2017

Annual Report

of the

Cornell Biological Field Station
Cornell Biological Field Station

Advisory Committee

Director: Lars Rudstam
Facilities Coordinator: Brian Young

Associate Director: Randy Jackson
Station Manager: JoAnne Getchonis

Chair:
Pat Sullivan Chair and Professor, Department of Natural Resources

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Katherine Bunting-Howarth Associate Director, New York Sea Grant Institute
Assistant Director, Cornell Cooperative Extension
Paul Curtis Associate Professor, Department of Natural Resources
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Amy McCune Senior Associate Dean, College of Agriculture and Life Sciences at Cornell University, and Professor, Ecology and Evolutionary Biology
Peter Paradise Assistant Dean of Capital Projects and Facilities, College of Agriculture and Life Sciences at Cornell University
Rebecca Schneider Extension Leader and Associate Professor, Department of Natural Resources
Richard Stedman Professor, Department of Natural Resources; Leader, Cornell Human Dimensions Research Unit

External:
John Farrell Director, Thousand Islands Biological Station, Associate Professor, Department of Environmental and Forest Biology, SUNY College of Environmental Science and Forestry at Syracuse
Brian Lantry Director, USGS Great Lakes Lake Ontario Unit.
Steve Hurst Fisheries Chief, NYS Department of Environmental Conservation
This year was the 61st year of activities at CBFS. Although I was gone for half the time on sabbatical with time spent in Wisconsin, Sweden, Germany and China, everything went well at Shackelton. Randy Jackson, as the acting director, with JoAnne, Brian, Jim and all the others at Shackelton made sure everything was running smoothly. Nice to know that CBFS does very well without me.

Important news for this year is that Jim Watkins and I, with Buffalo State scientists Karatayev and Burlakova, were awarded a large five year grant from the Great Lakes National Program Office to continue our research program on zooplankton and benthos in all five of the Laurentian Great Lakes. This grant and Jackson’s warmwater fisheries grant that is in its 2nd year of 5 provides the majority of funding for CBFS research. But in addition, we teamed up with Karatayev, Burlakova, Lodge, Hairston, Pfrender and Hebert and obtained three connected EPA grants to do barcoding for Great Lakes invertebrates. CBFS scientists and staff continued work on a range of other research projects on both Great Lakes (vertical distribution of salmonids revealed by satellite tags, genetics and habitat constraints for cisco rehabilitation, metabarcoding of mysid diets, the deep chlorophyll layer, amphipod circoviruses, biomonitoring in Ontario and Erie, economic costs of invasive species), and Oneida Lake and other New York lakes (walleye, bass and goby interactions, cormorants, mussel dynamics, lake ecosystems, coupled human and natural systems, ecological calendars, Onondaga Lake food web dynamics, and various comparative projects through the Global Lakes Ecological Observatory Network (GLEON). More details are in the research section of this annual report.

The summer of 2017 saw lots of activities at CBFS. Twelve undergraduates, two graduate students, one visiting scientist from the Ukraine, faculty from Cornell campus, SUNY-ESF, Buffalo State, and Hobart and William Smith, and our own CBFS staff were all involved in various projects in fisheries and aquatic science. We also had interns from SUNY-ESF and Hobart and William Smith Colleges. A number of these interns are continuing their research as honors thesis students this year. Every week there is an invited seminar speaker at CBFS, which this year included Joe Warren from SUNY-Stony Brook, Martin Stapanian from USGS, Chris Pennuto from Buffalo State College, Henry Regier from University of Toronto, and Karin Limburg from SUNY-ESF. We also had a workshop with scientists from the Winberg Field Station in Belarus (Hanna Zhukava and Boris Adamovich), our Buffalo State colleagues Karatayev and Burlakova, and Bart DeStasio from Lawrence University, Wisconsin. In addition to seminars, this group worked with us to compare long term trends of mussel effects in Oneida Lake, Lake Winnebago, and three Belarus lakes. These lakes may have the best long term data sets on mussel ecosystem effects in the world. Another workshop organized by Tom Stewart (OMRF), Brian Weidel (USGS) and I discussed the connections between productivity and fisheries in the Great Lakes with participants from Germany (Langenargen by Lake Constance, Dr. Roland Rösch), academia and agencies around the Great Lakes. Two other workshops organized by Jim Watkins were about zooplankton in the Great Lakes. Patrick Hudson and Patricia Armenio spent a week with us discussing zooplankton taxonomy and a Canadian group a several months later discussed ballast water species identification. Our new NSF funded boat was finally launched in Oneida Lake. We tested our new FlowCam and Fluoroprobe to enhance lower trophic level sampling on Oneida Lake and elsewhere, and video cameras to assess gobies. Other improvements include upgrades to gas tanks and a new truck. Great summer!

I am proud of all of the CBFS staff and the results and activities of 2017. Thanks to all of you that contributed to another successful year.
CBFS Staff and Students

Senior Scientists
Lars Rudstam (Director, aquatic ecology)
Randy Jackson (Associate Director, fisheries)
James Watkins (Research Associate, Great Lakes program coordinator)

Administration and Buildings
JoAnne Getchonis (Station manager, education/outreach coordinator)
Brian Young (Facilities coordinator)
Pete Kite (Maintenance mechanic)
Dann Brede (Director of Facilities, Agriculture Experiment Station)

Research Support Specialists
Tom Brooking (Fisheries)
Kristen Holeck (Limnology, Great Lakes ecology)
Tony VanDeValk (Fisheries)

Technicians
Joe Connolly (Great Lakes ecology)
Gabriella Doud (Great Lakes ecology)
Christopher Hotaling (Limnology)
Christopher Marshall (Great Lakes ecology)
Beth Whitmore (Great Lakes ecology)
Case VanDeValk (Angler survey)

Education Coordinator
David White (New York Sea Grant)

Visiting Scientists and Postdoctoral Associates
Dmytro Khrystenko (Fisheries)

Professor Emeriti
John Forney (Fish ecology)
David Green (Fisheries)
Ed Mills (Limnology)

Cornell Graduate Students
Kalia Bistolas (PhD, Microbiology, Hewson): Ecological effects of amphipod viruses
Ellen George (PhD, Natural Resources, Rudstam/Hare): Cisco ecology in the Great Lakes
Toby Holda (PhD, Natural Resources, Rudstam): Ecology of Mysis diluviana
Matt Paufve (M.Sc. Natural Resources, Sethi/Rudstam): Cisco rehabilitation
Annie Scofield (PhD, Natural Resources, Rudstam): Great Lakes ecology
Lyndsie Schaffner (M.Sc., Ecology and Evolutionary Biology, Hairston): Daphnia population dynamics

CBFS and Oneida/Great Lakes data are also used by graduate students from other universities, including Tiffany Vidal from University of Georgia (with Brian Irwin), Allison Hrycik and Brian O’Malley from University of Vermont (with Jason Stockwell) and Caitlin Stifle from SUNY-ESF (with Gordon Paterson).
Interns at CBFS during the summer of 2017 were involved in a number of research projects addressing current ecological concerns. Funding for our intern program in 2017 came from the Great Lakes National Program Office grant, NYSDEC Warmwater grant, NY Sea Grant, NY Agriculture Experiment Station, the John and Janet Forney Foundation, and the Doris Duke Foundation. The interns presented their findings in August as part of the CBFS Summer Seminar program at Shackelton Point and in December of 2017 at the Department of Natural Resources Undergraduate Research Symposium. A special thanks to the intern advisors whom this program would not exist – in 2017 they were Chris Hotaling, Kristen Holeck, JoAnne Getchonis, Lars Rudstam, Randy Jackson, Tom Brooking, Tony VanDeValk, Paul Curtis, Rebecca Schneider, Annie Scofield, Toby Holda, Karin Limburg (SUNY ESF), and Susan Cushman and Roxanne Razavi (HWS).

**Gabriella Alvarez**, Class of 2020, Computer Science  
*Mussel growth rates in Oneida Lake*

**Sue Chan**, Class of 2018 (December), Environmental and Sustainability Sciences (Forney Scholar, Honors student)  
*Internal nutrient loading model and its effects on a lake ecosystem*

**Jackie Doerr**, Class of 2018, Environmental and Sustainability Sciences (Honors student)  
*The potential for nutrient loading through ground water flux in Oneida Lake*

**Sophie Hearn**, Class of 2018, Environmental and Sustainability Sciences (Forney Scholar, Honors student)  
*Enumeration of blue-green algae in Oneida Lake: a methods comparison*

**Allyson Jones**, Class of 2019, Biology and Society (Duke Scholar),  
*Goby habitat selection in Oneida Lake*

**Amy Li**, Class of 2020, Ecology and Evolutionary Biology (Duke Scholar)  
*Round goby population survey via GoPro video and effects of benthic life in Oneida Lake*

**Kayden Nasworthy**, Class of 2018, Environmental and Sustainability Sciences (Honors student)  
*Predation by calanoid copepod *L. macrurus* on lower trophic levels in the Great Lakes*

**Iman Pakzad**, Class of 2018, Environmental and Sustainability Sciences (Duke Scholar, Honors student)  
*Round gobies effect on diet and growth of Oneida Lake picivores*

**Madeline Rich**, Class of 2017 (December), Biology  
*Ecological calendars to anticipate climate change*

Other universities:  

**Noland Michels**, Class of 2017, Biology/Environmental Studies (HWS)  
*The round goby: changing mercury accumulation patterns in fish*

**Kaylyn Zipp**, Class of 2018, Environmental Sciences (SUNY ESF)  
*Assessment of anoxia and hypoxia in Oneida Lake through the microchemistry of trout-perch otoliths*
COLLABORATORS

CBFS provides a center for ecological research on aquatic ecosystems, and strives to provide an exciting, inviting, and collegial working and learning environment. CBFS faculty and staff collaborate with a large number of investigators in the US, Canada, and other countries. Our collaborators are very important to our program. The following individuals were involved in various aspects of the program (research, teaching, extension, administration in 2017).

**Cornell University:**

*Department of Natural Resources:* Paul Curtis, Nancy Connelly, Dan Decker, Angela Fuller, Matt Hare, Karim Kassam, Cliff Kraft, Bruce Lauber, Steve Morreale, Rebecca Schneider, Suresh Sethi, Peter Smallidge, Rich Stedman, Patrick Sullivan

*Department of Ecology and Environmental Biology:* Nelson Hairston, David Lodge, Amy McCune, Paul Simonin, Lyndsie Schaffner

*Department of Microbiology:* Ian Hewson

*Biological and Environmental Engineering:* Todd Walters

*Civil and Environmental Engineering:* Todd Cowen

*Department of Food Science:* J. T. Brenna

*Dyson School of Management:* Greg Poe

*College of Veterinary Medicine:* James Casey, Rod Getchell, Donna Cassidy-Hanley

*Cornell Cooperative Extension/New York Sea Grant:* Kathy Bunting-Howarth, Helen Domske, Jesse Lepak, David White

*Mann Library:* Erica Johns

**SUNY Colleges and Universities:**

*SUNY College of Environmental Science and Forestry:* Greg Boyer, John Farrell, Karin Limburg, Kim Schulz, Don Stewart, Gordon Paterson, Roxanne Razavi

*SUNY Buffalo:* Joe Atkinson, Yanping Feng, Mohammed Ghaneeizad

*SUNY Buffalo State College:* Lyuba Burlakova, Alexander Karatayev, Susan Daniels, Knut Mehlert

*SUNY- New Paltz:* David Richardson

*SUNY Oneonta:* Bill Harman, Holly Waterfield, Kiyoko Yokota

*SUNY Brockport:* Joe Makarewicz, Jacques Rinchard

*SUNY Plattsburgh:* Tim Mihuc

**US Universities:**

*CUNY Institute for Sustainable Cities:* Nihar Samal

*Central Michigan University:* Hunter Carrick

*Hobart and William Smith College:* Meghan Brown, John Halfman

*Hartford College:* Bin Zhu

*Illinois State University:* Catherine O’Reilly, Rex Rowley

*Florida State College:* Christopher Perle

*Montana State University:* Richard Ready

*Miami University, Ohio:* Craig Williamson, Mike Vanni, Rachel Pilla

*Michigan State University:* Pat Soranno, Jim Bence

*Lawrence University, Wisconsin:* Bart DeStasio

*The Ohio State University:* Stuart Ludsin, Rebecca Dillon

*Purdue University:* Thomas Höök, Paris Collingsworth

*University of Georgia:* Brian Irwin, Tiffany Vidal

*University of Michigan:* Tom Nalepa, David Jude, Tom Johengen, Hongyang Zhang

Beth Whitmore, Jim Watkins, Gabriella Doud, Jon Swan, Chris Marshall and Joe Connolly
University of Minnesota Duluth: Euan Reavie, Kitty Kennedy, Andrew Bramburger, Katya Kovalenko

University of Notre Dame: Stuart Jones, Jacob Zwart, Michael Pfrender

University of Vermont-Burlington: Donna Parrish, Jason Stockwell, Allison Hrycik, Brian O’Malley

University of Wisconsin-Madison: Paul Hansen, Peter McIntyre, Corinna Gries, Emily Stanley, Sarah Collins

University of Wisconsin-Superior: Mary Balcer

Virginia Tech: Kelly Cobourn, Cayelan Carey, Kevin Boyle, Michael Sorrice, Amy Hetherington

Canadian Universities and Institutions:
Environment Canada: Alice Dove
Department of Fisheries and Oceans, Canada: Kelly Bowen, Warren Currie, Ora Johannsson, Marten Koops, Mohi Munawar, Heather Niblock, Mark Fitzpatrick
Ontario Ministry of Natural Resources: Tim Johnson, Tom Stewart, Jeremy Holden, Jake LaRose, Brent Metcalf, Eric Berglund, Anthony Chiodo
University of Windsor: Aaron Fisk
University of Guelph: Paul Hebert

International Universities and Institutions:
Anhui Agricultural University, China: Xueying Mei
Jinan University, China: Xiufeng Zhang
University of Western Australia: Matt Hipsey, Louise Bruce
University of Stockholm, Sweden: Sture Hansson
Swedish Agriculture University: Rahmat Naddafi
Uppsala University, Sweden: Gesa Weyhenmeyer, Don Pierson
Mistra, Sweden: Biljana Macura
Umeå University, Sweden: Pär Byström
Belarus University: Boris Adamovich, Hanna Zhukava, Tatayna Zhukova, Tamara Mikheyeva
University of Bologna, Italy: Laura Airoldi
University of Groningen, Netherlands: Brita Klemens Eriksson
Technical University of Denmark: Josianne Støttrup

Czech Academy of Sciences: Jan Kubecka, Milan Riha
French National Institute for Agricultural Research: Orlane Anneville
University of Geneva, Switzerland: Bas Ibelings
University of Konstanz, Germany: Dietmar Straile
Fishereiforschung Lagenargen, Lake Constance: Roland Rösch, Alexander Brinkner

Local, State and Federal Agencies:
NYS Canal Corporation: Peter Pazer
NYS DEC-Albany: Lisa Holst, Steve Hurst, Shaun Keeler, Jeff Loukmas, Doug Stang, Leslie Surprentant, Don Zelazny
NYS DEC-Region 8: Brad Hammers, Web Pearsall, Matt Sanderson
NYS DEC-Region 7: Dan Bishop, David Lemon, Scott Prindle
NYS DEC-Region 6: Doug Carlson, Frank Flack, Roger Klindt, Russ McCullough, Michael Wilkinson
NYS DEC-Lake Ontario Unit: Michael Conerton, Jana Lantry, Steven LaPan, Chris Legard
NYS DEC-Lake Erie Unit: Don Einhouse, James Markham
NYS OPRHP - Central Region: Tom Hughes
EPA-Region 2: Fred Luckey
EPA-Duluth: Joel Hoffman, Michael Sierszen, Anett Trebitz, Tom Hollenhorst
NOAA-Great Lakes Laboratory: Doran Mason, Ed Rutherford, Ashley Baldridge, Hank Vanderploeg
**Michigan DNR:** Jory Jonas, Pat O’Neill  
**Little Traverse Bay Band of Odawa Indians:** Kevin Donner  
**Onondaga County:** Chris Gandino, Janaki Suryadevara  
**USFWS:** Jeremy Coleman, Scott Schlueter, Curt Karboski, Zy Biesinger, Dimitry Gorsky  
**USGS-Great Lakes Science Center, Ann Arbor, MI:** Bo Bunnell, Ed Roseman, Wendylee Stott, David Warner, Yu-Chun Kao, Robin DeBruyne, Patricia Armenio, Patrick Hudson  
**USGS-Great Lakes Laboratory, Oswego, NY:** Brian Lantry, Robert O’Gorman, Maureen Walsh, Brian Weidel  
**USGS-Tunison, Cortland, NY:** Dawn Dittman, Jim Johnson, Jim McKenna  
**USGS-Great Lakes Science Center Erie:** Patrick Kocovsky  
**USGS – Great Lakes Science Center Superior:** Dan Yule  
**Vermont Fish and Wildlife:** Bernie Pientka  
**Wisconsin DNR:** Willie Fetzer  

**Non-Government Organizations and Private Consulting Firms:**  
**CSRA:** Richard Barbiero, Barry Lesht  
**Cooper Environmental:** John Cooper  
**Ecologic:** Elizabeth Moran, Tom Vawter  
**The Nature Conservancy:** Darran Crabtree, Mathew Levine, Matt Herbert  
**Upstate Freshwater Institute:** Dave Matthews, Dave O’Donnell, Sue O’Donnell, Feng Peng  
**LimnoTech, Michigan:** John Lenters

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**2017 CBFS Summer Seminar Series**

6/7  **Martin Stapanian,** Research Ecologist, U.S. Geological Survey  
*Evaluating factors driving population densities of mayfly nymphs in Western Lake Erie*

6/14  **Randy Jackson,** Associate Director, Cornell Biological Field Station, Department of Natural Resources, Cornell University  
*Oneida Lake as a melting pot: the impact of invasive species on historic and modern fisheries*

6/21  **Joe Warren,** Associate Professor, SUNY Stonybrook, School of Marine and Atmospheric Sciences  
*Acoustic ecology: from water fleas to blue whales and creatures in between*

6/28  **Karin Limburg,** Professor, SUNY ESF, Department of Environmental and Forest Biology  
*Hypoxia is not the same old dead zone: global deoxygenation, and how an 'otolithologist' approaches the study of impacts on fish and fisheries*

7/5  **Boris Adamovich** and **Hanna Zhukava,** Belarus State University Biological Field Station, Belarus  
*Limnological Research at the Winberg Biological Field Station, Belarus*

7/12  **Henry Regier,** Professor Emeritus, University of Toronto, former Director of the Inst. for Environmental Studies  
*The historical role within the past 1.5 centuries of the Cornell-centered network of fish and fisheries researchers within the context of a three-tiered network: the Great Laurentian Basin, the North Atlantic Ocean Basin, and the Circumpolar Belt of periodically glaciated landscapes*
2017 Workshops at CBFS

Four workshops were organized by CBFS during 2017:

Long term mussel effects in shallow lakes. This workshop, organized by Lars Rudstam, Karatayev and Burlakova, brought in two scientists from Belarus to CBFS (Drs Boris Adamovich and Hanna Zhukava) to Shacklelton for comparative analyses of long term data sets of various ecosystem component before and after mussel invasions in the four lakes with possibly the best long term data sets to investigate mussel effects in the world: Oneida Lake and lakes Naroch, Myastro, and Batorino in Belarus. We also looked at Lake Winnebago with Dr Bart DeStasio who joined us for part of the workshop. We are investigating the continuity of mussel effects over decadal scales in these lakes, and adding an analysis of the effect of quagga mussels in Oneida. Quagga mussels have not yet invaded the Belarussian lakes. This analysis is continuing and will be presented at the International Society of Limnology in Nanjing, China in August, 2018.

A workshop on the connection between lake productivity and fisheries production was organized by Tom Stewart (OMNRF), Julie Hinderer (GLFC), Brian Weidel (USGS) and Rudstam in August 2017. With invited participants from around the Great Lakes and both Canada and the US, we explored the available data for a production to fish yield connection in the Great Lakes and added discussions of water clarity. Ecopath with Ecosim models for each Great Lake was compared for the primary production to fish production ratios and inconsistencies discussed. This workshop was funded by the Great Lakes Fisheries Commission.

Two zooplankton taxonomy workshops were organized by Jim Watkins. The first workshop, Oct 17-20, 2017, included Patrick Hudson and Particia Armanio from USGS Ann Arbor and our zooplankton group. They discussed issues with species identification and tested a new on-line key that Pat Hudson is developing for the Great Lakes. In the second workshop, scientists from DFO-Canada (Sarah Bailey and Kelly Bowen) spent several days at CBFS (Nov 27-28, 2017) familiarizing themselves with our zooplankton counting setup and discussing connections with their ballast water program.

2017 CBFS Program Highlights

Oneida Lake and other Inland Lakes

A major research program at CBFS is the Oneida Lake projects involving two of CBFS’ senior scientists: Jackson concentrating on fish and fisheries and Rudstam concentrating on lower trophic levels. Paul Curtis continued his work on colonial waterbirds in the lake, Rebecca Schneider studied ground water phosphorus input, Karin Limburg investigated trout-perch otoliths as markers.
of anoxia, and Roxanne Razavi worked with mercury contamination in sport fish as affected by round goby. Hetherington and Schneider continued work on mussel dynamics. The Oneida program involves the research staff Brooking, VanDeValk, Holeck, and Hotaling, and summer interns. Oneida Lake is a site member of the Global Lakes Ecological Observatory Network (GLEON) and part of several research projects comparing data from lakes across the world. Oneida Lake is also one of three lakes studied in an NSF project in the Coupled Human and Natural Systems program area (PIs Carrey, Cobour and Boyle, Virginia Tech). The Oneida Lake fisheries data was analyzed by research groups in the USGS Coop Unit in Georgia (Irwin), the University of Pennsylvania (Wagner) and USGS (Bunnell and Kao). In addition, Nelson Hairston and Lyndsie Schaffner are wrapping up a study on rapid clonal evolution in *Daphnia*. Work on other inland lakes include studies of alewife and zooplankton on Silver Lake, PA, and on alewife, mussels, zooplankton and phytoplankton in Onondaga Lake.

**Ongoing project: Long-term studies of Oneida Lake**

*Randi Jackson, Tom Brooking, Tony VanDeValk, Lars Rudstam, Kristen Holeck, Christopher Hotaling, John Forney (Funded by New York State Department of Environmental Conservation)*

Our studies of the fisheries and limnology of Oneida Lake were initiated in the mid-1950s as an assessment of the status of the lake’s important walleye and yellow perch fisheries. The program has enjoyed continuous funding from the New York State Department of Environmental Conservation (DEC), and for over 40 years has included annual monitoring of multiple trophic levels and physical conditions, representing a true ecosystem approach to understanding the dynamics of the lake’s fish community and fisheries. Ongoing studies on Oneida Lake include detailed studies of walleye and yellow perch from larval to adult life stages, assessment of offshore and inshore fish community composition and monitoring of nutrients, primary and secondary production, as well as annual creel surveys. While maintaining the continuous data set started by John Forney, we have increased the scope of our studies, which now include intensive sampling of the lake’s nearshore fish community and annual creel surveys. Oneida Lake is the State’s second most heavily fished lake, and data collected by Field Station staff provide timely information to DEC managers to ensure sustainable fishing opportunities, particularly for walleye, yellow perch and smallmouth bass. The data series has also allowed important insights into the response of lake ecosystems to perturbations such as exotic species and climate change. We have already documented fundamental shifts in fish community composition resulting from increases in water clarity associated with zebra mussels, and are currently assessing the impacts of displacement of zebra mussels by quagga mussels. The double-crested cormorant had profound impacts on walleye and yellow perch, and our studies of these impacts have informed cormorant management throughout their range. Analyses of the response of walleye and yellow perch to cormorant management are shedding light on the relative importance of that management and concurrent restrictions of walleye harvest. Warming water temperatures may be contributing to increased production of largemouth and smallmouth bass, gizzard shad and other species near the northern extent of their range. Sampling in 2014 revealed that the round goby has finally become established in the lake, although densities were low. By late summer of 2015, gobies were the most abundant species in our trawl samples and gobies continued to be abundant in 2016. There is evidence that there was a die off of round goby during the winter of 2016-17, but enough remained to reproduce successfully and fall catches of young goby in 2017 were comparable to previous years. Gobies appeared in the diets of
most of our more common fish species and were also foraged upon by cormorants. In 2017, we continued targeted sampling of common predators to assess the importance of gobies in predator diets. Consistent with evidence of reduced goby numbers following the winter, gobies were not as common in predator diets in 2017 as 2016, but were still used by all sport fish. This study is scheduled to continue another year. We observed marked declines in angler success in 2016, which is most likely related to the abundant new prey resource represented by gobies, but angler catches improved in 2017, further supporting the other indications that goby numbers declined overwinter. We will have an excellent opportunity to continue assessing the impacts of this new invasive on the lake’s fish and fisheries in the upcoming years. Walleye continue to be the most popular sport fish in Oneida Lake. Bass are also a popular fishery, and almost 30% of the anglers interviewed during our June/July creel survey were targeting bass, another sign of change from the days when walleye anglers comprised most of the lake users. As Oneida Lake has changed, so too has the fish community and the fishery, and our studies continue to expand our efforts to understand the dynamics of this economically important resource.

**Ongoing project: Common terns on Oneida Lake**
*Paul Curtis, Martin Feehan, Jacqueline Doerr (Funded by the New York State DEC)*

The long-term studies on the colonial waterbirds on Oneida Lake, initiated in the 1970s, continued during 2017. Investigators Paul Curtis and Martin Feehan worked with intern Jackie Doerr to monitor the nesting activity of Common Terns on Little Island. Breeding success for Common Terns at Oneida Lake was below average during the 2017 field season due to high water levels in early spring and competition from ring-billed gulls for nesting space. The peak count was 397 tern nests on June 22 at Little Island. We banded 460 total chicks during the 2017 field season on Little, Willard, and Grassy Islands. On Little Island there was an apparent 97.8% chick survival rate, with 395 chicks surviving through the season. The terns attempted to nest on Willard and Grassy Islands in 2017 because Little Island was inaccessible when they returned from migration due to the high water levels. This year we also continued a study of tern migration to determine where birds nesting on Oneida Lake are migrating and overwintering. We recaptured one of two terns marked with geolocators (small tracking devices that record bird location using daylight sensors), and saw one other marked tern we could not capture. We are working on a collaborative manuscript describing tern migration with other northeastern waterbird scientists, and this paper is in review with *The Auk*.

**Ongoing Project: Silver Lake alewife – zooplankton interactions**
*Lars Rudstam, Beth Whitmore (Funded by the Rose Conservancy and the Actus Foundation)*

The research on alewife in a small lake in northern Pennsylvania investigates the interactions between alewife, zooplankton, and stocked brown and rainbow trout. With the help of citizen scientist Russ Cole, we collect data on the zooplankton and water clarity in Silver Lake and suggest possible management strategies.

**Ongoing project: Food web changes in Onondaga Lake**
*Lars Rudstam, Chris Hotaling, Dave Matthews, Chris Gandino, Janaki Suryadevara (Funded by Onondaga County, NY)*

CBFS is involved with analysis of lower trophic levels, including phytoplankton, zooplankton and dreissenid mussels in Onondaga Lake, a valuable resource for the city of Syracuse. We conduct a survey of the alewife population each year- in 2017 this survey was in June and showed continued high alewife
abundance in the lake. The 2016 data was incorporated in the Ambient Management Plan report produced by Onondaga County in cooperation with Upstate Freshwater Institute and CBFS. Gobies have increased in the lake and mussel abundance, in particular quagga mussels, declined in 2016. We are using this data to investigate the relative importance of grazing by zooplankton and mussels in a stratified lake to compare with the same interactions in Oneida Lake. We are also involved with overseeing the sampling program through the Onondaga Lake Technical Advisory Board (Mills and Rudstam).

**Ongoing Project: Ecological calendars to anticipate climate change**

Karim-Aly Kassam, Madeline Rich, Tamar Law, Adnan Akyuz (North Dakota State University), Art DeGaetano, Christopher Dunn, Randy Jackson, Amanda Rodewald, Lars Rudstam, Morgan Ruelle, David Wolfe (Funded by the Atkinson Center for a Sustainable Future, Academic Venture Fund)

This project is developing ecological calendars as a source of anticipatory capacity for climate change at the scale of community. Ecological calendars are systems to keep track of time based observation of weather, plants, and animals. Seasonal events – such as the nascence of a flower, the emergence of an insect, the arrival of a migratory bird, the movement of fish, or the breakup of lake ice – may serve as more reliable indicators of seasonal change than counting of days based on the position of the sun, moon, and stars. Indigenous and other place-based ecological knowledge of seasonal indicators has enabled communities to coordinate their activities with the rest of their ecosystems. By integrating such knowledge with cutting-edge science, the project will develop ecological calendars that anticipate trends and variability resulting from global climate change. This participatory action research project is designed and implemented in partnership with fishing and farming communities in the Oneida Lake Basin, as well as Dakota and Lakota First Nations in the Standing Rock Sioux Reservation of North and South Dakota. During 2016, Tamar Law was based at CBFS and undertook semi-structured interviews. In 2017, Madeline Rich continued this work at CBFS. Ecological calendar research in Oneida Lake and Standing Rock will serve as a proof of concept for similar projects in the rest of the world. In March 2016, the research team received an additional 1.2 million Euros from the Belmont Forum to conduct further research on ecological calendars in the Pamir Mountains of Afghanistan, China, Kyrgyzstan, and Tajikistan in collaboration with Chinese, German, and Italian scholars. Both projects will culminate in a high-profile international conference focused on the role of ecological calendars to building anticipatory capacity for anthropogenic climate change and variability.

**Ongoing Project: Daphnia eco-evolutionary process meets the clear water phase: seasonal plankton dynamics when consumers evolve**

Nelson Hairston, Lyndsie Schaffner, Steve. Ellner, Eliza Bonner (Cornell) BE Miner (Ithaca College), P Spaak (EAWAG Switzerland), M Yamamichi (Kyoto University), Lynn Govaert (KU Leuven, Belgium)

The seasonal change in phytoplankton and *Daphnia* abundance is a classic pattern in the ecology of temperate zone lakes. It includes a spring bloom dominated by edible diatoms, followed by an increase in grazing *Daphnia* that terminates the bloom with a clear-water phase dominated by small rapidly-growing phytoplankton, at the end of which the *Daphnia* population declines and a summer bloom of cyanobacteria and colonial green algae dominates. We show for *Daphnia mendotae* in Oneida Lake, New York, that the *Daphnia* population responds evolutionarily to the natural selection imposed by seasonal change in phytoplankton quality. Genetically distinct clones (identified using microsatellite DNA loci) rise to prominence at different times of year consistent with their ability to grow on phytoplankton of different edibility. Clonal performance was determined in the lab by measuring juvenile (somatic) growth rate on “spring phytoplankton” comprised of
diatoms, cryptophytes and greens, and on “summer phytoplankton” comprised of cyanobacteria and greens.” Clones that dominated in spring grew much better on spring than on summer phytoplankton, while the one that dominated in summer grew nearly equally well on both food types. Calculations of clonal population growth rates show seasonal changes in fitness differences, and projections of effects of clonal evolution on total Daphnia population growth rate shows the importance of seasonal evolution on lake plankton dynamics. The result is that classic seasonal plankton consumer-resource dynamics in this lake are eco-evolutionary in nature: underlain by consumer evolution which affects those dynamics while they are in progress. Future plans are to study differences in gene expression among clones when exposed to different food types.

**Ongoing Project:** Coupled Natural and Human Systems CNHS: Linking land-use decision making, water quality, and lake associations to understand human-natural feedbacks in lake catchments

*Kelly Cobourn, Cayelan Carey, Kevin Boyle, Amy Hetherington (Virginia Tech) and others including Rudstam and Jackson: Funded by the National Science Foundation (2016-2019) Administrated through Virginia Tech.*

Freshwater lakes and their catchments present a rich and fascinating opportunity to examine the dynamics of coupled natural and human systems (CNHS). To identify and quantify feedbacks between lake water quality and human behavior, we are developing a novel, coupled modeling framework that captures how land-use decision making interacts with hydrological and limnological processes to transform nutrient loads into changes in lake water quality, and how altered water quality feeds back to human systems by affecting the amenities that people value. Our coupled modeling framework will integrate key human and natural systems in three focal lake catchments, allowing us to investigate human-natural feedbacks in those catchments and to build on our understanding of those linkages to generate insight into CNHS at a broad scale. Our interdisciplinary team of scientists and community partners seeks to comprehensively investigate the flows, nature, and extent of linkages among human and natural systems in three focal lake catchments, Oneida Lake, Lake Sunapee in New Hampshire and Lake Mendota in Wisconsin. Models of lake dynamics, watershed nutrient influx, crop dynamics, economics of crop choice selection, property price dependency on lake characteristics, and analysis of social interactions are proceeding and a conceptual paper have been developed and submitted.

**Completion Report:** Climate change and invasive mussels: interacting effects on New York lakes

*Lars Rudstam, Rebecca Schneider, Randy Jackson, Amy Hetherington, JoAnne Getchonis, James Watkins, Edwin Cowen, Nelson Hairston, Art DeGaetano, Erica Johns, David White (Cornell University), Steve Effler (UFI), Gideon Gal (Kinneret Laboratory), Paul Hansen (Univ. Wisconsin), Kim Schulz (SUNY-ESF), Matthew Hipsey (Univ. Western Australia). (Funded by a Cornell Hatch grant).*

Need: NYS has over 8300 lakes that are critical resources for recreation, angling, drinking water, and tourism. Lakes are a major attraction and economic driver for Upstate NY. Two of the most important threats to the structure and function of these lakes are climate change and invasive mussels. Two dreissenid mussels (zebra and quagga mussels) are considered ecosystem engineers because they increase water clarity and transform the bottom structure of lakes. Climate change effects depend on lake morphometry and includes increased thermal stratification in lakes. These two drivers of ecological change will interact, but the degree of interactions and the magnitude of ecological change to the lakes will depend on the morphometry of the lake. Therefore, ecological forecasting requires consideration of both lake physics and lake biology.

**Approach:** To provide a framework for ecological forecasting, we
worked with collaborators to test a General Lakes Model (GLM) across 20 lake types from around the world, including Oneida Lake, and to add mussel filtering to this model. A mussel module was implemented, parameterized and added to this model. We are continuing testing this component as part of a coupled hydrodynamics-biological model (GLM-AEM). The models are driven by limnological, and such data was compiled into databases available online through the Knowledge Network for Biocomplexity and eCommons. The databases were used in analyses presented in several chapters in a book on Oneida Lake edited by Rudstam, Mills, Jackson and Stewart. The data sets are also used for comparisons across lake types and for global patterns of temperature.

Impact: The GLM model and its extension to coupled hydrodynamics-ecological systems is being used worldwide for assessing effects of climate change and effects of humans on lake systems. The mussel module which this project helped develop is an important component of the GLM model. Data analyses allowed us to separate effects of food web changes from improvement to the Onondaga County sewage treatment plant on water clarity in Onondaga Lake, an important urban lake in the city of Syracuse. In Oneida Lake, water clarity is tightly linked to mussels. We forecast that climate change induced longer stratification will cause increased algal blooms due to increased anoxic conditions in the bottom waters (which will eliminate mussels from a large portion of the lake bottom), and increase nutrient release from the sediments). Concerns about Oneida Lake led to a grant application from the New York Planning Board to develop and evaluate better watershed management. This proposal was approved. Oneida Lake data was also used in an analysis of global temperature changes which has received considerable attention in the media.

Comparisons of Oneida Lake across North America and the World

Oneida Lake is known for the available long-term data. But it is only one lake and we rely on comparisons of our data sets with lakes around the nation and around the world to deduce general trends. Many of the projects are through the Global Lakes Ecological Observatory Network (GLEON). As a site member of GLEON, CBFS are partners in several projects that benefit from comparative approaches to limnology and lake – watershed interactions. Additional projects have developed through the interests of the scientific community in the Oneida data independent of GLEON, examples are the mussel project and the inland fish production project. Most of the projects listed under this heading are administrated by other agencies or universities than Cornell. They do provide important insights into the structure and function of lake ecosystems and we are proud to be part of these internationally collaborative projects. We are pleased that our many years of efforts on collecting long-term data on Oneida Lake are being used by others across the globe. To facilitate these interactions, we have made 10 datasets available (walleye, yellow perch, gillnet catches, trawl catches, limnology, phytoplankton, zooplankton, benthic invertebrates, ice cover, dreissenid mussels) on the DataONE data archiving system and update these data sets each year.

New GLEON Project: Top-down versus Bottom-up controls on aquatic food webs

Taylor Leach, Amber Rock, Annie Scofield, and other GLEON collaborators

This project aims to better understand the relative importance of top-down and bottom-up forces on aquatic food web structure in lakes and ponds. We are in initial stages of the project and are in the process of compiling data sources with data for three or more trophic levels over a 10-year period of monitoring. We have the primary questions:

1) What is the relative importance of top-down vs. bottom-up control of food webs?
2) What lake characteristics explain patterns of top-down vs. bottom-up control?
We seek to improve our knowledge of the conditions under which and at what trophic levels we observe differences in food web structuring processes.

**Ongoing GLEON Project: Modeling long-term trends in ice seasons of geographically distributed lakes in a changing climate**
*Nihar Samal (CUNY Institute for Sustainable Cities), Don Pierson (Uppsala University, Sweden), Bruce Hargreaves (Lehigh University, Pennsylvania), Craig Williamson (Miami University, Ohio), Lars Rudstam, and other GLEON collaborators*

Long-term trends and variability in lake ice dynamics are related to changes in climate conditions. Changes in the duration and timing of ice cover are well documented effects of climate change that are expected to continue into the future. Simulations of ice conditions and duration are essential to understanding the mechanisms through which ice cover potentially mediates the effects of climate on lake thermal structure and mixing and influences phytoplankton succession and trophic status of a lake.

**Ongoing GLEON Project: Global evaluation of the impacts of storms on freshwater habitat and structure of phytoplankton assemblages**
*Orlane Anneville (INRA, France), Bas Ibelings (University of Geneva, Switzerland), Jason Stockwell (University of Vermont), Lars Rudstam and other GLEON collaborators.*

The GEISHA project relates the effects of physical disturbances and water column stability on plankton communities. This project started in 2015 and received funding in 2016 in both the US and France to do comparative analysis of long term data series of phytoplankton, including Oneida Lake, to better understand the effect of storms on phytoplankton community organization. Data sets for Oneida Lake have been submitted to GEISHA.

**Ongoing GLEON Project: Importance of the timing of spring runoff to summer production in lakes**
*Allison Hrycik, Jason Stockwell (Univ Vermont), Lars Rudstam, Amy Hetherington and other GLEON collaborators*

The research question tested in this project is “changes in the timing of spring runoff, specifically more runoff occurring in the winter and early spring, will lead to reduced productivity and phytoplankton biomass during the summer stratified period”. Data sets have been assembled, including one from Oneida Lake. We expect the above might be true because nutrients delivered to a lake during colder deeply mixed and possibly ice covered conditions could be less effective at stimulating phytoplankton growth.

**Ongoing GLEON Project: Investigating the overlap in subsurface chlorophyll fluorescence and dissolved oxygen saturation maxima: when are DCLs productive?**
*Jennie Brentrup, Annie Scofield, Liz Ryder, and other GLEON collaborators*

This project seeks to better understand under what conditions subsurface maxima of chlorophyll fluorescence are associated with positive net production below the epilimnion. To investigate this, we are using high-resolution profile data from lakes in the GLEON network which have buoys measuring temperature, chlorophyll fluorescence, and dissolved oxygen on a daily timescale.
Completed GLEON Project: General lake model

Louise Bruce and Matthew Hipsey (University of Western Australia), Gideon Gal (Yigal Allon Kinneret Limnological Laboratory, Israel), Jordan Read (USGS, Wisconsin, United States), Amy Hetherington, and other GLEON collaborators

The General Lake Model Multi-Lake Comparison Project (GLM-MLCP) is a community driven initiative where researchers collectively simulate lakes using a common approach to setup and assessment. More than 20 lakes, including Oneida Lake, have been simulated, ranging in latitude from 56°N to 38°S, in elevation from -210 to +560 m above sea level, in trophic status from oligotrophic to eutrophic, in depth from 12 to 253 m, in volume from $6.9 \times 10^5$ to $4.8 \times 10^{10}$ m$^3$, in mixing regimes from polymictic to meromictic and in climates, including warm lakes to lakes with seasonal ice cover. This work was accepted for publication in November 2017 and we predict this will increase the use of the GLM throughout the world.

Completed GLEON Project: Temperature sentinels northeast North America: In-depth study of lake thermal responses and teleconnections in northeastern North America

Amy Hetherington, Dave Richardson (SUNY New Paltz), Stephanie Melles (Ryerson University), Rachel Pilla (Miami University), Lesley Knoll (University of Minnesota), Craig Williamson (Miami University), Rudstam and Jackson and other GLEON collaborators.

Lake surface water temperatures are warming worldwide, raising concerns about the future integrity of valuable lake ecosystem services. In contrast to surface water temperatures, we know far less about what is happening to water temperature beneath the surface, where most organisms live. Moreover, we know little about which characteristics make lakes more or less sensitive to climate change and other environmental stressors. We examined changes in lake thermal structure for 231 lakes across northeastern North America (NENA), a region with an exceptionally high density of lakes. We determined how lake thermal structure has changed in recent decades (1975–2012) and assessed which lake characteristics are related to changes in lake thermal structure. In general, NENA lakes had increasing near-surface temperatures and thermal stratification strength. On average, changes in deepwater temperatures for the 231 lakes were not significantly different than zero, but individually, half of the lakes experienced warming and half cooling deepwater temperature through time. More transparent lakes (Secchi transparency >5 m) tended to have higher near-surface warming and greater increases in strength of thermal stratification than less transparent lakes. Whole-lake warming was greatest in polymictic lakes, where frequent summer mixing distributed heat throughout the water column. Lakes often function as important sentinels of climate change, but lake characteristics within and across regions modify the magnitude of the signal with important implications for lake biology, ecology and chemistry. This work was published in 2017 in Water 9, 442.

Ongoing Project: Macrosystems Biology Research in US lakes across space and time

Pat Soranno, Sarah Collins (Michigan State), Emily Stanley (Univ Wisconsin), Rudstam, Jackson and collaborators across the Northeast and Midwest US

The CSI Limnology research group has been busy building the LAGOS database, which currently includes both limnological and geospatial information covering ~ 49,000 lakes in a 17-state extent in the Northeastern and Midwestern United States. You can find more information about this group, its recent research efforts, and LAGOS publications on our website (www.csilimnology.org). The database is
described in LAGOS-NE: A multi-scaled geospatial and temporal database of lake ecological context and water quality for thousands of U.S. lakes (GigaScience https://doi.org/10.1093/gigascience/gix101

**Ongoing Project: Dreissenid mussel dynamics across systems**
*David Strayer (Cary Institute), Rudstam and 15 collaborators from North America and Europe*

A group of scientists started a cross-system analysis of *Dreissena* population dynamics. Probably most *Dreissena* biologists have wondered at one time or another how their study population compares with others, but there have been few formal attempts to make comparisons across populations. We do not think that these previous analyses have exhausted the full potential of such cross-population analyses, and so we are conducting a formal comparison of *Dreissena* population dynamics using as many data sets as we can find. All datasets have been compiled and are being analyzed.

**Ongoing Project: Evaluating effects of climate change and land use on fisheries production in inland lakes**
*Yu-Chun Kao, David Bunnell, Mark Rodgers (USGS), Rudstam, Jackson, and 24 collaborators across the globe*

We are evaluating effects of climate change and land use on inland fisheries by analyzing time series of fisheries harvests in inland lakes across the globe. Tracking large-scale landscape changes (e.g., land use) as well as annual changes (e.g., water levels that can drive recruitment and fishing access) on a lake-by-lake basis can help inform how long-term trends may influence fisheries. One challenge of analyzing longer time series on a relatively small number of inland lakes is the generality of these results to the millions of inland lakes of the world. Hence, we confront this issue by categorizing lakes based on their depth and vulnerability to food and water security. Previous studies have shown that lake depth is one of the most important factors affecting fisheries production in response to climate change. For example, decreases in lake levels caused by climate change may have strong effects on fisheries production in shallow lakes, potentially via decreased access or littoral area, but not in deep lakes. In addition, regions of the world can be grouped based on their vulnerability to food security and water security, which are important indicators of anthropogenic stressors on lake ecosystems. Thus, land use and climate changes should have disproportionately stronger effects on fisheries production in lakes in regions of higher levels of food and/or water security threat, as these lakes commonly have been stressed by water deficit, pollution, and overfishing.

**The CBFS Great Lakes Program**

In 2017, CBFS continued to develop our strong Great Lakes research program. Most notably, CBFS and Buffalo State successfully extended for another five years to 2022 our US Environmental Protection Agency (US EPA) grant to monitor all five Great Lakes. CBFS also entered a Great Lakes basin research collaboration with the National Ocean and Atmospheric Administration (NOAA) known as the Cooperative Institute for Great Lakes Research (CIGLER). CBFS participated in the Cooperative Science and Monitoring Initiative (CSMI) efforts in Lake Huron for 2017 and helped plan for Lake Ontario in 2018. A special issue with twelve manuscripts on the Lake Ontario CSMI efforts of 2013 was published in the Journal of Great Lakes Research, and CBFS efforts in Lake Michigan 2015 is
also in preparation. CBFS continued leading the Lake Ontario lower trophic level biomonitoring program continuous since 1995 with NYDEC, USGS, and USFWS. We continue to work on two NY Sea Grant projects in Lake Ontario- cisco restoration and tagging Chinook salmon. CBFS entered a new partnership with researchers from Cornell, Buffalo State, Notre Dame, and the U of Guelph on a 2 year EPA grant to improve the library of genetic barcodes for Great Lake invertebrates. We also organized several special sessions at IAGLR 2017 and one at ASLO 2017.

**Ongoing project: EPA GLNPO Great Lakes monitoring program**

Lars Rudstam, Jim Watkins, Toby Holda, Annie Scofield, Joseph Connolly, Chris Marshall, Gabriella Doud, Beth Whitmore; at SUNY Buffalo State College: Alexander Karatayev, Lyubov Burlakova, Knut Mehler, Susan Daniels (Funded by US EPA Region 5 Great Lakes National Program Office, Chicago, IL)

In 2017, we continued to collect and analyze samples for chlorophyll, zooplankton, mysid shrimp, and benthos (Buffalo State) from all five Great Lakes. Also in 2017, we successfully extended the current grant for another five years to 2022. The US EPA monitors all five Great Lakes each April and August aboard their 180 ft. research vessel, the Lake Guardian. The ship has state of the art sampling equipment including a Seabird CTD (equipped with sensors for temperature, dissolved oxygen, light, particles and chlorophyll) and onboard laboratory facilities. They also have traditional nets and dredges for plankton and benthic sampling. We explored advanced technology (i.e. hydroacoustics and Triaxus vehicle) in comparison with our traditional measurements. These tools provide high-resolution measurements on horizontal and vertical spatial scales. Zooplankton and mysid samples from these surveys are brought back to CBFS for analysis by our four technicians in our microscopy laboratory. In addition to monitoring, research projects in the grant include mysid biology (Cornell graduate student Toby Holda) and deep chlorophyll layers (Cornell graduate student Annie Scofield). At Buffalo State, our collaborators Karatayev, Burlakova and Mehler have developed new video transect techniques to measure dreissenid mussel abundance. Improved detection of invasive species is an important component of our grant. In 2017, an exotic rotifer species (*Brachionus leydigii*) new to the Great Lakes was identified by lead analyst Joseph Connolly in a sample from western Lake Erie. This new observation was reported by many media outlets including USA Today.

**New Affiliation: NOAA Cooperative Institute for Great Lakes Research (CIGLER)**

In 2017 CBFS and Cornell University entered a five-year research collective led by NOAA’s Great Lakes Environmental Research Laboratory (GLERL) in Ann Arbor, Michigan. Focused on the Great Lakes Basin, this is one of sixteen regional NOAA collaborations nationwide. In addition to Cornell, eight other academic partners from across the basin represent many of the leaders in Great Lake research. This partnership provides CBFS unique access to the expertise of agency scientists and the capabilities of government laboratories and vessels, including state-of-the-art equipment. The cooperative also offers funding opportunities to support speakers, post-doctorate researchers, and small research grants.

**New Project: Genetic Barcoding of Great Lake invertebrates**

Lars Rudstam, Jim Watkins, Joseph Connolly, Chris Marshall, and Beth Whitmore; on Cornell campus: David Lodge and Nelson Hairston, Jr.; at SUNY Buffalo State College: Alexander Karatayev, Lyubov Burlakova, Susan Daniels; at Notre Dame University: Michael Pfrender; at University of Guelph: Paul Hebert (three individual projects funded by US EPA Region 5 Great Lakes National Program Office, Chicago, IL)
Genetic barcoding technology has become an important tool in the early detection of invasive species, monitoring diversity, and dietary analysis. However, the current extent of the barcode library for invertebrates in the Great Lakes is very sparse, severely limiting the usefulness of this technology. Effective barcodes depend on accurate identifications, hence the need for a close coordination of taxonomical confirmation and expertise with genetic approaches. The essential goal of this project is to fill in barcodes for all Great Lakes invertebrate species lacking at least 5 established barcodes in the Barcode of Life Directory (BOLD), housed at the University of Guelph. This effort will update what is known about Great Lakes invertebrate biodiversity. Barcodes are short (600 base pairs) genetic sequences, most commonly located as mitochondrial cytochrome oxidase (COI), effective in separate species. This project is divided up into three individual grants focusing on specific taxa, led by Buffalo State (benthic molluscs and oligochaete worms), Notre Dame (zooplankton and rotifers), and Cornell (benthic arthropods). CBFS will lead taxonomic sorting of copepods, cladocerans, and rotifers within the Notre Dame led project. University of Guelph, home of BOLD, is contracted to do the genetic analysis.

**Ongoing Project: Cooperative Science and Monitoring Initiative (CSMI)**  
*Lars Rudstam, Jim Watkins, Toby Holda, Annie Scofield, Joseph Connolly, Chris Marshall, Gabriella Doud, Beth Whitmore*

The Cooperative Science and Monitoring Initiative (CSMI) is a five-year rotation of intensive sampling efforts for each of the five Great Lakes specified within the binational Great Lakes Water Quality Agreement. This increased focus enables higher spatial and temporal resolution of sampling than typical annual surveys. CBFS is involved in several CSMI efforts through the support from US EPA. CBFS faculty, graduate, and undergraduate students participated in the summer survey of Lake Huron on the Lake Guardian in 2017, including zooplankton and mysid tows and Triaxus and acoustic transects. CBFS staff and students presented data from similar efforts in Lake Michigan 2015 at a 2017 State of Lake Michigan Meeting at Green Bay, WI. Also in 2017, a special issue on Lake Ontario efforts in 2013 was published in the Journal of Great Lakes Research led by guest editors Watkins (CBFS), Weidel (USGS), Fisk (University of Windsor) and Rudstam (CBFS). This issue included twelve manuscripts on topics throughout the food web from algae to fish. A second special issue in JGLR is in the planning stages for 2018. CBFS continued to lead planning for the next CSMI for Lake Ontario, scheduled for 2018.

**Ongoing Project: Tagging Chinook Salmon in Lake Ontario**  
*Jim Watkins, Lars Rudstam, Chris Perle (Florida State College), Jesse Lepak (NY Sea Grant), Mike Connerton (NY DEC). Funded by New York Sea Grant.*

Chinook Salmon provide an exciting and economic recreational fishery in Lake Ontario. Chinooks in Lake Ontario are known to heavily depend on alewife forage, but an understanding of specific depth and thermal habitats and predator behavior is elusive. In July-August 2017, CBFS scientists collaborated with two charter boat captains in Oswego and Rochester with their extensive acquired knowledge in collecting fish. Ten mature Chinooks were fitted with pop-off satellite archival tags (PSATs) and released back to the lake to track over several months. These tags collect high resolution data for depth, temperature, light, and acceleration, and upon programmed release, transmit their position and data to satellites. Tagged fish eventually travelled to spawning areas including Cobourg Creek on the north shore and the Salmon River. Tag data confirm a general affinity for cool (12-14 C) water temperatures that generally represent the base of the thermocline. Due to the dynamic changes in water column structure, this temperature can represent habitats as deep as 30 m and as shallow as the surface during upwelling. At night, salmon frequently took short term (10 minute) forays into warmer surface waters presumably to hunt alewife. During the day, salmon commonly took short term dives as deep as 100 m for unknown reasons. This detailed understanding of Chinook thermal preferences and hunting behavior will improve bioenergetic modelling of this important predator, and toward managing this stocked species in a setting with a high interannual variability in the alewife forage base.
**Ongoing Project: Dynamics of the deep chlorophyll layer**

Annie Scofield, Jim Watkins, Brian Weidel (USGS), Maureen Walsh (USGS), Milan Riha (University of South Bohemia, Czech Rep), Kayden Nasworthy, Lars Rudstam (funded by GLFC and EPA–GLNPO).

Deep chlorophyll layers (DCLs) are important features during thermal stratification in large oligotrophic lakes. The presence of a DCL has been observed in all five of the North American Great Lakes, but its ecological significance is not well understood. In 2017, we continued working with GLNPO researchers to understand the importance of DCLs for lake production, zooplankton, and fish distributions. Three manuscripts were published in the Journal of Great Lakes Research during 2017 (Watkins et al., Scofield et al., Riha et al.), and additional manuscripts on long-term DCL trends and zooplankton diel vertical migration in Lake Michigan are in preparation for submission in 2018. For Kayden Nasworthy’s honors thesis work, additional experiments were completed on *Limnocalanus* predation on nauplii, with and without algae present, and stable isotope work is in progress to better understand the trophic position and feeding habits of this important calanoid species.

**Ongoing Project: Mysis ecology in the Great Lakes**

Toby Holda, Matt Hare, Jim Watkins, Patrick Sullivan, Brian O’Malley, David Jude (University of Michigan), Mary Balcer (University of Wisconsin-Superior), Dima Khrystenko, Kelly Bowen (DFO Canada), Jeremy Holden (OMNRF), Mike Connerton (NYDEC), Brian Weidel (USGS), Lars Rudstam (funded by GLNPO–EPA, Great Lakes Research Consortium)

Mysids are an important native species in all the Great Lakes. Understanding mysid ecology is an essential component of understanding these systems as the species is both a major predator on zooplankton and a major prey for alewife, smelt and native coregonids. Even so, there are multiple questions about mysid ecology that remain unanswered. In 2017, investigations were continued on the following three studies: 1) spatial patterns and population demographics of Lake Ontario mysids in 2013, 2) temporal trends in mysids abundance in the Great Lakes, and 3) the GLFC-funded project to investigate metabarcoding approaches to mysid diet analyses. A standardized database for 2013 mysid data from Lake Ontario became available on the web in 2017.

**On-going project: Lake Ontario and Lake Erie Biomonitoring Program**

Kristen Holeck, Chris Hotaling, and Lars Rudstam (Cornell University); Jana Lantry, Mike Connerton, Chris Legard, and Steve Lapan, Russ McCullough, Dave Lemon, Web Pearsall and Jim Markham (NYDEC); Brian Lantry and Brian Weidel (USGS); and Zy Biesinger (USFWS). (Funded by NYDEC)

Ecosystem-based management is an approach to managing environmental issues that considers how an ecosystem functions as a whole rather than focusing on a single species or issue in isolation. In Lake Ontario, managers have used an ecosystem-based approach to managing the productivity and availability of alewife and stocked salmonids since the end of the 1980s. In support of this approach, the New York State DEC initiated research in 1995 called the Lake Ontario Biomonitoring Program (BMP) to evaluate the condition of lower trophic levels in offshore, nearshore, and embayment areas of Lake Ontario. Lower trophic level components (nutrients, phytoplankton, and zooplankton) are indicators of ecosystem health and determine the lake’s ability to support prey fish upon which both wild and stocked salmonids depend. In 2016, this project was expanded to include zooplankton samples from the New York waters of Lake Erie. The BMP is a collaborative project that, in 2017, included the NYDEC Cape Vincent Fisheries Research Station (Lake Ontario), NYDEC...
Ongoing Project: Biogeochemical and ecological impacts of amphipod circoviruses in benthic habitats.
Kalia Bistolas, Ian Hewson, Elliot Jackson, Jim Watkins, and Lars Rudstam (Funded by National Science Foundation)

Benthic amphipods are key indicators of ecosystem health in the Laurentian Great Lakes. Annual monitoring programs depict progressive and precipitous declines in populations of the dominant amphipod, Diporeia spp, in three of the four deep lakes between 1997 and 2015. The mechanism(s) responsible for Diporeia population decline remain contentious. A previous study identified several putative CRESS-DNA viruses associated with Diporeia. The current project corroborates these findings and indicates that CRESS-DNA viruses are common constituents of Diporeia nanobiomes from both Great Lakes and Finger Lakes populations. One previously identified viral genotype, LM29173, is prevalent and recurrent among Lake Michigan and Lake Huron Diporeia. While this viral genotype is more abundant in declining Diporeia populations, we found that the distribution of LM29173 is most closely associated with amphipod haplotype demographics (irrespective of the state of population decline). Little is known about the role of CRESS-DNA viruses in mediating the ecology, physiology, or mortality of crustaceans. In 2017, we performed comparative transcriptomics on individual amphipods to elucidate the relationship between LM29173 and amphipod gene expression. We generated twelve transcriptomes from amphipods from genetically distinct populations (Lakes Michigan and Superior) to assemble and annotate a Diporeia transcriptome and identifying 2,208 genes/gene pathways that are differentially expressed in the presence of LM29173. The greatest proportion of annotated, differentially expressed genes were associated with functions including: (1) replication, recombination and repair, (2) cell wall/membrane/envelope biogenesis, and (3) post-translational modification, protein turnover, and chaperones. Transcriptome analysis and quantification (RT-qPCR) of three transcripts (non-muscular myosin heavy chain, β-actin, and ubiquitin-conjugating enzyme E2) indicated that Lake Michigan and Lake Superior amphipods with high viral load exhibit opposite trends in gene expression. This investigation provided the first survey of the transcriptional profile of invertebrates in relation to CRESS-DNA viral load.

Ongoing Project: Cisco Restoration in Lake Ontario
Matt Hare, Ellen George, Lars Rudstam, Darran Crabtree (TNC), Brian Lantry (USGS), Zy Biesinger (USFWS). (Funded by New York Sea Grant with contributions from TNC, USGS and USFWS)

Cisco (Coregonus artedi) are an important native prey fish species for lake trout (Salvelinus namaycush) and Atlantic salmon (Salmo salar). Today Chaumont Bay holds one of the last known remnant spawning stocks of cisco in the New York waters of Lake Ontario. Although Lake Ontario cisco populations are likely heavily dependent on the success of the Chaumont Bay population, little is known of their spawning habitat or the degree of reproductive success. Cisco populations are also threatened by the potential loss of genetic diversity and possible introgression with lake whitefish (Coregonus clupeaformis) following recent reductions in population size. Restoration of cisco in Lake Ontario has been identified as a critical element to the successful restoration of other salmonids, as they offer an alternative prey base that is low in thiaminase. However, simply increasing cisco numbers is not sufficient – availability of suitable spawning habitat and the genetic integrity of the spawning stock are vital for a strong, self-sustaining population. In 2017 we sampled historical spawning areas in the eastern basin of Lake Ontario to identify any previously unknown spawning sites. In addition, genetic data was collected to evaluate population risks based on inbreeding and hybridization effects as well as to inform broodstock collections and hatchery procedures in support of restoration.
Ongoing Project: Development of descriptive indices for the spawning and nursery habitat for Great Lakes cisco and their application to areas targeted for restoration.

Brian Lantry (USGS), Suresh Sethi, Lars Rudstam, Matt Paufve (Cornell). (Funded by USGS)

Cisco (Coregonus artedi) are a native fish species of conservation concern in the Great Lakes, and are the subject of ongoing management in Lake Ontario. Characteristics of suitable habitat for cisco reproduction are not well described and are needed for prioritizing areas targeted for restoration activities. To inform restoration efforts in Lake Ontario we are studying spawning sites of established populations in Lakes Superior and Michigan to (1) define quality habitat for cisco spawning and incubation in the Great Lakes and (2) relate habitat characteristics to egg viability and mortality. In 2017, egg sampling and habitat measurements were completed at both study sites in Lakes Superior and Michigan, and a similar project was completed in Lake Ontario. A controlled experiment testing the efficiency of benthic pump egg sampling was also completed. Planning is underway for a second sampling season at the study sites in Lakes Superior and Michigan.

Ongoing Project: What is the impact on fish recruitment of anthropogenic physical and structural habitat change in shallow nearshore areas in temperate systems? A systematic review protocol

Pär Byström (Umeå University), Biljana Macura (Mistra, Sweden), Laura Airoldi (University of Bologna, Italy), Britas Klemens Eriksson (Groningen University, Netherlands), Lars Rudstam (Cornell), Josianne Støttrup (Technology University, Denmark). (Funded by Mistra, Sweden)

Background: Shallow nearshore marine ecosystems are changing at an increasing rate due to a range of human activities such as urbanization and commercial development. The growing numbers of construction and other physical and structural alterations of the shoreline often take place in nursery and spawning habitats of many fish and other aquatic species. Several coastal fish populations have seen marked declines in abundance and diversity during the past two decades. A systematic review on the topic would clarify if anthropogenic physical and structural changes of near-shore areas have effects on fish recruitment and what these effects are. Methods: The review will examine how various physical and structural anthropogenic changes of nearshore fish habitats affect fish recruitment. Relevant studies include small- and large-scale field studies in marine and brackish systems or large lakes in temperate regions of the Northern and Southern hemispheres. Relevant studies may be based on comparisons between undisturbed and disturbed areas, before and after disturbance, or both. Relevant outcomes include measures of recruitment defined as abundance of juveniles of nearshore fish communities. Searches will be made for peer-reviewed and grey literature in English, Dutch, Danish, Finnish, German, Swedish and Spanish. All fish species and species groups will be considered in this review. Included relevant studies will be subject to a critical appraisal that will assess study validity. From relevant included studies, we will extract information on study characteristics, measured outcomes, exposure, comparators, effect modifiers and critical appraisal. Data synthesis is being completed and the report expected in early 2018.

Completion Report: Biological and social impacts of aquatic invasive species in the Great Lakes: development of scenarios through expert judgment and assessment of impacts on recreational angling.

Richard Ready (Penn State University), Bruce Lauber, Lars Rudstam, Richard Stedman, Nancy Connelly, and Gregory Poe (Cornell University). (Funded by the Great Lakes Fisheries Commission)

The magnitude of future impacts of aquatic invasive species (AIS) on Great Lakes fish communities and the subsequent impacts on recreational fisheries are potentially large, but unknown and the subject of intense public debate. With little scientific basis, stakeholders are making projections of the impacts of
AIS on sport fishing that range from negligible to catastrophic. Projections of the consequences of AIS in the Great Lakes should be based on the best ecological science available on the potential impacts of AIS on fish communities and on the best social science available on how anglers will react and be impacted by those changes. In 2017, we completed model analyses and published the last paper expected from this project in the Journal of Environmental Management (206:304-318). Concern over the potential transfer of aquatic nuisance species (ANS) between the Great Lakes basin and the Upper Mississippi River basin has motivated calls to re-establish hydrologic separation between the two basins. Accomplishing that goal would require significant expenditures to re-engineer waterways in the Chicago, IL area. These costs should be compared to the potential costs resulting from ANS transfer between the basins, a significant portion of which would be costs to recreational fisheries. In this study, a recreational behavior model is developed for sport anglers in an eight-state region. It models how angler behavior would change in response to potential changes in fishing quality resulting from ANS transfer. The model also calculates the potential loss in net economic value that anglers enjoy from the fishery. The model is estimated based on data on trips taken by anglers (travel cost data) and on angler statements about how they would respond to changes in fishing quality (contingent behavior data). The model shows that the benefit to recreational anglers from re-establishing hydrologic separation exceeds the costs only if the anticipated impacts of ANS transfer on sport fish catch rates are large and widespread.

CBFS Outreach, Extension and Education Programs

On-going project: Lake Ontario and Oneida Lake Education Initiative
JoAnne Getchonis, David White and Lars Rudstam (funded by the Shackelton Endowment, Cornell Hatch grant, New York Sea Grant)

In 2017, our CBFS interns were actively involved with the watershed education initiative. The interns presented some of the current CBFS research projects at a community outreach program at the local elementary school. Community members could have their picture taken with a “sturgeon” as they learned about current breeding success of sturgeon in Oneida Lake. Interns also spoke on the invasive round goby and the effect that species is having on the Oneida Lake ecosystem. Additional events included a historical perspective of the research at the Field Station, presented at the Sullivan Free Library and attendance at a “Fieldwork Fair” held at Mann Library on the Ithaca campus.

A project in the discussion phase involves educators from local school districts working together to develop a collaborative student project to be addressed during the academic year. It would be relevant to the local watershed and coordinated by one of the school district STEAM directors, with participants meeting at the Field Station during the school year.

On-going project: Doris Duke Conservation Scholars Program.

This grant from the Doris Duke Foundation provided stipends for 4 Cornell students interested in conservation and human diversity. The students are provided summer stipends for two summers, the first with a research program (in 2017, 2 interns were at Shackelton Point and 2 interns in the Adirondacks), and the second summer with a conservation organization. During the year, the scholars meet each second week with a graduate student mentor (with Vanessa Springer). They also take a one credit class with leadership training and diversity issues in the conservation field.
**FACILITIES AND MAINTENANCE**

In 2017 the newly completed dormitory provided housing for the summer intern program, workshops, and visiting classes for Cornell and outside groups. The second floor was furnished with new beds, mattresses, and foot lockers with matching funding from CALS Department of Natural Resources.

CBFS boat and vehicle fleets were upgraded in 2017. A new Dodge RAM 1500 Pickup was purchased and replaced the 2008 Chevy Silverado that was leased from Cornell Fleet Services. A new boat was funded by NSF, and CBFS staff worked with Winninghoff Boats, Inc. to craft a design that would meet various research needs. The boat was delivered in May and it replaces the Steigercraft for limnology sampling on Oneida Lake. The boat’s design also supports a variety of sampling activities, including acoustics and diving. This is the fourth vessel manufactured by Winninghoff Boats for Cornell University and second in CBFS’s fleet. The other two are in service at Shoals Marine Laboratory.

Concrete repair and improvements were a focus of maintenance in 2017. The entryway to the Main Office was updated. Concrete between the Main Office and Truck Garage had deteriorated enough to become a safety issue, so it was demolished and replaced with a new sidewalk and increased lawn area. The exterior stairs servicing the Main Office were also replaced. Other concrete projects included repairs to the deteriorated concrete and brickwork on the Point Garage and addition of a concrete walkway to the Classroom.

Removal of some trees at CBFS was necessary in 2017. The large sugar maple on the Gatehouse front lawn was dropping large limbs, so it was removed to prevent further property damage. A group of ash trees, located near a structure that houses Shackelton’s meter and backflow prevention valves for the water line, were removed because of the arrival of emerald ash borer.

Increased evening and weekend vehicle traffic was becoming a concern, so the wooden entrance gate was replaced with a motorized lift gate. The gate remains open during work hours and a code is required during off hours.

The 2,000 gallon gasoline tank was replaced with a new 300 gallon tank. The downsized replacement better services the fuel consumption needs of the facility.

CBFS would like to congratulate Dann Braid on his retirement. As Director of Facilities, Dann has made significant contributions to facility improvements and projects at Shackelton. We extend our gratitude and appreciation for his service to CBFS and his 39 years working for Cornell. We also would like to welcome Dustin Darnell as the new Director of Facilities. CBFS is looking forward to working with Dustin to continue improving Shackelton facilities and fostering relationships with Geneva and Ithaca.
**Grants and Funding**

Funding for the various elements of the research program include the CBFS (Shackelton) Brown endowment and a wide range of public and private agencies.

**Completed in 2017:**
Ecological calendars to anticipate climate change. Atkinson Center Academic Venture Fund (PI Kassam, with Akyuz (North Dakota State University), DeGaetano, Dunn, Jackson, Rodewald, Rudstam, Ruelle, Wolfe; $120,000, 2015-2017).

Climate change and invasive mussels: interacting effects on New York lakes. Cornell Hatch Grant (PI Rudstam, co-PI Jackson and Schneider; $75,000, 2014-2017).

Biomanipulation of Silver Lake, PA. Rose Conservancy and Actus Foundation (PI Morreale and Rudstam; $40,000, 2008-2017).


**Continuing in 2017:**
Ecology and management of warm water fish communities. NY DEC (PI Jackson, co-PI Rudstam; $1,800,000, 2015-2020).


Analysis of lower trophic levels in Onondaga Lake. Onondaga County (PI Rudstam; $50,000, 2015-2018).


Development of descriptive indices for the spawning and nursery habitat for Great Lakes Lake Herring and their application to areas targeted for restoration. GLRI (PI Lantry, co-PI Sethi and Rudstam; $180,000, 2016-2018).

Biomonitoring of Lake Ontario and Lake Erie. NY DEC (PI Rudstam; $120,000, 2017-2019).


Vertical habitat of salmonids in Lake Ontario using archival tags and hydrodynamic models. New York Sea Grant (PI Watkins, co-PI Rudstam, Perle; $183,000, 2016-2019).

Identifying genetic and habitat limitations to cisco restoration in Lake Ontario. New York Sea Grant (PI Hare, co-PI Rudstam; $209,000, 2016-2019).

**New initiatives in 2017:**

Understanding Declining Offshore Productivity in the Great Lakes. Great Lakes Fisheries Commission. (PI Stewart, coPI Rudstam, $30,000, 2017-18)


PUBLICATIONS AND PRESENTATIONS

Masters Theses:


Journal articles:


Books and Special Issues:


Research and technical reports:


Ontario lower trophic levels. NYSDEC Lake Ontario Annual Report Section 16.
Jackson, JR and DM Carlson. 2017. Distributional changes of stream fishes in New York State: Comparisons of results from the New York State Watershed Surveys of the 1930s and modern surveys from the 2000s. NYDEC Reports.

Presentations and abstracts:

Outreach presentations:

Getchonis, JG. 2017. There’s a dinosaur in my lake: The success story of lake sturgeon in Oneida Lake. Chittenango Central Schools, Chittenango, NY. April 2017
Getchonis, JG. 2017. Oneida Lake Education Initiative. Chittenango Central Schools, Chittenango, NY. June 2017
Getchonis, JG. 2017. Oneida Lake Education Initiative. Central Square Central Schools, Central Square, NY. October 2017
Jackson, JR. 2017. Fish population responses to invasive species and environmental change in Oneida Lake. Annual Meeting of the New York State Federation of Lake Associations, Hamilton, New York.

1st Binational Great Lakes Aquatic Invasive Species Forum. Erie, PA, June 2017:
2nd Binational Great Lakes Aquatic Invasive Species Forum. NOAA Great Lakes Environmental Research Laboratory Ann Arbor, MI, November 2017:

Great Lake Fishery Commission Board of Technical Experts Meeting. Ann Arbor, MI March 2017:

GLEON-19, Mohonk, NY, November 2017:

Lake Michigan Conference, IAGLR, Green Bay, WI, November 2017:

International Coregonid Conference, Bayfield, WI, September 2017:
George, EM, M Hare and LG Rudstam. Genetic limitations to cisco recovery in Lake Ontario
Rudstam, LG. Introduction to European coregonid research for the Cisco assessment workshop

Ecological Society of America Annual Meeting, Portland, OR, August 2017:
Pakzad, IY, JR Jackson, AJ VanDeValk and TE Brooking. The effect of round goby invasion on piscivory and growth rates of young-of-year largemouth and smallmouth bass in Oneida Lake
Roh, S, and LG Rudstam. Zebra and quagga mussel growth rates and mortality in Oneida Lake

International Association for Great Lakes Research Annual Meeting, Detroit, MI, May 2017:
Anneville, O, J Lenters, LG Rudstam, AM Ventela, G Bullerjahn, RM McKay and BS Somogyi. Large lakes, small world – not all Great Lakes are Laurentian. Special Session
Dillon, RA, JD Conroy, LG Rudstam and SA Ludsin. Quantifying potential bias of planktonic invertebrates in acoustic surveys of prey fish density.
George, EM, MP Hare and LG Rudstam. Genetic limitations to Cisco restoration in Lake Ontario.
Kovalenko, KE, ED Reavie, LE Burlakova, AY Karatayev, LG Rudstam and RP Barbiero.


2017 Great Lakes Biology Monitoring Program Assessment, Chicago, IL, May, 2017:
Rudstam, LG and JM Watkins. Status, quality assurance, and long-term trends in zooplankton and Mysis data.
Watkins, JM, LG Rudstam and AE Scofield. Collection, quality assurance, and status of chlorophyll a data.

8th Binational Meeting of the Lake Erie Millennium Network, University of Windsor, Canada, February 2017:

Association for Limnology and Oceanography Annual Meeting, Honolulu, HI, February 2017:

Karatayev, VA, TF Nalepa, AY Karatayev, BC Weidel, LG Rudstam and LE Burlakova. Living fast or slow: habitat specific demography of invasives regulates their large scale food web impacts.

New York Chapter of the American Fisheries Society Annual Meeting, Buffalo, NY, February 2017:
Brooking, TE, JR Jackson, LG Rudstam and AJ VanDeValk. Fisheries surveys of Canadarago Lake.
Jackson, JR, TE Brooking and AJ VanDeValk. Status of lake sturgeon in Oneida Lake.
Pakzad, I, JR Jackson, AJ VanDeValk and TE Brooking. Round gobies and piscivory rate in Oneida Lake young-of-year largemouth and smallmouth bass.

15th Symposium on Aquatic Microbial Ecology, Zagreb, Croatia, September 2017
Bistolas KSI, LG Rudstam and I Hewson. Phylogeography and transcriptional impact of CRESS-DNA viruses associated with aquatic microcrustaceans.

Finger Lakes Research Conference, Geneva, NY, November 2017
Sethi, SA, J Lepak, A Rice, K Andres, E Duskey, B Estabrooks, K Fitzpatrick, E George, B Marcy-Quay, K Perkins, M
Pauvve, A Scofield. Characterizing the ecological niche of invasive round goby in Cayuga Lake.

Departmental Seminars in 2017:
University of Stockholm, Sweden, April 2017
Jinan University, Guangzhou, China, November 2017

AWARDS AND SERVICE

Awards:
George, EM: David Bryson Memorial Scholarship Award. New York Chapter of the American Fisheries Society. Awarded at the Annual Meeting of NYCAFS, February 1-3 2017, Buffalo NY.

Service:
George, EM: International Association of Great Lakes Research, Outreach Committee
George, EM: Treasurer, Cornell Student Subunit of the American Fisheries Society
Holla, T: Co-President for the DNR Graduate Student Association
Jackson, JR: Member, Advisory Panel to the Rare and Endangered Fish Unit of NYSDEC
Jackson, JR: Member, NYSDEC Bureau of Fisheries, Black Bass Research Team
Jackson, JR: Member, NYSDEC Bureau of Fisheries Statewide Database Committee
Jackson, JR: Member, NYSDEC Bureau of Fisheries, Sauger Management Team
Mills, EL: Member, ISAC Advanced Biotech Task Team of the National Invasive Species Advisory Council
Mills, EL: Member, National Invasive Species Advisory Council (Re-appointed by U.S. Department of Interior Secretary Ken Salazar for three year term)
Mills, EL: Member, Prevention and Early Detection and Rapid Response subcommittees of the National Invasive Species Council
Mills, EL: Member, NYS Invasive Species Advisory Council (Representing Cornell University)
Mills, EL: Board of Directors, Oneida Lake Association

Mills, EL: Associate Editor, Aquatic Ecosystem Health and Management
Mills, EL: Lake Advisor, Onondaga Lake, Onondaga County, NY
Pauvve, M: Co-President, DNR Graduate Student Association
Pauvve, M: President, Cornell Student Subunit of the American Fisheries Society
Rudstam, LG: Lake Advisor, Onondaga Lake, Onondaga County, NY
Rudstam, LG: Associate Editor, Journal of Great Lakes Research.
Rudstam, LG: Guest Editor JGLR Special Issue for GLNPO
Rudstam, LG: Associate Editor, Aquatic Ecosystem Health and Management
Rudstam, LG: Member, Lake Ontario Technical Committee – New York State
Rudstam, LG: Senator, Cornell Faculty Senate
Rudstam, LG: Campus representative for Great Lakes Research Consortium
Rudstam, LG: Council of Fellows, Cooperative Institute for Great Lakes Research
Rudstam, LG: Board member International Association for Great Lakes Research
Rudstam, LG: Program Committee. Joint meeting of IAGLR and European Large Lakes Group
Scofield, AE, President, Cornell Student Subunit of the American Fisheries Society
Scofield, AE, Treasurer for the DNR Graduate Student Association
Watkins, JM, Associate Editor, Aquatic Ecosystem Health and Management
Watkins, JM, Guest Editor, Journal of Great Lakes Research
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<th>Event Description</th>
<th>Location</th>
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<td>CNYRPDB – Anne Saltman</td>
<td>Classroom</td>
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<td>3/28</td>
<td>NYDEC and Suresh Sethi</td>
<td>Classroom</td>
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<td>Finger Lakes fisheries assessments meeting</td>
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<td>3/30-31</td>
<td>Nuffield Scholars – Larry VanDe Valk</td>
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<td>4/11</td>
<td>NYDEC – Jeff Loukmas</td>
<td>Cafeteria meeting room</td>
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<td>4/17-20</td>
<td>SUNY ESF-Don Stewart</td>
<td>Shoreline</td>
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<td>4/21-23</td>
<td>FLCC – Maura Sullivan</td>
<td>Dormitory, shoreline</td>
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<td>4/24</td>
<td>NYDEC - Oneida Lake project meeting</td>
<td>Cafeteria meeting room</td>
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<td>4/27</td>
<td>Buffalo State-A. Karatayev, L. Burlakova</td>
<td>Library</td>
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<td>5/3</td>
<td>NYDEC – Lisa Holt</td>
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<td>5/10-11</td>
<td>NYDEC – Mike Putnam</td>
<td>Classroom, cafeteria, housing</td>
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<td>5/23</td>
<td>CNYRPDB – Anne Saltman</td>
<td>Library</td>
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<td>6/1</td>
<td>Boater Safety Training-Dave White</td>
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<td>CBFS Summer Seminar Series</td>
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<td>Martin Stapanian, U.S. Geological Survey</td>
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<td>6/14</td>
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<td>Randy Jackson, Cornell University</td>
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<td>CPR/First Aid-Dave Jensen</td>
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<td>Joe Warren, SUNY Stonybrook,</td>
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<td>6/28</td>
<td>CBFS Summer Seminar Series</td>
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<td>Karin Limburg, SUNY ESF</td>
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<td>6/29-7/5</td>
<td>Buffalo State-A. Karatayev, L. Burlakova</td>
<td>Housing</td>
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<td>6/29-7/5</td>
<td>Belarusian State University-B Adamovich, H Zhukava</td>
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<td>Boris Adamovich and Hanna Zhukava, Belarusian State University Biological Field Station</td>
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<td>7/12</td>
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<td>Henry Regier, University of Toronto</td>
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<td>7/19</td>
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<td>Chris Pennuto, SUNY Buffalo State</td>
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<td>7/26</td>
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<td>Jim Watkins, Cornell University</td>
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<td>8/3</td>
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<td>Undergraduate intern presentations</td>
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<td>8/28-8/30</td>
<td>GLFC Fish and Productivity Workshop</td>
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<td>9/12-13</td>
<td>Cornell Pro-Dairy-Heather Darrow</td>
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<td>9/23</td>
<td>Field Bio-Marc Goebel</td>
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<td>9/27-28</td>
<td>NYDEC-Jeff Loukmas</td>
<td>Cafeteria meeting room</td>
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<td>10/16-20</td>
<td>Zooplankton Workshop</td>
<td>Classroom, lab, housing</td>
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<td>10/17</td>
<td>NYS Sea Grant-Dave White</td>
<td>Cafeteria meeting room</td>
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<td>10/26</td>
<td>NYS Sea Grant-Dave White</td>
<td>Cafeteria meeting room</td>
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<tr>
<td>11/27</td>
<td>NYDEC-Project meeting</td>
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<td>11/28-29</td>
<td>DFO-Canada</td>
<td>Classroom, lab, housing</td>
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<td></td>
<td>Zooplankton training workshop</td>
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<tr>
<td>12/20</td>
<td>NYDEC-Oneida Lake project</td>
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