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Talks and Poster Abstracts from Darrin Fresh Water Institute Researchers and Collaborators

(Bold type indicates speaker)

Species Introductions and the Effect on Native Fish Distribution in Adirondack Lakes

Robert Daniels (New York State Museum, Albany, NY), James Sutherland (New York State Department of Environmental Conservation, Albany, NY), and Charles Boylen (Department of Biology and Darrin Fresh Water Institute, Rensselaer Polytechnic Institute, Troy, NY)

Twenty-six taxa of fish were taken in eighteen lakes in the southwestern quadrant of the Adirondack Park, Herkimer and Hamilton counties, NY. Species richness in the lakes ranged from 1 to 18 species. Although the lakes studied are in one ecoregion and often in the same subdrainage, species composition differed among lakes, and composition and abundance differed within lakes over time. Most lakes support a rich, viable assemblage, although all but one includes, and many are dominated by, exotic species. We compare current species composition to that reported in surveys conducted in the lakes over a 75-year period. Assessments of the fish assemblage composition in these lakes, when compared over time, showed marked differences. These differences might be the result of several factors, but the presence of exotic taxa and extirpation of native fishes can explain gross changes in fish assemblage composition in these Adirondack lakes. We review the status of native fishes in these lakes, discuss the current distribution of these fishes, and relate that to environmental conditions and the distribution of exotic species.

Brooktrout Lake Fisheries and Macroinvertebrates from the Hydroacoustic Perspective

Jeremy Farrell, James Sutherland, Brian Keleher, Charles Boylen, and Sandra Nierzwicki-Bauer (Darrin Freshwater Institute, Troy, NY)

During the early 1900s, Brooktrout Lake (Hamilton County, NY) anecdotally had a thriving Brook Trout (*Salvelinus fontinalis*) community. Through the surveys of the 1900s the fishery was completely decimated by the influx of acid deposition, with the last recorded catch in 1975. By 1990, the US Congress passed the Clean Air Act Amendments that curtailed much of the acid deposition in the Adirondack Park. The EPA-funded Adirondack Effects Assessment Program (AEAP) began monitoring the chemical and biological response to the legislation in 1994 and noted that by the mid-2000s Brooktrout Lake had undergone enough "recovery" to possibly support fish again. In 2005, a fish reintroduction experiment was initiated, and to date, a total of 4000 fingerlings and 19 adult fish have been stocked in the lake. Hydroacoustic surveys have been conducted on the lake since that time to assess the impact, survivability, and sustainability of this reintroduced fish population. Early hydroacoustic estimates of fish populations were hindered by the small number of adult fish and a large population of phantom midge larvae (*Chaoborus americanus*) that masked the signal of the fingerlings when using a high frequency transducer (430 kHz). The hydroacoustics signal along with towed nets and zooplankton traps have been used to extensively map this phantom midge population diurnally and seasonally since 2005. Starting in 2009, more accurate fish population estimates have been achieved through utilization of a lower frequency (70 kHz) transducer. Hydroacoustic fish estimates have been verified with gill netting concurrent with surveys when possible.

Discovery and Eradication/Management Strategy for Asian Clam Invasion of Lake George

Sandra Nierzwicki-Bauer and **Jeremy Farrell** (Darrin Fresh Water Institute and Department of Biology, Rensselaer Polytechnic Institute, Troy, NY), Dan Marelli (Scientific Diving International), and Steven Resler (InnerSpace Scientific Diving)

On 19 August 2010, *Corbicula fluminea* (Asian Clam) was discovered in Lake George, NY. Subsequent to its discovery, a substantial effort to delineate its distribution within the lake was undertaken. Distribution surveys included SCUBA point-intercept coring, SCUBA transects, and Ekman dredging. Through this series of surveys the Asian Clam population was mapped to a distribution of less than 3.5 ha and within a 500-m proximity to its initial discovery. A working group of numerous agencies (APIPP, APA, FUND for Lake George, ISSD, LCBP, LGA, LGPC, SCIDI, NYSDEC, RPI/DFWI, LGWC, VTDEC) was formed, and steps to identify potential eradication or management strategies were initiated. Benthic barrier installation was identified as a promising strategy that should be explored because only limited research on the effectiveness of benthic barriers for killing Asian Clams exists. Therefore, a study was conducted to test the efficiency of different benthic barrier types (Rubber (EPDM), PVC, Torn PVC repaired with Gorilla Tape, Torn PVC repaired with adhesive patches) and duration of deployment (15 days, 30 days, 45 days, and 45 days with an interruption at day 15) at two sites within the infested zone. Results were compared with a control area at each site (no treatment). Dissolved oxygen and ammonia concentrations were quantified from 9 locations under each mat type plus three from the control areas on each of the first five treatment days and every fifth day thereafter, concluding after 45 treatment days. Clam mortality was quantified by analysis of sediment cores collected from locations near to where samples were collected for the chemical analyses. Results from the delineation mapping and this initial benthic barrier pilot study will be discussed and are being used to guide a larger-scale management effort that will be carried out in Spring 2011.

Application and Use of a Lay Monitoring Program for Lake George, New York

Ahrens L.E., L.W. Eichler and C.W. Boylen (Darrin Fresh Water Institute, Rensselaer Polytechnic Institute, 5060 Lakeshore Drive, Bolton Landing, NY, ph: 518-644-3541, ahrenl@rpi.edu)

Established in 1980, the Lake George Lay Monitoring Program celebrated its 31th anniversary in 2010. The primary goal of the program is the collection of a large amount of physical data over a long period of time through the voluntary efforts of Lake George basin residents. Lake George is a large, softwater, oligotrophic lake located at the southwest margin of the Adirondack Park in northern New York State. Long-term volunteer monitoring of changes in physical characteristics of the lake have been documented in a relatively cost-effective manner in the current program. A beneficial side effect of the Lay Monitoring program is the opportunity to educate basin residents with hands-on experience about lake water quality and techniques used to study freshwater ecology. Lay monitor secchi readings are combined with total phosphorus and chlorophyll analyses performed by the Darrin Fresh Water Institute to provide Carlson Trophic State Index values. Water quality testing and index values generated indicate a continued oligotrophic state for Lake George, signifying relatively low levels of nutrients. Lay monitor data has also demonstrated higher water clarity in the North basin of Lake George compared to the South basin, generally attributed to higher intensity of land use in the south basin. Elevated levels of sediment and nutrients in stormwater run-off from urbanized areas have resulted in decreased water transparency.

Evidence for Zooplankton Recovery in Chemically Recovering Acidified, Adirondack Mountain Lakes

William Shaw, James Sutherland, Charles Boylen ,and Sandra Nierzwicki-Bauer (Darrin Freshwater Institute, Troy, NY), and Bahram Momen (University of Maryland)

Thirty lakes with pH ranging from 4.5–7.1 were studied during 1994–2006 to generate a data base to evaluate chemical and biotic recovery expected with implementation of the Clear Air Act Amendments of 1990. We used regression analysis of pH and zooplankton community variables over time in each lake to identify trends occurring during the 13-year study period. Significant improvements in pH were found in 19 lakes. Biotic recovery was assessed primarily by improvements in species richness and secondarily in species diversity and community evenness. Zooplankton recovery was evaluated by groups in terms of initial pH of lakes at the onset, acidic (pH < 5.7) or circumneutral (pH > 5.9), and by lake hydrotype, according to Driscoll and Newton, to be defined. Evidence for recovery in crustaceans was found in 12 lakes and for rotifers in 13 lakes, 8 of which were for species richness in both groups. All but two of the improvements for rotifers and crustaceans were in lakes with significant improvements in pH. The instances of recovery of crustaceans were relatively weak (r2 = 0.28–0.46) and were largely restricted to the circumneutral lakes, whereas those for the rotifers were stronger (r2 = 0.59–0.71) and generally were restricted to the acidic lake group. Evidence for recovery was greatest in the medium-till drainage lakes and mounded-seepage lakes regardless of DOC, was moderate in the low-DOC, thin-till drainage lakes, and absent in those with high DOC. The meaning of these results and the significance of the hydrotypes will be presented. It appears that rotifer recovery may be more intense and may precede crustacean recovery as formerly acidic lakes return to circumneutral conditions. Overall, the evidence for both chemical and biotic recovery from acidification in the study lakes was limited. Approximately one third of the study lakes did not show any improvement in pH, and only about one half showed any evidence of biotic recovery.

Long Term Changes in Acidity and Other Water Quality Parameters in Adirondack Lakes and Ponds

Jay A. Bloomfield and Scott O. Quinn (Division of Water, New York State Department of Environmental Conservation), and **David Winkler** (Keck Water Research Laboratory, Darrin Fresh Water Institute, Rensselaer Polytechnic Institute)

Between 1984 and 1987, the Adirondack Lake Survey Corporation (ALSC) in cooperation with the New York State Department of Environmental Conservation (NYSDEC), conducted a survey of 1469 lakes and ponds in the Adirondack Mountain ecological zone (http://www.adirondacklakessurvey.org/alscpage.html). In 1996, waters that were considered "fishless" due to acid deposition impacts, were added to the NY 303(d) List (http://www.dec.ny.gov/chemical/31290.html), The 303(d) List contains all the waters in the State with either use impairments or water quality standards violations. In 2006, as per requirements in the Federal Clean Water Act, a total maximum daily load (TMDL) (http://www.dec.ny.gov/docs/water_pdf/tmdlacidrain06.pdf) analysis was conducted for a subset of these fishless waters. Since that time, the NYSDEC has attempted to collect water samples in a standardized fashion for a subset of the waters on the 303(d) List that are listed as being impacted by acid deposition (≈160 waters). This presentation will discuss comparisons of the earlier ALSC data and the more recent NYSDEC data (2007–2010).

Changes in Phytoplankton Assemblages in 30 Adirondack Mountain Lakes in Response to Decreasing Acidic Deposition

Donald Charles , F.A. Acker (Patrick Center for Environmental Research, Philadelphia, PA), P.A. Bukaveckas (Virginia Commonwealth University), and C.W. Boylen, and S.A. Nierzwicki-Bauer (Rensselaer Polytechnic Institute, Troy, NY)

Phytoplankton assemblages in 30 Adirondack lakes changed from 1994 through 2006 in many complex ways. Possible responsible factors are related to reduction in acidic deposition, climate change, and shifts in year-toyear weather patterns. Because assemblage data were from integrated samples of the epilimnion collected two times each summer (late June to early September), there was often important year-to-year variation within a lake because samples were collected at different stages of species succession and because depth and characteristics of the epilimnion changed among years. These sources of variability make it more difficult to determine the relative roles of acidic deposition, climate change, and weather patterns. The average number of phytoplankton taxa increased during the study period, reflects increasing lake pH, and suggests some recovery from acidification. In addition, we evaluated many of the patterns in species composition involving smaller sets of lakes, shorter sets of time intervals, and trends in major functional and taxonomic groups (e.g., flagellates, coccoid cyanobacteria). We attempted to determine if these were consistent with other trends indicating decreasing lake acidity. This research is part of the EPA-funded Adirondack Effects Assessment Program (AEAP), a multi-disciplinary study assessing biological recovery from acidification.

Biotic and Abiotic Ecosystem Component Variation in the Hudson River Estuary

Toby M. Michelena, Charles W. Boylen, Sandra A. Nierzwicki-Bauer

The Hudson River Estuary is a dynamic ecosystem that stretches approximately 154 miles, from the Federal Dam in Troy, New York, to the terminus in New York Harbor. Throughout the reach of the estuary, a series of tributaries merge with the mainstem of the estuary. The mouth of each of these tributaries has a unique physical configuration in the form of small embayments that form the confluence with the mainstem of the estuary. This investigation is designed to characterize the biotic communities and associated abiotic parameters in these embayments. Data collected to date indicates statistically significant variation ($P \leq 0.05$) in both biotic and abiotic parameters including chlorophyll a, benthic invertebrate diversity, nutrients, dissolved oxygen and light penetration as a function of both location and season. Turbidity, as measured by secchi disk readings reveal the two sampling locations outside the estuary have significantly ($P \leq 0.05$) less turbid water than all other sampling locations with a significant increase in turbidity moving north to south. Chlorophyll a concentrations vary significantly ($P \leq 0.05$) both temporally and spatially. Preliminary data indicates a potential spring/fall pattern of peak chlorophyll a concentrations occurring in the northern estuary in the spring and early summer and subsequently moving south in the fall and early winter. The variation in the biotic and abiotic components of these embayments reflect the structural differences of the confluence as well as the chemical and physical inputs that each tributary provides to the estuary. Understanding these differences will be used to help elucidate the role these embayments play within the estuary ecosystem.

Isolation and Identification of Bacteria from *Azolla caroliniana* Extract Grown with Select PPCPs.

Anne Roberts, Charles W. Boylen, Sandra A. Nierzwicki-Bauer (Darrin Fresh Water Institute and Department of Biology, Rensselaer Polytechnic Institute, Troy, New York)

Recently, there has been growing concern over the level of pharmaceuticals and personal care products (PPCPs) appearing in the aquatic environment. The floating fern, *Azolla caroliniana*, presents itself as a novel tool for the remediation of PPCPs. *Azolla caroliniana* is a widely known hyperaccumulator of diverse compounds and contains a multitude of bacterial symbionts within its leaf cavities. Studies have suggested that the bacteria within *Azolla* may use a wide range of organic compounds as energy sources, potentially aiding in the degradation of hyperaccumulated compounds. This research presents preliminary data on the isolation and identification of bacteria from *Azolla caroliniana* extracts capable of growing on media seeded with select PPCPs. To date, bacteria have been isolated capable of growing on R2A agar seeded with 10mM SDS, 100mM ibuprofen, and 100 ug/L 17β-estradiol. This study is significant as it explores the potential role played by bacterial symbionts within the plant and, also, could provide an additional approach for remediation of PPCPs.

Diatoms in Brooktrout Lake Sediments: A Record of Lake Acidification

H. Chandler Rowell[1], Sharon L. Kanfoush[2], Richard Bopp[3] and Charles W. Boylen[4]

Over 200 different diatom taxa were recognized in a 22.5 cm long core taken from Brooktrout Lake in June 2004. The changes in species assemblages through time, dating back to the early 1700s, reflect the lake's history of progressive acidification and its recent recovery. An acidobiontic species, *Fragilariforma acidobiontica*, dominates (>60%) the diatom assemblage in the top 4 cm, representing deposition since 1960. Abundant *F. acidobiontica* in Adirondack lakes has been associated with pH levels below 5.0. Lower in the core species transition over time toward forms of greater acid tolerance. *F. acidobiontica* is absent and acidobiontics are at 10% of the assemblage, but acidophilic species make up as much as 70%, while alkaliphils constitute less than 5%. Through the application of various diatom-based pH index models it is postulated that Brooktrout Lake never had a pH much above 6.0. The top core sample, representing the last 10+ years of deposition, shows a drop in *F. acidobiontica* and associated rise in diatom assemblage diversity, indicative of air SO_2-reduction driven water quality improvement towards the summer mean epilimnetic pH 5.6 reported for the lake in 2005.

[1] Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, NY 12233
[2] Department of Geology, Utica College, Utica, NY 13502
[3] Department of Earth and Environmental Science, Rensselaer Polytechnic Institute, Troy, NY 12180
[4] Darrin Fresh Water Institute, Rensselaer Polytechnic Institute, Troy, NY 12180