant areas, converted into georeferenced polygons, were also added to the map. These maps are used on CAES IAPP's website (http://www.caes.state.ct.us/aquaticplants/) to educate the public on the subject of invasive aquatic plants, to provide baseline data useful in determining how native aquatic plant communities change in response to invasion, and to track the spread of invasive aquatic plants in Connecticut water bodies. GIS models will be used to predict future invasions in Connecticut lakes and ponds by comparing factors such as water chemistry, land use, and sediment type with successful invasions. Ultimately, GIS data will be used in the management of invasive aquatic plants in Connecticut.

Roslyn Selsky is a researcher with the Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program. Roslyn surveys the lakes of Connecticut for invasive aquatic plants, and handles all of the program's GIS and data needs. She received her masters in Conservation and Biodiversity from the University of Connecticut.

Expanding the Spatial Efficacy of Macrophyte Monitoring: Lessons Learned from Application of Hydroacoustics.

Jeremy Farrell, James Harrison, Lawrence Eichler, Charles Boylen

Jeremy Farrell
Darrin Fresh Water Institute
RPI
Bolton Landing, NY 12814
farrej2@rpi.edu

Surveillance of nuisance submersed aquatic vegetation (SAV) such as Eurasian watermilfoil, *Myriophyllum spicatum L*, is a major aspect of managing freshwater systems. Traditional methods for monitoring macrophyte growth and locating new infestations (scuba surveys) can prove to be time-consuming, labor-intensive, and even inaccurate and ineffective across large spatial scales. Advances in hydroacoustic technology and associated processing software, along with substantial reductions in unit costs, are enabling its application as an important tool for SAV identification at a much larger scale than attainable by traditional survey methods. As part of an ongoing long-term littoral zone study of Lake George, a large, oligotrophic lake in the southeastern Adirondack Mountains in upstate New York, we have tested the large scale efficacy of hydroacoustic technology in providing accurate identification and mapping Eurasian watermilfoil. All results from hydroacoustic work were compared to scuba surveys. Results showed that hydroacoustic surveys could provide accurate large scale identification and mapping of Eurasian watermilfoil sites; however, site specific characteristics must be accounted for and applied to data analysis to ensure survey accuracy and compatibility to traditional survey methods. Methods discussed include site specific calibrations, data acquisition parameters, and processing control for saving data excluded due to 'noisy' or 'out of water' pings, frequently encountered in areas with heavy SAV growth. Hydroacoustic data was collected with a Biosonics DT-X unit with a 9.5° split beam, 430khz transducer mounted on a biofin. Software used for plant analysis included Biosonics EcoSav, Biosonics Visual Analyzer, MapInfo, and Surfer8.

Geographic Patterns of Multilocus Genetic Variation in Variable Milfoil

Dr. Ryan A Thum
University of Illinois
rthum@uiuc.edu

Variable milfoil, *Myriophyllum heterophyllum*, has become a major management concern in the northeastern US. The reason for concern is its apparently recent invasion into states where it is not currently listed as native. In some of these water bodies, *M. heterophyllum* forms dense monocultures that negatively impact desired lake attributes. However, limited information regarding the taxonomy and distribution of milfoil lineages continues to challenge management efforts, including the determination of management status (e.g., native versus non-native) of focal populations. As such, it remains unclear whether nuisance populations currently identified as *M. heterophyllum* represent range expansions of non-native lineages versus population outbreaks of native lineages. To begin addressing this problem, I have begun a genetic survey of plants identified as *M. heterophyllum* from geographic areas where the species is considered non-native versus native. The molecular markers include DNA sequences from both nuclear (ITS) and chloroplast DNA (trnL-trnF) and microsatellite markers. I contrast observed patterns of relatedness among individuals using different molecular markers (e.g., nuclear versus chloroplast DNA sequences) and discuss alternative explanations for these patterns, including variation in rates of molecular evolution, hybridization, and retention of ancestral genetic polymorphisms due to recent evolutionary divergence. I discuss the implications of these genetic patterns for determining management status of focal populations and stress the importance of broader taxonomic, geographic, and genomic sampling in future work.

I received my undergraduate education at the Florida State University in 1998 and moved to Dartmouth College, where I received my PhD in 2004. My research considers the interactive roles of ecological variables, evolutionary dynamics, and historical biogeography for determining species' geographic ranges and community composition. Much of my basic research is conducted in lake ecosystems, with particular emphasis on zooplankton. However, over the past several years I have become increasingly interested and engaged in research focusing on the factors that determine the distribution and abundance of non-native variable water-milfoil. I have had many great collaborators on these projects and we have made a tremendous amount of progress with molecular genetic tools for studying milfoil biogeography.

The Development of Microsatellite Markers as Tools for Management of Milfoils

Michael Bronski, Steven Bogdanowicz, and Ryan Thum

Michael Bronski
Cornell University
mjb77@cornell.edu

Genetic tools are becoming increasingly important for the identification of native versus non-native milfoil species and invasive lineages. To date, molecular identification methods have used DNA sequences from single genes (e.g., ITS). While useful in many circumstances, these single gene approaches have several limitations, including but not limited to 1) low level of genetic resolution because of slow evolutionary rates and 2) idiosyncratic patterns of genetic relatedness among individuals because single gene genealogies do not necessarily reflect the true pattern of evolutionary descent or pedigree. Molecular methods employing multiple genetic markers scattered throughout the genome, such as microsatellites, have the potential to alleviate these problems. Here, we describe the development of a microsatellite library for *Myriophyllum heterophyllum*. We present microsatellite data from a pilot survey of milfoils and discuss the utility of our microsatellites for studying patterns of genetic variation within *M. heterophyllum* and identifying milfoil species. We discuss the general importance of fine and coarse scale geographic sampling for molecular identification of milfoil lineages and suggest additional directions for the development of genetic tools for management questions.

Michael Bronski attended Cornell University as an undergraduate where he received degrees in Biological Sciences and Government. As an undergraduate he worked for Dr. Richard Harrison studying the genetics of speciation in the European Corn Borer (ECB). He is currently employed by Cornell University where he is developing two microsatellite libraries for Dr. Jeff Doyle. These libraries will be used to study the evolutionary relationships and population genetics of perennial soybeans. He also continues his research on the ECB in the Harrison Lab. Michael began his work on invasive milfoils while also an undergraduate at Cornell. With a strong background in molecular genetics, Michael's chief interest in milfoil was using molecular genetics to answer basic questions about invasive species, with the ultimate goal of informing management strategies. Working with Post Doctoral Researcher Ryan Thum, Michael helped to develop a microsatellite library for *Myriophyllum heterophyllum*.