THE RESEARCH FOUNDATION
The State University of New York

SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

Office of Research Programs
1 Forestry Drive
Syracuse, New York
13210

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November 6, 2008

New York Power Authority
Edward Alkiewicz
123 Main Street
White Plains, NY 10601

RE: PL-5025/7419

Dear Mr. Alkiewicz:

The enclosed proposal entitled, "Muskellunge Esox Masquinongy Genetic Structure, Reproductive Ecology and Interaction with the Fish Community: An Application for Funding Through the Greenway Ecological Fund" is being submitted for your consideration by the Research Foundation of State University of New York, for and on behalf of the State University of New York College of Environmental Science and Forestry.

Technical responsibility of the project rests with the SUNY College of Environmental Science and Forestry and has been assigned to the technical representative identified below. Questions about the substance of the application should be directed to the technical representative or to the Office of Research Programs. This office will also respond to questions on the budget. Please reference the number assigned to this application in your correspondence or inquiries.

If action on the application is favorable, the award should be made to the Research Foundation of State University of New York which will provide fiscal administration. Negotiations concerning the terms and conditions of the award should be conducted with the administrative representative identified below.

Sincerely,

Dr. Neil H. Ringler
Dean of Research

Administrative Representative
Robert Mason
The Research Foundation of
State University of New York
PO Box 9
Albany, NY 12201
(518) 434-7113

Technical Representative
Dr. John M. Farrell
State University of New York
College of Environmental Science
and Forestry
Syracuse, New York 13210
(315) 470-6990/4300

cc: Dr. Donald J. Leopold
Mr. William Nicholson

Muskellunge *Esox masquinongy* Genetic Structure, Reproductive Ecology, and Interaction with the Fish Community: Acquiring Information Needed for Successful Management

An Application for Funding Through the Ecological Greenway Fund

By

Dr. John M. Farrell and Kevin L. Kapuscinski
State University of New York
College of Environmental Science and Forestry
1 Forestry Drive
Syracuse, NY 13210

Purpose

We seek to fill critical gaps in our understanding of muskellunge *Esox masquinongy* biology, thereby reducing management uncertainty and increasing the probability of conserving this ecologically and economically important resource. Our proposed project will continue and expand upon work begun during 2007-2008.

Background & Objectives

Muskellunge are large, predacious fish, serving important ecological functions in aquatic communities and supporting local economies in New York State (Menz 1981). The New York Statewide Angler Survey (Connelly et al. 1997) indicated muskellunge was the second most sought after species in the upper Niagara. Unfortunately, angler catch rates of muskellunge from the Buffalo Harbor, Lake Erie, and the upper Niagara River (Figures 1 & 2) have declined dramatically over the past decade (Figure 3).

After meeting with concerned local anglers (Niagara Musky Association), New York State Department of Environmental Conservation (NYSDEC) and State University of New York, College of Environmental Science and Forestry (SUNY-ESF) staff undertook and completed surveys targeting spawning and young-of-year (YOY) muskellunge during 2007-2008; the results of our spring 2007 efforts are enclosed

(Kapuscinski and Wilkinson 2008). Results from electrofishing surveys targeting YOY muskellunge suggest recent declines in YOY production (Figure 4); however, the incomplete time series makes this conclusion tenuous.

Relatively little is known about muskellunge compared to many other fishes because their low abundance and cryptic behavior makes them difficult to study. Mike Wilkinson (NYSDEC) conducted electrofishing surveys for YOY muskellunge in the Buffalo Harbor and upper Niagara River during 1992-1994 and 2006-2008, but these populations have otherwise been rarely sampled since the 1970s. Major information gaps make management of muskellunge difficult. For example, muskellunge in large systems are typically managed as single stocks (fisheries management units) due to lack of knowledge about genetic or demographic structure. Failure to identify discrete stocks can lead to losses of genetic variation (evolutionary potential) and reproductive output via localized overexploitation or habitat degradation. Similarly, difficulty in sampling muskellunge has made it impossible to quantify spawner-recruitment dynamics with traditional methods (e.g., the Ricker models used to quantify spawner-recruitment dynamics of walleye; Hansen et al. 1998), forcing biologists to manage muskellunge without a sound understanding of these critical dynamics. Specifically, we do not know to what extent declines in angler catch rates (Figure 3) reflect declines in the spawning stock or YOY production. Therefore, the over-arching goal of this project is to reduce uncertainty in muskellunge management by filling critical information gaps, thereby increasing the probability of conserving this important species.

Objectives & Justification

1) Examine genetic population structure of muskellunge to identify discrete stocks and determine if spawning and nursery sites are equivalent.
    - Quantifying the genetic structure of muskellunge will allow for the identification of discrete stocks. Stock-specific management will decrease the likelihood of local extirpations, which would otherwise decrease muskellunge genetic variation and long-term survival probabilities. Stock identification and understanding the genetic relatedness between stocks will also benefit biologists attempting to reintroduce or augment

populations. Biologists can select appropriate brood source(s) by considering the relatedness of stocks along with geographic location and local environmental conditions. Without this knowledge, augmenting existing populations via stocking may compromise the genetic integrity and sustainability of Buffalo Harbor and Niagara River muskellunge.

- It is often assumed that muskellunge spawning and nursery sites are equivalent. If this assumption is falsified, biologists estimating first year survival of muskellunge must account for mortality associated with migration from spawning to nursery sites. Detection of differences between spawning and nursery sites will also require that we protect both of these critical habitats; currently nursery sites are identified and awarded special protections from disturbance.

2) Estimate the effective number of breeding muskellunge from YOY genetic samples.
    - Estimating the number of effective breeders at specific spawning sites will provide biologists with a surrogate of abundance that they can use to guide management decisions. Muskellunge abundance estimates are currently lacking for the Buffalo Harbor and Niagara River due to sampling difficulties, but are necessary for developing management plans and evaluating management success (Van Den Avyle 1993).
3) Survey fish communities and YOY muskellunge production to monitor reproduction and identify priority areas for protection and habitat improvement.
    - Achievement of this objective will provide YOY muskellunge catch rates at individual nursery sites for a third consecutive year. These catch rates serve as relative abundance estimates of YOY muskellunge and allow for site-specific comparisons. Examining the relationships between catch rates of YOY muskellunge and other fishes may provide insight into which members of the fish community are supporting or negatively impacting muskellunge. This information will be used to provide guidance to the NYSDEC for development of an annual, standardized monitoring survey of YOY muskellunge.

- Our 2008 efforts identified a previously undocumented, but extremely productive nursery site at the mouth of Big Six Mile Creek. Identification of such sites provides justification for protection from future disturbances and can lead to habitat restoration where necessary.
- Evidence gathered during 2006-2008 suggests YOY muskellunge are no longer produced in the once important Strawberry Island embayment. Strawberry Island was altered to prevent erosion, but our results suggest adjacent aquatic habitats are in need rehabilitation. Conversely, we captured YOY muskellunge at a previously remediated site (102nd Street embayment). Monitoring the fish community and YOY muskellunge production at sites where habitat is being purposely altered will allow for evaluation of these activities.
- Includes sampling YOY muskellunge in the lower Niagara River for the first time since 1993 - little is known about muskellunge in the lower river.
- Important information on species of greatest conservation need in NY State may also be collected during this seining effort. For example, we collected a blackchin shiner *Notropis heterodon* during 2008. Blackchin shiner have a NY Natural Heritage Program rank of S1, meaning typically 5 or fewer occurrences (see http://www.dec.ny.gov/animals/9406.html).

4) Describe the diet of YOY muskellunge.
    - Understanding what fish muskellunge rely on during their first year of growth is vital for proper management of the aquatic communities that support muskellunge. We do not know if YOY muskellunge feed on non-native species such as rudd *Scardinius erythrophthalmus*, round goby *Neogobius melanostomus*, carp *Cyprinus carpio*, or goldfish *Carassius auratus*. It is important to understand how muskellunge are responding to fish community changes caused by non-native invasions.

Methods

Objectives 1 & 2 require collection and analysis of muskellunge genetic samples. We will collect non-lethal fin clips from juvenile and adult muskellunge via electrofishing

during May and June. All muskellunge will be measured, and those large enough will be tagged prior to release with a uniquely numbered tag. Similarly, we will collect fin clips from YOY muskellunge captured at nursery sites by seining (July-September) and electrofishing (September). We will attempt to trap muskellunge eggs during the mid May to mid June spawning period (see Farrell 2001). Genetic structure, the effective number of breeders, and within-site differences between egg and YOY samples will be quantified with microsatellite markers. Microsatellites typically contain high mutation rates and are therefore useful for intra-population studies of genetic diversity and population structure (Lowe et al. 2004). Samples will be analyzed at the U.S. Geological Survey Wisconsin Cooperative Fishery Research Unit Laboratory, University of Wisconsin-Stevens Point, under the supervision of Dr. Brian Sloss, Assistant Unit Leader. We will use Wright's F-statistics for inbreeding (F_{IS}) and genetic divergence (F_{ST}) to assess genetic population structure and to test for within-site differences in genetic variation between eggs and YOY (Allendorf and Luikart 2007). We will use the formulae of Pudovkin et al. (1996) and Luikart and Cornuet (1999) to estimate the effective number of breeders $\hat{N}_{eb}$ at each nursery site. Approximately 400 samples were collected during 2007-2008, and we expect to collect about 200 more during 2009. The analytical cost is about $14.00 per sample.

We will sample YOY muskellunge and the fish community at nursery sites with a bag seine (Objective 3). Seine hauls will be of equal length (30.5 m) to allow for standardized comparisons of catch rates between sites. We will conduct two rounds of seining, one with a fine-mesh seine (9.1 m; approximate sampling dates 27 July-7 August) and one with a large mesh seine (18.3 m; approximate sampling dates 24 August-4 September). All fish captured will be identified and released. All northern pike *Esox lucius* and muskellunge will be measured for total length (mm), and a fin clip will be collected from muskellunge for genetic analyses. Site-specific catch rates of YOY muskellunge will be calculated, and trends in site-specific YOY muskellunge production will be examined where multiple years of data exist. The YOY muskellunge catch rates, trends, and presence/absence data will be used to identify priority areas for protection and habitat improvement. These data can also be used to develop annual, standardized surveys for YOY muskellunge and the fish community at nursery sites.

Stomach contents will be lavaged out of muskellunge ≥ 80 mm (non-lethal technique, see Farrell 1998) captured during seining efforts (Objective 4). All prey items will be identified and measured for total length when possible. The percent composition of individual species in YOY muskellunge diets and the average size of prey items will be quantified.

Organization

The Research Foundation for and on behalf of State University of New York, College of Environmental Science and Forestry
P.O. Box 9
Albany, NY 12201
Robert Mason (Contact)

Federal ID Number

14-1368361

Points of Contact

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Evidence of Consultation with the Niagara River Greenway Commission

A completed *Niagara River Greenway Commission Consultation and Review Form* will be provided to the Commission by 14 November 2008 along with this project proposal document. We will forward a copy of the consultation and review form to Secretary Alkiewicz. Any comments made by the Commission, and our response will also be forwarded to the Secretary.

Evidence of Consultation with Affected Municipalities, Counties, or Indian Nations

N/A – Project activities will not be conducted on municipal, county, or Indian Nation lands.

Evidence of Consultation with State and Federal Agencies

The New York State Department of Environmental Conservation (NYSDEC) is a project cooperator and has reviewed this application in full. NYSDEC project reviewers were Paul McKeown (Allegany office, phone: 716-372-0645) and Mike Wilkinson (Buffalo office, phone: 716-851-7010). We obtained collector's permits from the Ontario Ministry of Natural Resources (OMNR) for work conducted during 2007-2008, and we provided OMNR with a summary report of 2007 activities; we will again obtain all required permits for future work. Our OMNR point of contact was Alistair Mathers (Picton, Ontario office, phone: 613-476-8733). Consultation with U.S. federal agencies was not applicable for this project and therefore not conducted.

Operation and Maintenance Plan

N/A – No physical structures are being built.

Project Consistency with the Niagara River Greenway Plan (NRGP)

Our project will advance several principles outlined in the NRGP, especially *Sustainability*, *Ecological Integrity*, and *Restoration*. The results obtained from our analyses of genetic structure, the number of effective breeders, and whether or not spawning and nursery sites are equivalent will be vital for sustainable management of muskellunge. In addition, conservation of muskellunge genetics will maximize their evolutionary potential, a primary component of ecological integrity. Conservation of muskellunge will promote the ecological integrity of the Niagara River aquatic community, because they conduct critical ecosystem functions as apex predators. The identification of priority nursery areas for protection and habitat rehabilitation will help restore both the muskellunge population and a wide variety of fishes that rely on similar habitat. Our project will also advance the NRGP's principles of *Partnerships* and *Community*. This project will continue and strengthen a collaborative effort between the NYSDEC and SUNY-ESF to gain knowledge about the Niagara River fish community. Both agencies rely on local anglers (Niagara Musky Association) to provide catch rate data, report tag recaptures, and collect fin clips (genetic samples) from muskellunge. The partnerships between the NYSDEC, SUNY-ESF, and local community are critical for conservation of the muskellunge population (ecological resource) and fishery (public resource).

This project will strongly support the NRGP's goals to *Protect and Restore Environmental Systems* and *Promote Long Term Sustainability* by identifying areas in need of protection and habitat restoration, and providing information needed to preserve muskellunge. An improved muskellunge population will attract more anglers, even from out of state, who will spend money locally and help *Spark Revitalization and Renewal*.

Our project proposal is consistent with the criteria *Priority Status: Restoration of Niagara River Ecosystem* because our results can be used to guide restoration and preservation of the muskellunge population, and the habitat and fish community it relies upon. Our collaborative efforts with the Niagara Musky Association will promote stewardship of the resource by including them in the data collection process. Project activities will be conducted almost entirely within the *Focus Area*; limited sampling will occur at sites near Navy Island and upstream from the Niagara Parks Marina in Ontario

waters. We believe that all aspects of our project are *Implementable*. Our proposed work builds upon activities completed during 2007-2008, so our prior experience allows us to propose a realistic workload and budget. One concern we do have is our ability to capture muskellunge eggs and satisfy Objective 3. We deployed 16 egg traps at four sites in 2008 as a pilot study, checked them weekly, but did not capture muskellunge eggs. Most traps were covered with filamentous algae that would have prohibited capture of eggs deposited over the traps. We believe deploying more traps in a few of the most productive areas, and checking (cleaning) them every other day will increase our odds of capturing muskellunge eggs. Several *Matching Funds* will contribute to the implementation of this project, including contributions from: the Niagara Musky Association, the NYSDEC, SUNY-ESF, and Dr. Brian Sloss's genetics lab (USGS); dollar amounts are provided below. The results of this project will provide *Clear Benefit*s to the Niagara River and the local community by filling critical information gaps needed for proper management of muskellunge. A healthy muskellunge population will provide ecological benefits to the aquatic community by preserving their role as the apex predator, and will provide economic benefits by improving the sport fishery.

Project Consistency with State and Federal Laws

NYSDEC collaborators reviewed the project description for consistency with state laws, and NYSDEC staff will be involved with most project activities, providing real-time consultation on any changes to the project. We will obtain a collector's permit from OMNR for any activities in Ontario waters, and therefore be in compliance with all Ontario laws. Our proposed activities do not require exemption from federal laws, so U.S. agencies were not consulted.

Efforts and Opportunities to Obtain Matching Funds

Approximately $71,915.00 in matching funds will support this project. The Niagara Musky Association has agreed to provide $300.00 for Kapuscinski to attend two of their meetings to facilitate collaboration and present important findings to club members. The NYSDEC has agreed to provide services totaling $33,471.00 (salary, mileage, and boat fuel). The SUNY-ESF will provide a cost-share of $21,149 in the form of salary, tuition,

and indirect costs; a matching grant held by SUNY-ESF will provide another $11,696.00 in similar services. Dr. Brian Sloss will analyze approximately 400 genetic samples collected during 2007-2008, at a matching cost of $5,600.00.

Existing Costs as of 31 August 2007

We will not use any awarded Greenway Funds to defray obligations, operations, or maintenance costs existing prior to 31 August 2007.

Land Ownership Associated with Project

N/A

Project Budget

Extensive field sampling will be conducted during 2009 to achieve the project objectives. Methods section. Data analysis, synthesis with 2007-2008 data, and report writing will be conducted during 2010. Therefore, funding for two years is being requested:

2009 Budget Summary			
Activity	Approximate dates	Item	Cost
Sampling for musky eggs, capture juveniles and adults via electrofishing	18 May - 12 June	Lodging	$1,600
		Per diem	$500
		Mileage	$1,053
		Supplies	$1,310
		Tags & applicators	$391
		Boat fuel	$468
Seine for young-of-year musky & fish community at nursery sites	27 July - 7 Aug	Lodging	$800
		Per diem	$250
		Mileage	$527
		Boat fuel	$195
Seine for young-of-year musky & fish community at nursery sites	24 Aug - 4 Sept	Lodging	$800
		Per diem	$250
		Mileage	$527
		Boat fuel	$195
Assist NYSDEC with young-of-year musky electrofishing survey	14 - 18 Sept	Lodging	$400
		Per diem	$125
		Mileage	$176
Genetic sample analysis			$1,400
Kapuscinski	1 Jan - 31 Dec	Salary	$25,500
		Benefits	$3,358
		Tuition	$5,111
Farrell	1 Jan - 31 Dec	Salary	$2,566
		Benefits	$1,112
Technician	1 May - 30 Sept	Salary (12 weeks)	$7,200
		Benefits	$1,152
SUNY-ESF indirect costs			$33,610
			$90,575

2010 Budget Summary			
Activity	Approximate dates	Item	Cost
Genetic sample analysis			$1,400
Kapuscinski	1 Jan - 31 Dec	Salary	$26,520
		Benefits	$3,668
		Tuition	$1,063
Farrell	1 Jan - 31 Dec	Salary	$2,681
		Benefits	$1,171
SUNY-ESF indirect costs			$21,537
			$58,040

Proposal Budget
NY Power Authority - Greenway Ecological Fund

Muskellunge *Esox masquinongy* Genetic Structure, Reproductive Ecology and Interaction with the Fish Community: An Application for Funding Through the Greenway Ecological Fund
January 1, 2009 - December 31, 2010

NYPA-Greenway-Jfarrell:08q3:rbs 11/10/08

CATEGORY	Year 1	Year 2	TOTAL
A. Senior Personnel:			
PI: John Farrell, 5% CY (NYPA-3%)	2,566	2,681	5,247
Total Senior Personnel	2,566	2,681	5,247
B. Other Personnel:			
1- Technician, 12 weeks (Summer Appt)	7,200	0	7,200
1- Graduate student	25,500	26,520	52,020
Total Salaries and Wages	35,266	29,201	64,467
C. Benefits @ 43.34%; 43.67%	1,112	1,171	2,283
Regular Employees @ 38.83%, 39.5%	0	0	0
Summer Salary @ 16%	1,152	0	1,152
Graduate Students @ 13.17, 13.83%	3,358	3,668	7,026
Undergraduate Students @ 6%	0	0	0
Total Benefits	5,622	4,839	10,461
Total S, W and B	40,888	34,040	74,928
D. Permanent Equipment:			
	0	0	0
	0	0	0
E. Materials and Supplies	1,701	0	1,701
F. Travel:			
1. Domestic	7,866	0	7,866
2. Foreign	0	0	0
G. Participant Support Costs:	0	0	0
H. Other Direct Costs:			
1. Publication Costs/Page Costs	0	0	0
2. Consultant Services	0	0	0
3. Computer Services	0	0	0
4. Subcontracts:	0	0	0
5. Other:			
* Tuition (1 full semester - 3 semesters@ 1Credit)	5,111	1,063	6,174
A&T Services - USGS/Sloss	1,400	1,400	2,800
	0	0	0
Subtotal (6. Other)	6,511	2,463	8,974
Total Other Direct Costs	6,511	2,463	8,974
I. Total Direct Costs	56,966	36,503	93,470
J. Indirect Costs @ 59% TDC (waived from 71% TDC)	33,610	21,537	55,146
K. Total Direct and Indirect Costs	90,576	58,040	148,616
L. Residual Funds	0	0	0
M. Amount of Request	**90,576**	**58,040**	**148,617**
SUNY CESF Contribution:	11,788	9,361	21,149
Other Costshare	42,043	8,674	50,716
Total Costshare	**53,831**	**18,035**	**71,865**

Represents salaries, wages,indirect costs associated with the faculty time commitment indicated above and unrecoverable indirect costs at non federal rate of 71% TDC .

SUNY CESF COST-SHARING

PI: John Farrell, 5% CY (NYPA-3%)	1,711	1,711	3,422
Total PI and CoPI Salaries & Wages	1,711	1,711	3,422
Benefits @ 42.67%; 43.67%	730	747	1,477
Total Salaries and Fringe	2,441	2,458	4,899
A& T Services	0	0	0
Tuition	455	455	910
Total Direct Cost	2,896	2,913	5,809
Indirect Costs @ 71% TDC	2,056	2,068	4,124
Unrecoverable Indirect Costs @ 71% TDC	6,836	4,380	11,216
Total Cost-Sharing	11,788	9,361	21,149
Other Costshare:			
DEC Match			
Labor	32,338	0	32,338
Milege	920	0	920
Boat Fuel	163	0	163
Total DEC	33,421	0	33,421
Matching Grant 37790 (terms June 30, 2010)			
Salary	4,500	4,500	**9,000**
Fringe	563	608	1,171
Total Direct Cost	5,063	5,108	10,171
Indirect Costs @15.7% TDC	759	766	1,525
	5,822	**5,874**	**11,696**
USGS-Dr. Brian Sloss- A&TS	**2,800**	**2,800**	**5,600**
Total Costshare	**53,831**	**18,035**	**71,865**

References

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Connelly, N. A., T. L. Brown, and B. A. Knuth. 1996. New York statewide angler survey, report 1: angler effort and expenditures. DEC Publication, Albany, NY.

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Pudovkin, A. I., Zaykin, D. V., and D. Hedgecock. 1996. On the potential for estimating the effective number of breeders from heterozygote-excess in progeny. Genetics 144:383-387.

Van Den Avyle, M. J. 1993. Dynamics of exploited fish populations. Pages 105-135 *in* C. C. Kohler and W. A. Hubert, editors. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Figure 1. Buffalo Harbor, Lake Erie. Stars indicate areas to be included in seining survey.

Figure 2. Upper Niagara River. Stars indicate areas to be included in seining survey.

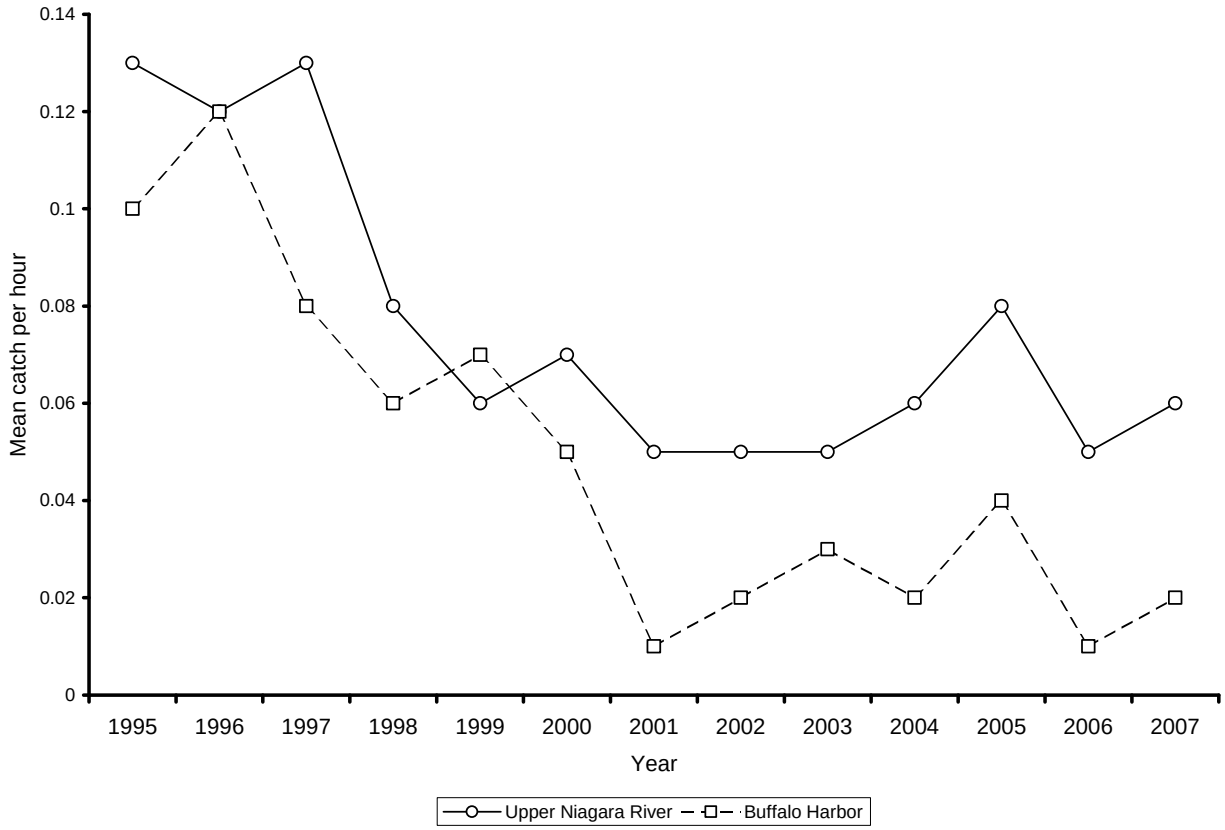

Figure 3. Mean catch rate of muskellunge (number caught per hour) by anglers participating in the Niagara Musky Association angler cooperation program during 1995-2007.

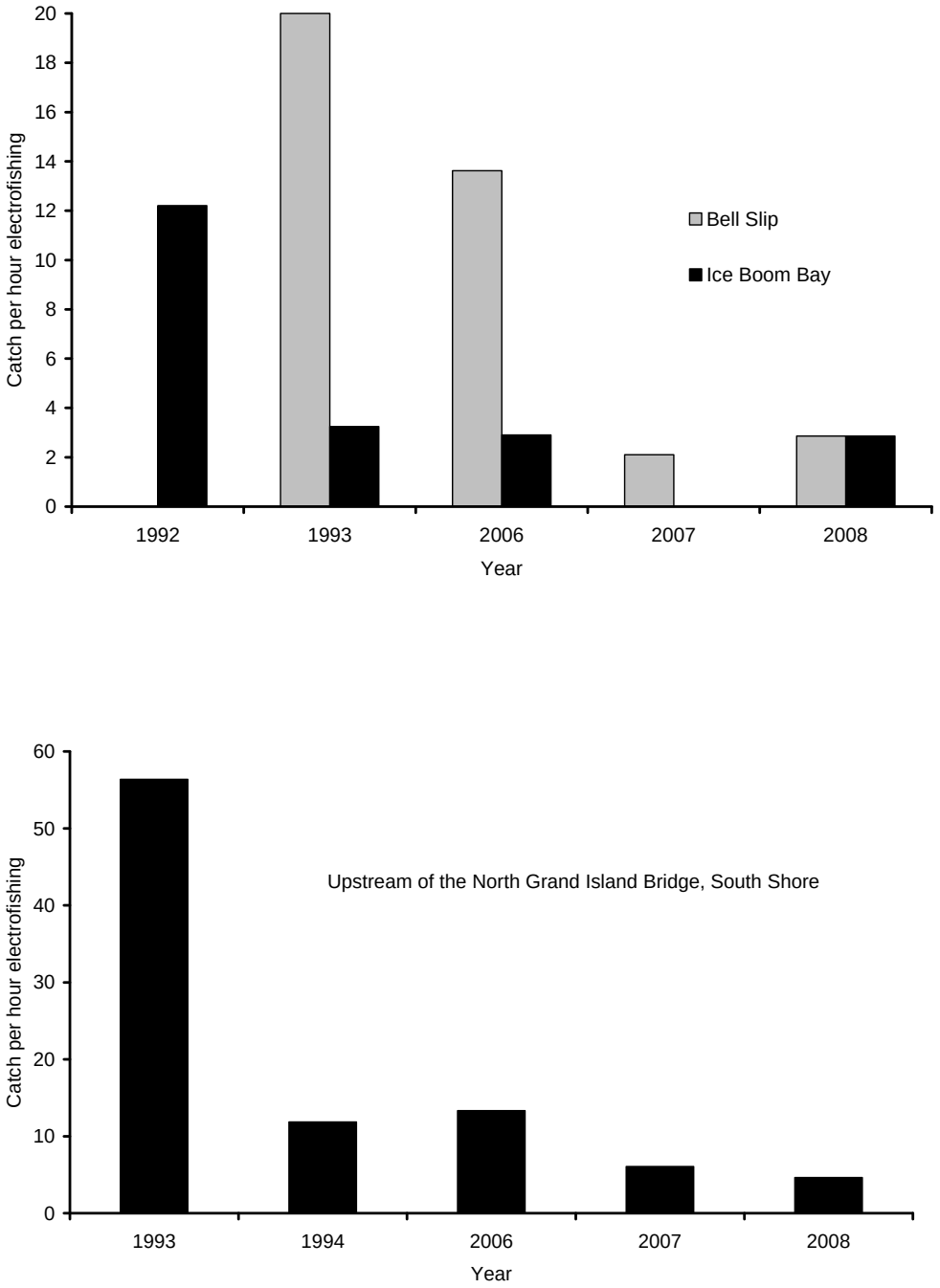

Figure 4. Mean catch per hour of young-of-year muskellunge by electrofishing at two sites in the Buffalo Harbor, Lake Erie (top panel), and one site in the upper Niagara River (lower panel) during 1992-2008.

JOHN M. FARRELL – VITA

EDUCATION:

Ph.D. Ecology (fish), SUNY College of Environmental Science and Forestry, 1998
M.S. Fish and Wildlife Management (fisheries), SUNY College of Environmental Science and Forestry, 1991
B.S. Natural Resources (Fisheries), Cornell University, 1987
A.A Conservation, Finger Lakes Community College, 1984

EMPLOYMENT HISTORY:

Senior Research Associate & Director of Thousand Islands Biological Station, SUNY College of Environmental Science and Forestry	2007-
Research Associate, SUNY College of Environmental Science and Forestry	2000-2007
Adjunct Professor, SUNY College of Environmental Science and Forestry	1999-2000
Research Assistant, SUNY College of Environmental Science and Forestry	1994-1998
Research Assistant, York University	1992-1993
Research Assistant, Penn State University	1992
Research Assistant, SUNY College of Environmental Science and Forestry	1988-1991
Research Support Specialist, Cornell University	1987

TEACHING AND GRADUATE STUDENT MENTORING:

Courses taught: Aquatic Ecosystem Restoration and Management; Seminars in Aquatic Ecology; Ecology of Adirondack Fishes; Limnology; Fisheries Science.

Graduate mentoring:; 1 PhD, 4 MS, 2 MPS (completed); 3 PhD, 3 MS,1 MPS (current). Committee work (committee or reader): 9 MS, 1 PhD (completed), 2 MS, 1 PhD (current).

PUBLICATIONS:

Farrell, J. M., C. Skov and A. P. Nilsson. 2008. Preface to an International Pike Symposium: Merging Knowledge of Ecology, Biology, and Management for a Circumpolar Species. Hydrobiologia 601:1-3.

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Werner, R. G., B. Jonchkere, M. Clapsadl, and J. M. Farrell. 1996. A bioenergetic exploration of piscivory and planktivory during early life history of two species of freshwater fishes. Journal of Marine and Freshwater Research. 47:113-121.

SYNERGISTIC ACTIVITIES:

- Associate Editor, *Wetlands*
- Guest Editor, Special Issue *Hydrobiologia* (April 2008)
- International Joint Commission, Environmental Technical Working Group for the Lake Ontario-St. Lawrence River Water Levels Study, 2002-2005
- New York State Fish and Wildlife Management Board 2002-2006
- New York Chapter of the American Fisheries Society, President 2001-2002
- Save The River, President 1999-2002; Board of Directors 1996-present.
- St. Lawrence River Esocid Workgroup, Chair 2001-present
- Member, International Association of Great Lakes Research, Great Lakes Research Consortium, American Fisheries Society, Society of Wetland Scientists

Kevin L. Kapuscinski
Email: klkapusc@syr.edu

EDUCATION

M.S., University of Wisconsin-Stevens Point, Natural Resources (Fisheries), August 2002, GPA = 3.79. Thesis: *Movements of Lake Trout in U.S. Waters of Lake Superior During 1973-2001.*
B.S., University of Wisconsin-Stevens Point, Water Resources (Fisheries) and Biology, December 1999, GPA = 3.24.

EXPERIENCE

Research Assistant, Ph.D. Student - State University of New York College of Environmental Science and Forestry (Aug 2006-present)
My duties include assisting with various research projects conducted at the Thousand Islands Biological Station (Dr. John M. Farrell, Director) on the St. Lawrence River, developing and conducting my individual research projects on the St. Lawrence and Niagara rivers, and furthering my education towards the goal of obtaining a doctoral degree. My research focuses on Great Lakes muskellunge genetic population structure, reproductive ecology, and interaction with the invasive round goby.

Fisheries Biologist - Wisconsin Department of Natural Resources (May 2004-Aug 2006)
My duties included (1) developing, implementing, and directing fisheries management projects, (2) protecting aquatic habitat, fisheries resources, and water quality, (3) participating in statewide management teams, (4) developing and distributing educational information, (5) preparing reports, and (6) developing and implementing a land acquisition plan. While my duties were varied, I was especially involved in efforts to reestablish a self-sustaining population of Great Lakes muskellunge in Green Bay, Lake Michigan.

Pallid Sturgeon Biologist - Montana Department of Fish, Wildlife & Parks (Aug 2002-May 2004)
My primary duty was to coordinate and enact the state's recovery efforts for the endangered pallid sturgeon; my duties also included monitoring native and exotic fishes. I employed various fish community and water quality assessment procedures to monitor the lower Missouri River's ecosystem. I also designed studies to monitor hatchery-reared pallid sturgeon that were stocked into the wild, secured funding, tracked budgets, hired and supervised up to five fisheries technicians, and wrote monthly, annual, and project completion reports. I expanded my project budget ($136,000) by $64,000 during 2003 and $94,000 during 2004.

M.S. Student - University of Wisconsin-Stevens Point (Jan 2000-Aug 2004)
I enrolled at UW-SP in January of 2000 and worked with Shawn Sitar (MI DNR) in Marquette, Michigan until April of 2000. My duties included entering fishery assessment data into a database, quality checking entered data, participating in fishery surveys, and starting my graduate research. I completed my coursework in May of 2002, and defended my thesis in August. The results of my thesis *Movements of Lake Trout in U.S. Waters of Lake Superior During 1973-2001* can be used to account for emigration and immigration when estimating population abundances and safe harvest limits for jurisdictional management units.

TEACHING EXPERIENCE

The Information-theoretic Approach to Model Selection: A New Paradigm in Ecological Research (EFB 797, Fall 2008 Seminar), State University of New York College of Environmental Science and Forestry.

PUBLICATIONS

Kevin L. Kapuscinski, Troy G. Zorn, Philip J. Schneeberger, Richard P. O'Neal, and Bradley T. Eggold. *In Review*. The status of Lake Michigan walleye stocks, 1969-2005.

Kapuscinski, K. L. and M. A. Wilkinson. 2008. Adult muskellunge sampling activities in the Buffalo Harbor and upper Niagara River May and June, 2007. Section U *in* D. Einhouse, editor. NYSDEC Lake Erie Unit 2007 annual report. New York State Department of Environmental Conservation, Albany.

Kapuscinski, K. L., Belonger, B. J., Fajfer, S., and T. J. Lychwick. 2007. Reintroduction of Great Lakes muskellunge to Wisconsin waters of Green Bay, Lake Michigan, 1989-2005. Environmental Biology of Fishes.

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Kapuscinski, K. L. 2004. Evaluation of hatchery-reared pallid sturgeon recaptured in recovery-priority management area #2 during 2003. Montana Department of Fish, Wildlife & Parks, Helena.

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Kapuscinski, K. L., and M. W. Baxter. 2003. Lower Missouri and Yellowstone rivers pallid sturgeon study, 2002 report. Montana Department of Fish, Wildlife & Parks, Helena.

PRESENTATIONS

Kevin L. Kapuscinski, Troy G. Zorn, Philip J. Schneeberger, Richard P. O'Neal, and Bradley T. Eggold, The status of Lake Michigan walleye stocks, 1969-2005, American Fisheries Society Annual Meeting, August 2006.

Kevin L. Kapuscinski, Brian J. Belonger, Steven Fajfer, and Terrence J. Lychwick. Reintroduction of Great Lakes muskellunge to Wisconsin waters of Green Bay, Lake Michigan, 1989-2005. Dr. Ed Crossman Muskie Symposium, October, 2005. View at: http://muskie.outdoorsfirst.com/muskievideo.asp

Kevin L. Kapuscinski, Pallid Sturgeon Status and Recovery Efforts in the Missouri and Yellowstone Rivers, Montana, American Fisheries Society Annual Meeting, August, 2004.

Kevin L. Kapuscinski, Status of Pallid Sturgeon in Montana, Montana Chapter of the American Fisheries Society Conference - Pallid Sturgeon Panel Discussion, February, 2003.

Kevin L. Kapuscinski, Population Abundance Estimates of Wild Pallid Sturgeon and Forecasting Abundance of Hatchery-reared Pallid Sturgeon in the lower Missouri and Yellowstone Rivers, Upper Basin Pallid Sturgeon Workgroup Meeting, Miles City, MT, December 2002.

Kevin L Kapuscinski and Michael J Hansen, Movements of Lake Trout in U.S. Waters of Lake Superior, Wisconsin Chapter of the American Fisheries Society Conference, January 2002.

Kevin L Kapuscinski and Michael J Hansen, Movements of Lake Trout in U.S. Waters of Lake Superior, 63rd Midwest Fish and Wildlife Conference, Des Moines, IA, December 2001.

CONTINUING EDUCATION

No more P-values? A Workshop on Model Based Inference in the Life Sciences, State University of New York College of Environmental Science and Forestry / Dr. David Anderson (March 2007)

Fish Aging Workshop, Wisconsin Department of Natural Resources (June 2006)

Biostatistics Workshop, Wisconsin Chapter of AFS / Dr. Hansen, UW-SP (Jan 2006)

Perceptive Communications, Wisconsin Department of Natural Resources (Dec 2005)

Fisheries Genetics Workshop, Wisconsin Chapter of AFS / Dr. Sloss, USGS / UW-SP (Mar 2005)

Basic Principles for a Collaborative Workplace, Wisconsin Department of Natural Resources (Dec 2004)

Intermediate Excel, Miles City Community College, online course (Feb 2004)

All kidding aside: Preventing harassment, State of Montana Professional Development Center, Glasgow, MT (Nov 2002)

ACTIVITIES

I have conducted manuscript reviews for the North American Journal of Aquaculture, Environmental Biology of Fishes, the American Midland Naturalist, Fisheries Management and Ecology, and Wetlands.

American Fisheries Society Hutton Scholar Mentor (two students, May-August 2007)

Active member of the WI DNR Lake Michigan Fisheries Team (May 2004-Present), Muskellunge Team (Feb 2005-present), Non-wadable Streams Team (Nov 2004-Present), and Monitoring Toxics Team (Nov 2004-Present)

Chair of the Upper Basin Pallid Sturgeon Workgroup Stocking Plan Committee (Dec 2003-May 2004)

Active member of the UW-SP Chapter of AFS (1996-2001) and the AFS (Feb 1999-present)

REFERENCES

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Fort Peck, MT 59223

Ontario

New York Power Authority
Edward Alkiewicz, Secretary
123 Main Street
White Plains, NY 10601

October 30, 2008

Secretary Alkiewicz,

I am writing today on behalf of the Ontario Ministry of Natural Resources (OMNR) to express support for Dr. John M. Farrell and Kevin L. Kapuscinski's project proposal entitled *Muskellunge Esox masquinongy Genetic Structure, Reproductive Ecology, and Interaction with the Fish Community: Acquiring Information Needed for Successful Management*.

The OMNR believes this work will increase our knowledge of Buffalo Harbor and Niagara River muskellunge, and will help guide successful management of this internationally important resource. We issued permits for Farrell and Kapuscinski's work activities in Ontario waters of the Niagara River during 2007 and 2008, and will be able to issue permits for similar work in the future. Farrell, Kapuscinski, and their New York State Department of Conservation collaborators adhered to all permit conditions and provided the OMNR with a summary of their work. Based on these previous activities and the merit of the proposed project, the OMNR encourages your committee to fund Farrell and Kapuscinski's proposal.

Sincerely,

Alastair Mathers

Alastair Mathers
Lake Ontario Management Unit
Ministry of Natural Resources
R.R. #4
Picton, Ontario K0K 2T0
Phone: 613-476-8733
Email: alastair.mathers@ontario.ca

New York Power Authority
Edward Alkiewicz, Secretary
123 Main Street
White Plains, NY 10601

24 October 2008

Secretary Alkiewicz,

I am writing today, on behalf of the Niagara Musky Association, to express support for the project proposal entitled *Muskellunge Esox Masquinongy Genetic Structure, Reproductive Ecology, and Interaction with the Fish Community: Acquiring Information Needed for Successful Management*, which was submitted to you by Dr. John M. Farrell and Kevin L. Kapuscinski. Our association believes this work will provide important information that is needed to successfully manage and preserve Buffalo Harbor and Niagara River muskellunge. The Niagara Musky Association is dedicated to promoting the perpetual survival of the naturally occurring muskellunge population in the Niagara River and Lake Erie. Therefore, we support the above-mentioned project and have pledged to provide at least $300.00 to defray travel costs for the proposal authors. We have worked with the authors in the past, and look forward to working with them in the future – we hope that your committee funds this important project.

Sincerely,

Josh Ketry
Membership Director
Niagara Musky Association
PMB 383
735 Delaware Road
Buffalo, NY 14223
Email: trout_tapout@yahoo.com

NIAGARA MUSKY
Association

New Y rk State Department of Environmental Conservation
Divis o of Environmental Permits, Region 9
270 Mi h an Avenue, Buffalo, New York, 14203-2915
Phone: (16) 851-7165 · **Fax:** (716) 851-7168
Websi e: ww.dec.ny.gov

Alexander B. Grannis
Commissioner

November 10, 2008

Mr. E lv rd Alkiewicz
Licen ir ; Manager
New Yo k Power Authority
123 Ma . Street
Whit P ins, New York 10601

Dear M Alkiewicz:

am writing to express support for the project proposal **Muskellunge (*Esox masquinongy*) Gene ic Structure, Reproductive Ecology, and Interaction with the Fish Community: Acquiring Infor m tion Needed for Successful Management,** which was submitted to you by Dr. John Farrell and Kevi . K pusc inski from State University of New York College of Environmental Science and Forestry. As N Y DEC Region 9 Fisheries Manager, with resource management authority for the Buffalo Harbor and N ia ara River, I strongly support this proposal and respectfully urge you to provide funding for this on-go in work.

Ve have worked cooperatively with Dr. Farrell and Mr. Kapuscinski in 2007 and 2008 to suppo t his work by providing considerable NYSDEC staff time and logistical support for field work and s ut equent reporting activities. As identified in the proposal, we are pledging to provide NYSDEC staff al or in the amount of $32,338 toward this proposed work in 2009. We are also pledging vehicle milea g in the amount of $970.20 and $164.00 for boat gasoline during 2009. The grand total for our pledg ec match toward this proposal is $33,472.20.

gain, I encourage you to provide funding support for this proposal that will yield information to bette r nage and conserve the muskellunge resource in the Niagara River corridor. Please let me know if an a ditional information is required.

Sincerely,

Paul McKeown
Region 9 Fisheries Manager

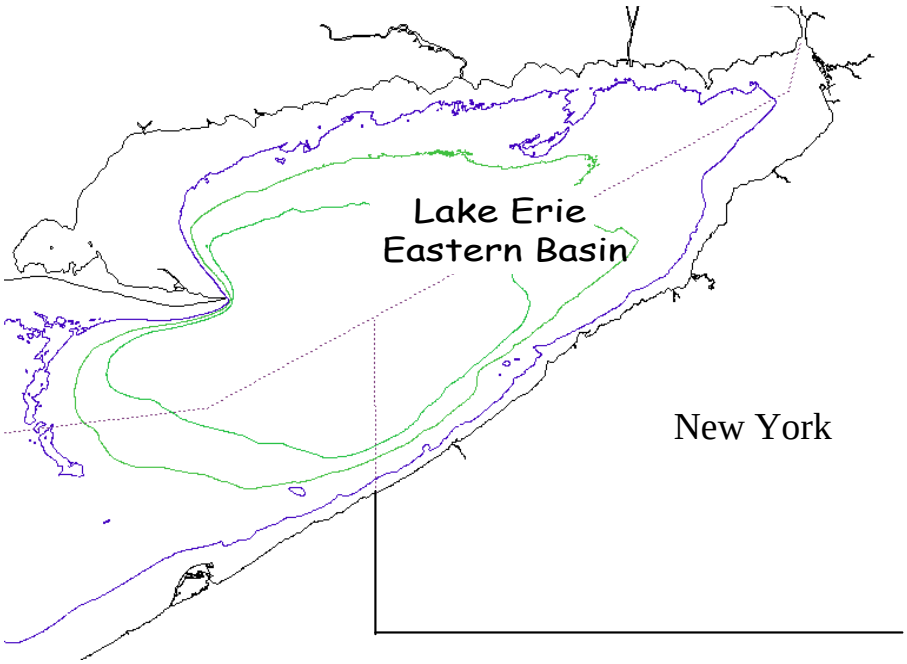
PM:w

cc: Dr. John Farrell, SUNY ESF
Mr. Kevin Kapuscinski, SUNY ESF
Mr. Michael Wilkinson, NYSDEC Region 9 Buffalo

New York State
Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

NYSDEC LAKE ERIE UNIT 2007 ANNUAL REPORT

to the Lake Erie Committee and the Great Lakes Fishery Commission



March 2008

New York State Department of Environmental Conservation
625 Broadway, Albany, New York 12233-4753

Eliot Spitzer, *Governor*

STUDIES REPORTED IN THIS DOCUMENT ARE SUPPORTED BY THE FEDERAL AID IN SPORT FISH RESTORATION PROGRAM

NYS DEC LAKE ERIE
2007 ANNUAL REPORT
to the
Lake Erie Committee

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Acknowledgments

Great Lakes program supervision is adeptly provided by William Culligan. The Lake Erie Fisheries Unit also recognizes the contributions of seasonal staff that are essential to completing an ambitious field program. During 2007 field year these individuals included Fish and Wildlife Technician's Mark Dusablon, Adam Haley, Shea Mathis, Peter Krakowiak, and Carrie Babcock. We also acknowledge contributions of DEC's Chautauqua Fish Cultural Station, DEC's Region 9 Fisheries Office, SUNY Fredonia's Biology Department and Buffalo State College's Great Lakes Center in supporting various Lake Erie field activities.

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Lake Erie Unit
Dunkirk, New York 14048

Presented at the Lake Erie Committee Meeting
Niagara Falls, Ontario
March 17, 2008

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D	WARMWATER GILL NET ASSESSMENT *(D. W. Einhouse)*
E	WALLEYE TAGGING STUDY *(D. W. Einhouse)*
F	COLDWATER ASSESSMENT SURVEY *(J. L. Markham)*
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U. ADULT MUSKELLUNGE SAMPLING ACTIVITIES IN THE BUFFALO HARBOR AND UPPER NIAGARA RIVER MAY AND JUNE, 2007

Kevin L. Kapuscinski and Michael A. Wilkinson

Introduction

Members of the Niagara Musky Association (NMA) approached New York State Department of Environmental Conservation (NYSDEC) and State University of New York College of Environmental Science and Forestry (SUNY-ESF) with concerns about declining muskellunge (*Esox masquinongy)* angler catch rates from the Buffalo Harbor and Upper Niagara River. NMA members compiled angler cooperator catch rate data from 1995 to 2006 that supported their concerns of declining catch rates (Figure U.1; Niagara Musky Association 2007). The three groups met to discuss the status of the muskellunge fisheries in question, and the anglers expressed interest in stocking muskellunge, particularly to augment the fishery in the Buffalo Harbor.

Although viral hemorrhagic septicemia (VHS) was suspected as a cause for declining angler catch rates, there was no direct evidence linking VHS to these muskellunge fisheries. Further, the muskellunge decline began in the late 1990's, prior to recent discoveries of VHS-related mortalities in Lower Great Lakes muskellunge, suggesting that other factors may be involved in the decline. As a result of the meeting, it was recommended to collect more muskellunge population data prior to starting a major management action such as a stocking program. NYSDEC and SUNY-ESF agreed to collaborate on efforts to survey spawning muskellunge, and NMA offered to assist the agencies where possible. This report summarizes initial efforts to survey spawning muskellunge in the Buffalo Harbor and Upper Niagara River from 14 May to 8 June 2007. A more detailed report on the muskellunge sampling activities is available in Kapucinski (2007).

Methods

Trap-netting

Oneida and hoop style trap-nets were set in areas suspected to be used by spawning muskellunge. These areas were typically 3 to 7 ft deep in the upper Niagara River and 6 to 9 ft deep in the Buffalo Harbor. The net sites were adjacent to deeper water, and had fine, soft sediment substrates with aquatic vegetation.

Four Oneida style trap-nets (6ft height, 1 inch bar measure, 100ft leads, 20ft wings) were set at four locations in the Buffalo Harbor on 14 May and fished until 8 June (Table U.1; Figures U.2 and U.3). An additional Oneida net (same height and lead dimensions with 0.5 in bar measure) was set in the Buffalo Harbor on 22 May and fished until 8 June. The leads of all five Oneida nets set in the Buffalo Harbor were secured to shore, and the nets were set approximately perpendicular to the shoreline.

Three hoop style trap-nets (4ft height, 1 in bar measure, 50ft leads, 20ft wings) were set in the upper Niagara River on 16 May, one inside Strawberry Island on the eastern shore (Figure U.4), one off the southeast shore of Grand Island near the East River Marina (Figure U.4), and one off the western shore of Buckhorn Island

State Park (Table U.1; Figure U.5). All leads were secured to shore, and the nets were set approximately perpendicular to the shoreline. The hoop net set off Strawberry Island was removed on 31 May and reset downstream of the island as a double-ended hoop net. This double-ended hoop net was set on a vegetated drop-off approximately perpendicular to the channel at a depth of about 4ft. This net was fished from 31 May to 8 June (85ft lead from 31 May to 6 June, 135ft lead from 6 June to 8 June) and removed from the river on 8 June. The hoop net set near the East River Marina was fished until 8 June, but fish were last enumerated on 6 June. The hoop net set off Buckhorn Island was fished until 29 May when it was overwhelmed with algae and debris and removed from the river. An Oneida net (6ft height, 0.5in bar measure, 100ft lead) was set in Ontario waters of the upper Niagara River, north of Miller Creek (Figure U.6). The lead was secured to shore and the net was set perpendicular to the shoreline. This net was removed on 3 June and reset as a double-ended Oneida net off Navy Island (see below). An Oneida net (6ft height, 0.5in bar measure, 100ft lead) was set on a vegetated flat off the north (downstream) shore of Navy Island on 25 May. The lead was set at a depth of about 4ft, and the net was set perpendicular to the shoreline with the trap end at a depth of about 6ft (Figure U.5). This net was pulled on 5 June and reset as a double-ended Oneida net (200ft lead) in the same vicinity, but parallel to the shoreline on a vegetated drop-off at a depth of about 6ft. This double-ended Oneida net was removed from the river on 8 June.

Each net was typically checked and emptied daily, however on a few occasions the nets were allowed to fish for two nights. All fish captured were identified to the species level when possible and enumerated. All northern pike *(Esox lucius)* and muskellunge captured were measured, examined for sex, and scales were collected. Mucus and urogenital pore swabs were collected from muskellunge, and a water sample was collected at each muskellunge capture site to test for the presence of viral hemorrhagic septicemia. A uniquely numbered Floy anchor or billfish style tag was applied to each muskellunge near the base of the dorsal fin, and a caudal fin tissue sample was collected for genetic analysis.

Electrofishing

Electrofishing was conducted at, and adjacent to, netting sites on 7 June to determine if muskellunge were still present and to collect additional samples. Electrofishing was done with an 18ft Smith-Root SR18EH electrofishing boat with a driver, two people netting, and a fourth person facilitating data collection. Pulsed (60 pulses/sec) direct current was used at 500 v and 9.5-12 amps. Muskellunge were netted and held on board in an aerated tank and processed as described above for trap-netted muskellunge.

Water quality data, including temperature, dissolved oxygen, pH, turbidity, conductivity, oxidation reduction potential, and total dissolved solids were measured at each trap-net lift and electrofishing run event. Water quality measurements were obtained using a HORIBA hand held meter. However, only water temperature results are presented in this report. Some water temperature measurements were also made with a hand held thermometer.

Thermographs were attached to the leads of some trap nets to record water temperatures at two-hour intervals during the netting effort. Thermographs were attached to trap-nets at various dates after the nets were set. Mean daily water temperatures were reported only for those dates for which 12 temperature readings were available from these trap-net thermographs.

Results

Trap-netting

A total of 5,455 fish were captured in trap-nets, including three muskellunge, one tiger muskellunge (*Esox masquinongy X Esox lucius*) and 70 northern pike. The most common species captured in trap-nets was the non-native rudd (*Scardinius erythrophthalmus;* n=2,066) followed by rock bass (*Ambloplites rupestris*; n=999), smallmouth bass (*Micropterus dolomieui;* n=690), and brown bullhead (*Ameiurus nebulosus;* n=643). At least 30 fish species were captured in trap-nets, and non-fish species included a bird, mice, turtles and mudpuppies.

A dead female muskellunge weighing 49 pounds was found near the Oneida net set in Ice Boom Bay and transported to Cornell University's Veterinary Medical Center for disease testing. This fish tested negative for viral hemorrhagic septicemia, but did show an immune response suggesting it was sick from an unknown agent at the time of death (Geoff Groocock, Cornell University, personal communication).

All three muskellunge captured during the trap-net surveys were captured in the Oneida net set in Ice Boom Bay; two were males and one was female (Table U.2). One tiger muskellunge was captured in the Oneida net set off Navy Island. The sex of the hybrid could not be confirmed but the shape of the urogenital pore suggested it was a female (Lebeau and Pageau 1989).

A total of 70 northern pike were also captured in trap-nets. Table U.3 provides information on length distribution of the northern pike caught in nets. Approximately 81% of the pike were captured in four Oneida trap nets located in the Buffalo Harbor. The northern pike catch rate in Buffalo Harbor trap nets was 0.020 fish/hr, while the catch rate in the upper Niagara River was 0.0048 fish/hr; an approximate four-fold difference. Interestingly, numerous northern pike were observed in the upper Niagara River during electrofishing activities on 7 June, however very few pike were caught in hoop nets set in the river during this project.

Electrofishing

A total of 11 muskellunge were captured by electrofishing, two from the Buffalo Harbor and nine from the upper Niagara River (Table U.2). Nine of the 11 muskellunge captured by electrofishing were males and two were of unknown sex.

Five of the 15 muskellunge sampled by both trap-netting and electrofishing exhibited lamprey wounds or notable lesions. Two of these muskellunge exhibited two lamprey wounds and two additional muskellunge exhibited hooking wounds.

Discussion

Temperatures at many trap-net sites were below 50°F when the nets were set on 14 May, and temperatures typically did not hold near 55°F (the preferred spawning temperature of muskellunge; Becker 1983) until about 10 days later (Table U.4; Figure U.7). The water temperature at Ice Boom Bay was 61°F on 29 and 30 May when three ripe muskellunge were captured (2 males, 1 female). The observation of ripe muskellunge at this temperature in the Buffalo Harbor was consistent with the optimum spawning temperatures of 61 to 64°F reported by Harrison (1978) for Niagara River muskellunge.

The nets collected enough algae and debris to cause them to fish inefficiently after about two weeks. Setting nets for future spawner surveys after water temperatures hold above 52°F is recommended so the nets fish effectively during the peak of muskellunge spawning activity.

Using longer leads on hoop nets, using trap-nets with larger mesh size, and focusing on areas where muskellunge were previously captured or observed can also enhance future efforts to sample spawning muskellunge. Trap-net leads of at least 100 ft should be used for each net. Using nets with larger mesh (1 inch vs 0.5 inch) will reduce algae and debris accumulation and therefore further improve netting efforts. Netting sites in the Buffalo Harbor should include Ice Boom Bay, Bell Slip, and Black Rock Canal. Catches during a 1991 electrofishing survey (Wilkinson 1991) and contemporary angler accounts suggest that a net should also be set on the outside wall of the Buffalo Small Boat Harbor if possible.

Netting effort in the upper Niagara River should include the area between Strawberry and Motor islands, the area upstream of East River Marina, and the area on the downstream side of Navy Island. Additional netting sites should be considered, keeping in mind that the trap-nets fished most efficiently in areas with little to no flow but Niagara River muskellunge may prefer to spawn in flowing areas (Harrison 1978). Most observed muskellunge were seen along vegetated drop-offs (6 to 8ft deep) adjacent to deeper water.

Electrofishing was very effective on 7 June 2007 and will likely be used in future surveys. However, the potential negative effects of electrofishing on egg viability must be considered (Snyder 1993). Electrofishing may be a valuable tool for identifying additional netting sites during the spawning period and for sampling areas that cannot accommodate a trap-net (e.g., outside the Buffalo Harbor breakwalls, Buffalo River, Big Six Mile Creek, and Beaver Island State Park Marina). Electrofishing should be avoided near existing net sites unless samples are needed due to low catch rates in nets.

Little can be inferred about muskellunge population characteristics from the May and June sampling data due to the small number of muskellunge collected. The small sample size was due to low trap-net catch rates and limited electrofishing efforts. The size structure of the 15 muskellunge captured (pooled sample from Buffalo Harbor and upper Niagara River) with both gears suggests multiple year classes were present. However, this conclusion is tenuous because of the small sample size and few females sampled (n = 2, including one live female captured in a trap-net and one found dead).

The mean length of male muskellunge collected by both trap-nets and electrofishing in the Buffalo Harbor during this study was 38.8 in (range = 29.1 to 43.3 in, n = 4). This was similar to that observed for male muskellunge collected in the Buffalo Harbor in 1991 by electrofishing with a mean length of 38.3 inches (range = 32.2 to 42.3 inches; N = 18) (Wilkinson). Adrian (unpublished data) observed a smaller mean length of 35.2 inches for a sample of male muskellunge collected by electrofishing in the Buffalo Harbor during 1998 and 1999 (range = 22.8 to 43.9 inches; N = 45).

The mean length of male muskellunge collected by electrofishing in the upper Niagara River was 36.0 in (range = 32.5 to 39.1 in, n = 7), larger than observed during 1998-1999 (33.7 in, range = 28.5 to 39.8 in, n = 37: Adrian, unpublished data). The small sample size of male muskellunge in this study prevents making conclusions about trends in mean length through time.

The catch rate of muskellunge in trap-nets was extremely low (0.0005 fish / hr), especially when compared to the electrofishing catch rate (2.74 fish / hr). It is important to consider, however, that electrofishing effort was quite limited (4.01 total hrs) relative to trap-net effort

(5,468 total hrs). The failure to capture muskellunge, and also possibly northern pike, in hoop nets was likely a result of the short leads (i.e., a small area was sampled relative to the Oneida nets with longer leads). Hoop net leads 100ft in length should be used in future efforts.

A number of live muskellunge (about eight) were observed near netting locations; two of these muskellunge were observed swimming along the leads of trap-nets (one Oneida, one hoop), but they both exited the nets before passing through the first funnel. Observed muskellunge were typically in water 6 to 8ft deep, along vegetated drop-offs adjacent to deeper water. Additionally, two muskellunge were encountered adjacent to trap-nets with the electrofishing gear. These observations and the discrepancy between trap-net and electrofishing catch rates suggest muskellunge were avoiding trap-nets. Future efforts to capture adult muskellunge should include more electrofishing runs, and additional capture methods should be considered.

The 7 June 2007 electrofishing catch rate of muskellunge from the Buffalo Harbor (1.02 fish/hr; 1.97 total hrs) was lower than that observed during a 1991 electrofishing survey. Wilkinson (1991) reported a catch rate of 3.15 muskellunge/hr from electrofishing in the Buffalo Harbor during the peak of spawning (17 to 23 May 1991; 6.35 total hrs), and 2.49 fish/hr during the entire period sampled (17 May to 6 June; 8.83 total hrs). The 7 June 2007 electrofishing catch rate of muskellunge from the upper Niagara River (4.4 fish/hr; 2.05 total hrs) was much higher than that observed by Harrison (1978; 0.8 to 1.0 fish/hr).

The 7 June 2007 electrofishing catch rate was 2.74 fish/hr (4.01 total hrs) for all areas combined in the Buffalo Harbor and upper Niagara River. Adrian (unpublished data) captured 99 muskellunge by electrofishing during May and June 1998 and 1999 in the upper Niagara River and Buffalo Harbor. However, the amount of electrofishing effort spent is unknown, so catch rates cannot be compared.

Acknowledgements

Many thanks are owed to Dr. John Farrell, SUNY-ESF, for his valuable assistance in designing and supporting this work. Special recognition is also provided to staff at the NYSDEC Lake Erie Unit and NYSDEC Prendergast Fish Hatchery for logistical and related field support. Grateful appreciation is also extended to Mike Clancy, Charles Curry, Brad Gruber, Robin Holevinski, Mike Koch and Jon Sztukowski for their very capable assistance with field activities.

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Table U.1. Trap-net descriptions, including set and pull dates and times, hours fished and muskellunge catch information, 14 May to 8 June 2007.

Site	Site[1]	Trap-net type	Lead length(ft)	Set date	Pull date[2]	Hrs fished	Mky captured	Catch per hour
Bell Slip	BH	Oneida	100	14-May	8-Jun	592	0	0
Black Rock Canal	BH	Oneida	100	14-May	8-Jun	596	0	0
Buckhorn Island	UNW	Hoop	50	16-May	29-May	313	0	0
Canada 1	UNW	Oneida	100	24-May	3-Jun	235	0	0
Donnellys Wall	BH	Oneida	100	14-May	8-Jun	593	0	0
Strawberry Is. - east[3]	UNM	Hoop	85, 135	31-May	8-Jun	432	0	0
Strawberry Is. west[3]	UNM	Hoop	85, 135	31-May	8-Jun	433	0	0
East River Marina	UNE	Hoop	50	16-May	6-Jun	496	0	0
Ice Boom Bay	BH	Oneida	100	14-May	8-Jun	591	3	0.0051
Navy Island	UNM	Oneida	100	25-May	5-Jun	264	0[4]	0
Navy Island east[3]	UNM	Oneida	100	5-Jun	8-Jun	68	0	0
Navy Island west[3]	UNM	Oneida	100	5-Jun	8-Jun	69	0	0
South End Marina	BH	Oneida	100	22-May	8-Jun	410	0	0
Strawberry Island	UNM	Hoop	50, 85	16-May	31-May	376	0	0
Total						5,468	3	0.0005

1) Locations:
   BH = Buffalo Harbor
   UNE = East Branch Upper Niagara
   UNW = West Branch Upper Niagara
   UNM = Main Stem Upper Niagara
2) Last date fish were enumerated
3) Double-ended net
4) One tiger muskellunge was captured

Table U.2. Data collected on 15 muskellunge sampled from the Buffalo Harbor and upper Niagara River from 22 May to 7 June 2007.

Site	Gear	Date	Sex	Length (in)	Tag #	Tag type	Notes
Ice Boom Bay	Found dead	22-May	Female	50.3	-	-	14 lb eggs, 2 lamprey wounds
Ice Boom Bay	Trap-net	29-May	Male	43.3	77	Billfish	-
Ice Boom Bay	Trap-net	29-May	Male	29.1	96	Billfish	-
Ice Boom bay	Trap-net	30-May	Female	49.4	80	Billfish	wound with scales missing on left side
Black Rock Canal	Shocker	7-June	Male	41.7	94	Billfish	Many wounds and scars
Bell Slip	Shocker	7-June	Male	41.1	82	Billfish	-
Strawberry & Motor Island	Shocker	7-June	Unk.	23.3	4025	Anchor	-
Strawberry & Motor Island	Shocker	7-June	Male	34.3	79	Billfish	Hooking wound, 1 lamprey wound
Strawberry & Motor Island	Shocker	7-June	Male	38.3	89	Billfish	2 lamprey wounds
Strawberry & Motor Island	Shocker	7-June	Male	36.8	81	Billfish	Hooking wound
Strawberry & Motor Island	Shocker	7-June	Male	32.5	78	Billfish	-
East River Marina	Shocker	7-June	Unk.	20.9	4024	Anchor	-
East River Marina	Shocker	7-June	Male	36.5	90	Billfish	-
East River Marina	Shocker	7-June	Male	34.6	87	Billfish	-
Navy Island	Shocker	7-June	Male	39.1	85	Billfish	-

Table U.3. Sex, number captured, length range (in) and mean length (in) of northern pike captured with trap-nets set in the Buffalo Harbor and upper Niagara River from 14 May to 8 June 2007.

Sex	Number Captured	Length range	Mean length
Male	37	18.7 – 28.5	22.6
Female	28	17.9 – 35.3	26.6
Unknown	5	24.1 – 31.4	27.6
TOTAL	70	17.9 – 35.3	24.6

Table U.4. Water temperature[1] (°F) recorded at each trap-net site at lift event at the Buffalo Harbor and the upper Niagara River, 15 May to 8 June 2007.

	Water temperature[1] (°F) measured during Buffalo Harbor and Upper Niagara River Trap Net Lifts									
	Bell Slip	Black Rock Canal	Buckhorn Island	Canada 1	Donnelly's Wall	E. River Marina	Ice Boom Bay	Navy Island	South End Marina	Strawberry Island
15-May	47	-	-	-	47	-	-	-	-	-
16-May	-	-	52	-	-	50	-	-	-	55
17-May	50	50	52	-	49	51	50	-	-	55
18-May	49	50	51	-	49	54	49	-	-	57
19-May	50	51	51	-	48	54	50	-	-	59
20-May	52	51	50	-	50	51	51	-	-	56
21-May	50	49	50	-	-	56	50	-	-	57
22-May	52	-	-	-	-	-	53	-	51	-
23-May	-	-	55	-	-	60	-	-	-	58
24-May	54	54	-	55	54	59	53	-	56	63
25-May	58	57	56	53	57	60	58	51	58	63
27-May	58	57	56	52	58	57	58	53	58	59
29-May	61	61	67	58	59	67	61	60	60	68
30-May	61	61	-	59	60	65	61	58	61	68
31-May	66	63	-	58	62	64	64	60	66	63
1-Jun	64	61	-	58	62	64	63	58	66	60[2]
3-Jun	68	63	-	55	65	61	67	60	70	62[2]
4-Jun	65	64	-	-	64	65	65	60	65	62[2]
5-Jun	-	64	-	-	-	-	-	60	-	-
6-Jun	65	64	-	-	64	62	66	61	65	62[2]
8-Jun	-	-	-	-	-	-	-	62	66	64[2]

[1]Water temperatures measured with HORIBA instrument and hand-held thermometer
[2] Water temperatures taken at downstream of Strawberry Island west net location

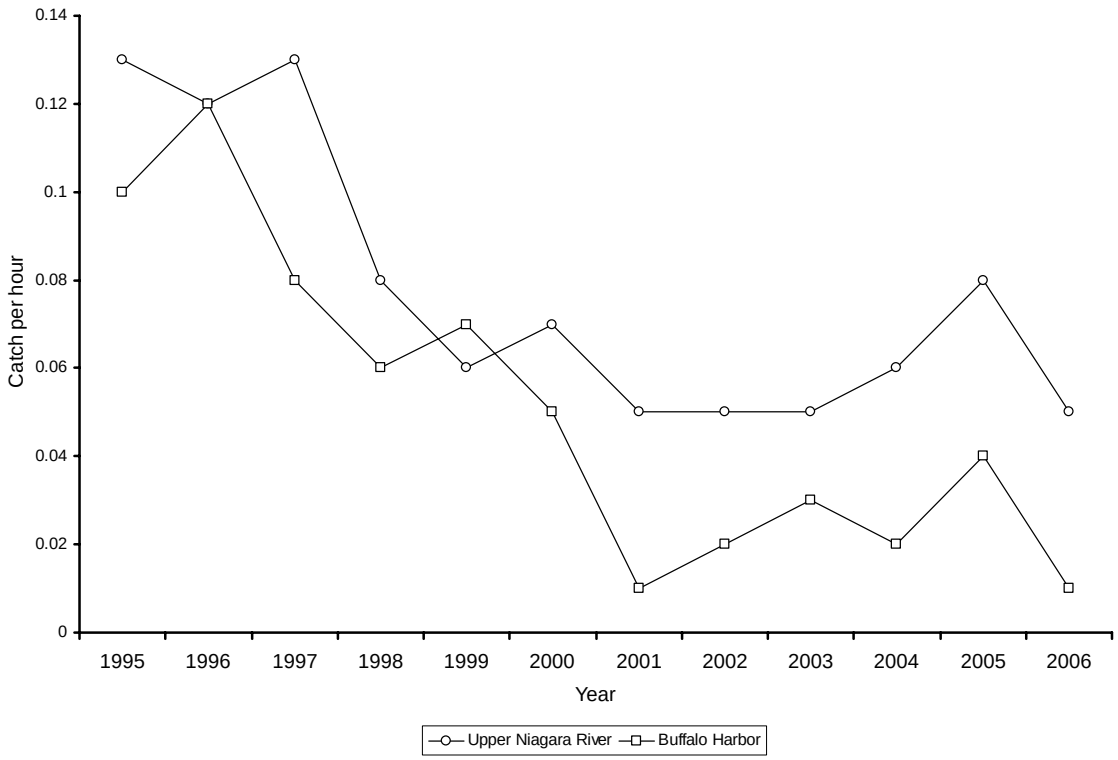

Figure U.1. Mean catch rate of muskellunge (number caught per hour) by anglers participating in the Niagara Musky Association Angler Cooperation Program on the upper Niagara River and Buffalo Harbor from 1995 to 2006.

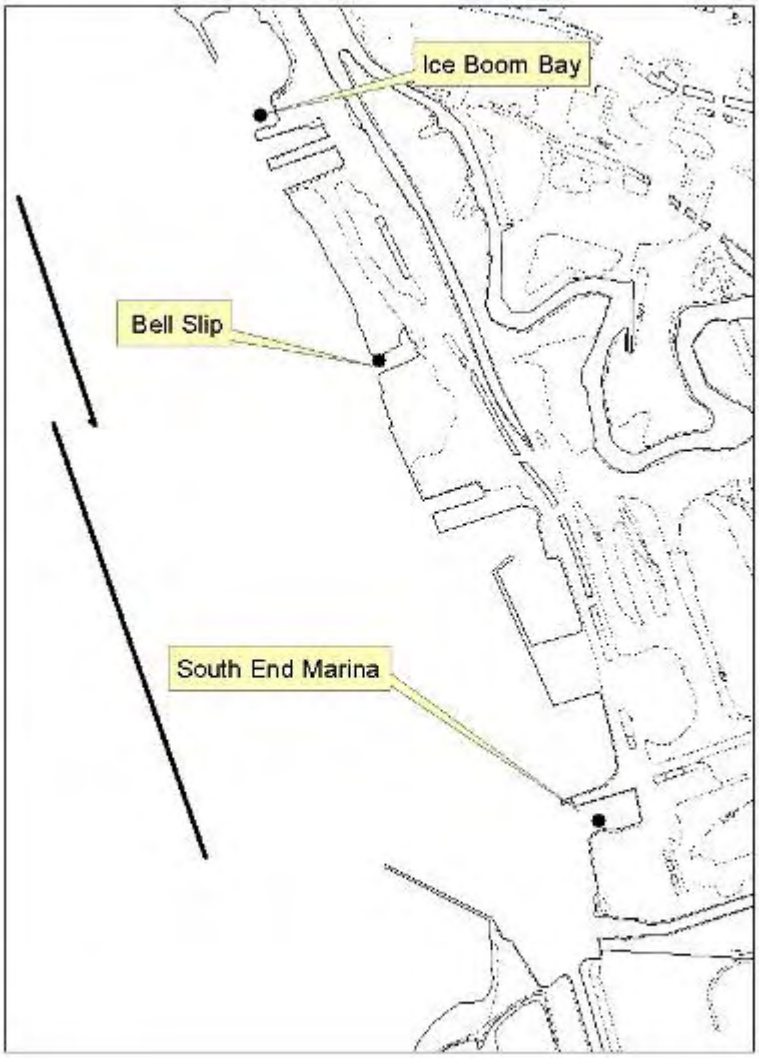

Figure U.2. Map of the southern section of the Buffalo Harbor, Lake Erie, depicting trap-net locations at South End Marina, Bell Slip, and Ice Boom Bay.
(Note: See table 1 for trap-net descriptions.)

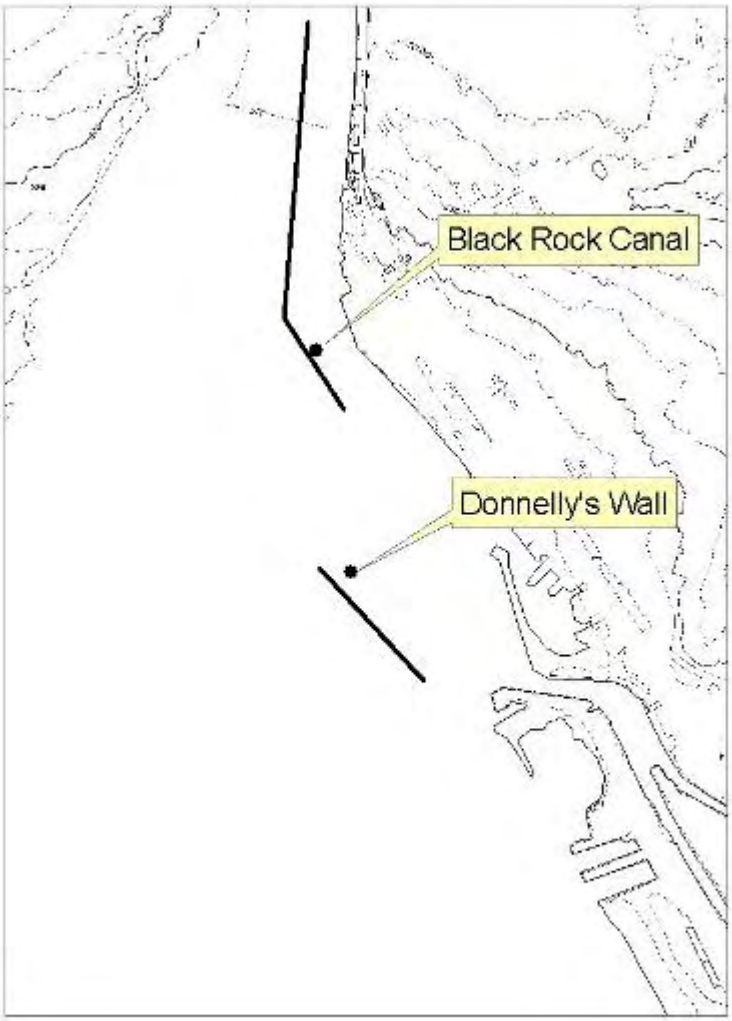

Figure U.3. Map of the northern section of the Buffalo Harbor, Lake Erie, depicting trap-net locations at Donnelly's Wall and Black Rock Canal. (Note: See Table 1 for trap-net descriptions.)

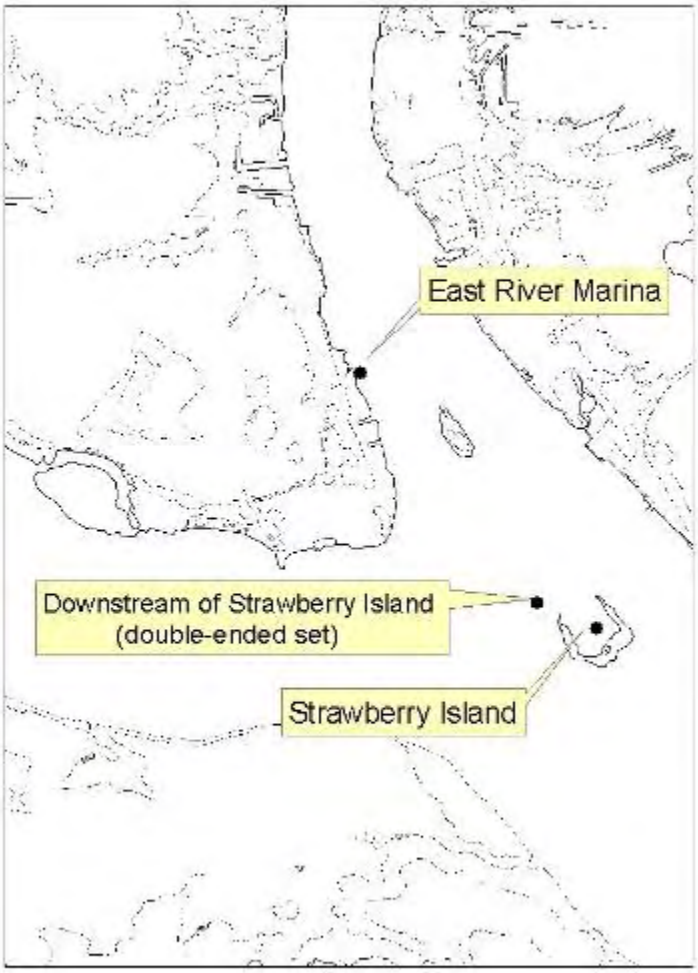

Figure U.4. Map of a section of the upper Niagara River depicting trap-net locations at Strawberry Island, Downstream of Strawberry Island (double-ended set), and East River Marina. (Note: See table 1 for trap-net descriptions.)

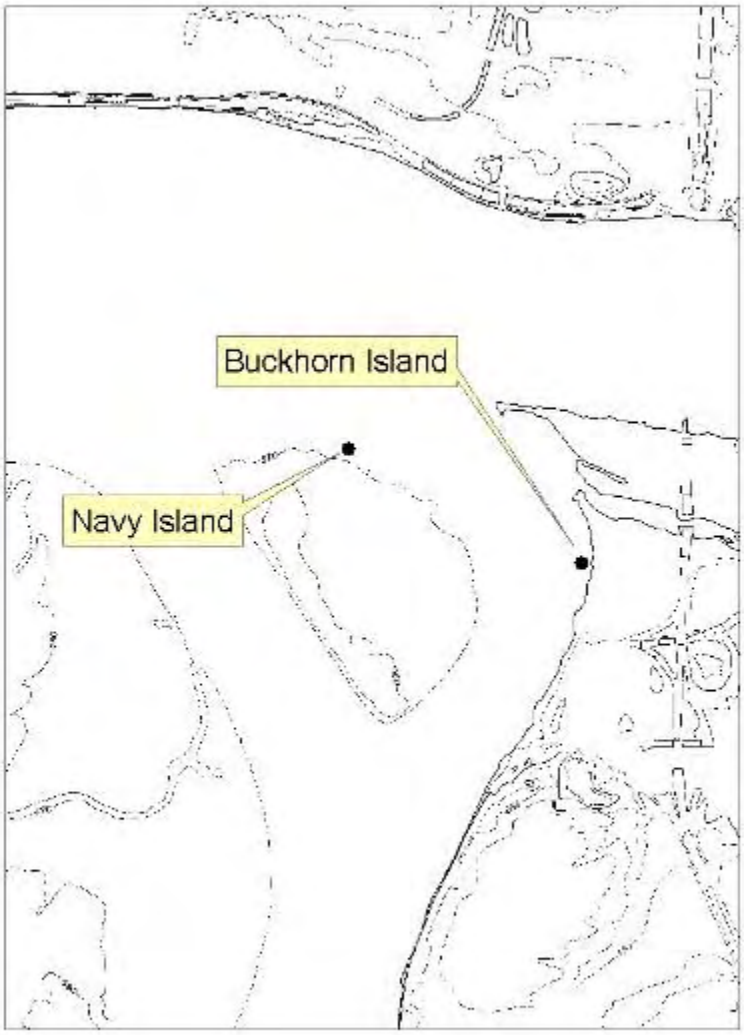

Figure U.5. Map of a section of the upper Niagara River depicting trap-net locations at Buckhorn Island and Navy Island. (Note: See table 1 for trap-net descriptions.)

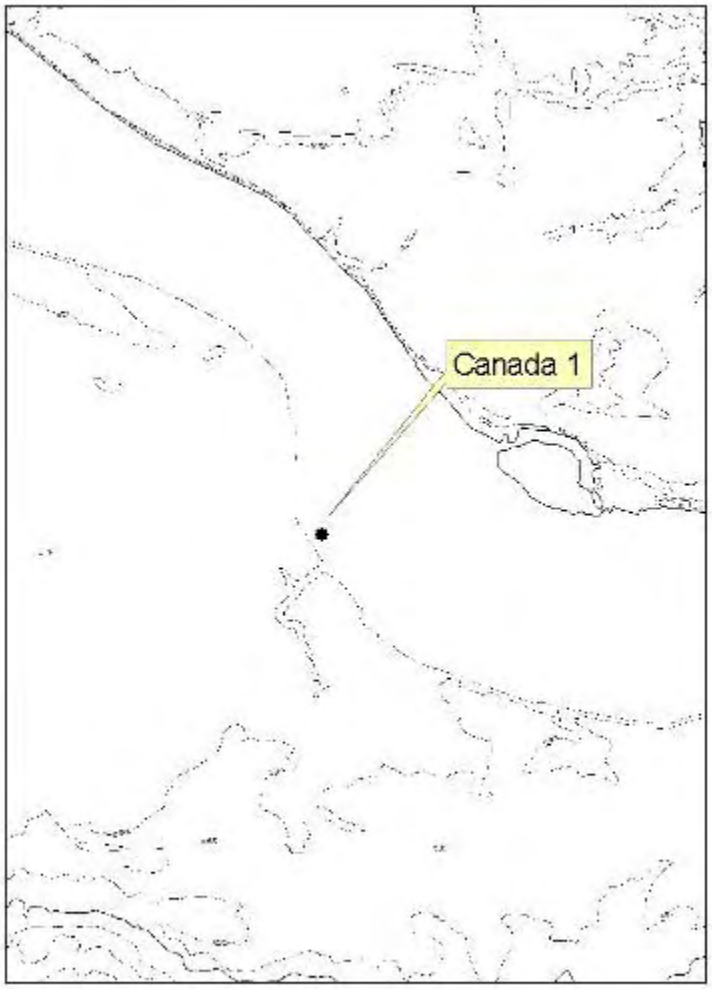

Figure U.6. Map of a section of the upper Niagara River depicting trap-net location at Canada 1. (Note: See table 1 for trap-net descriptions.)

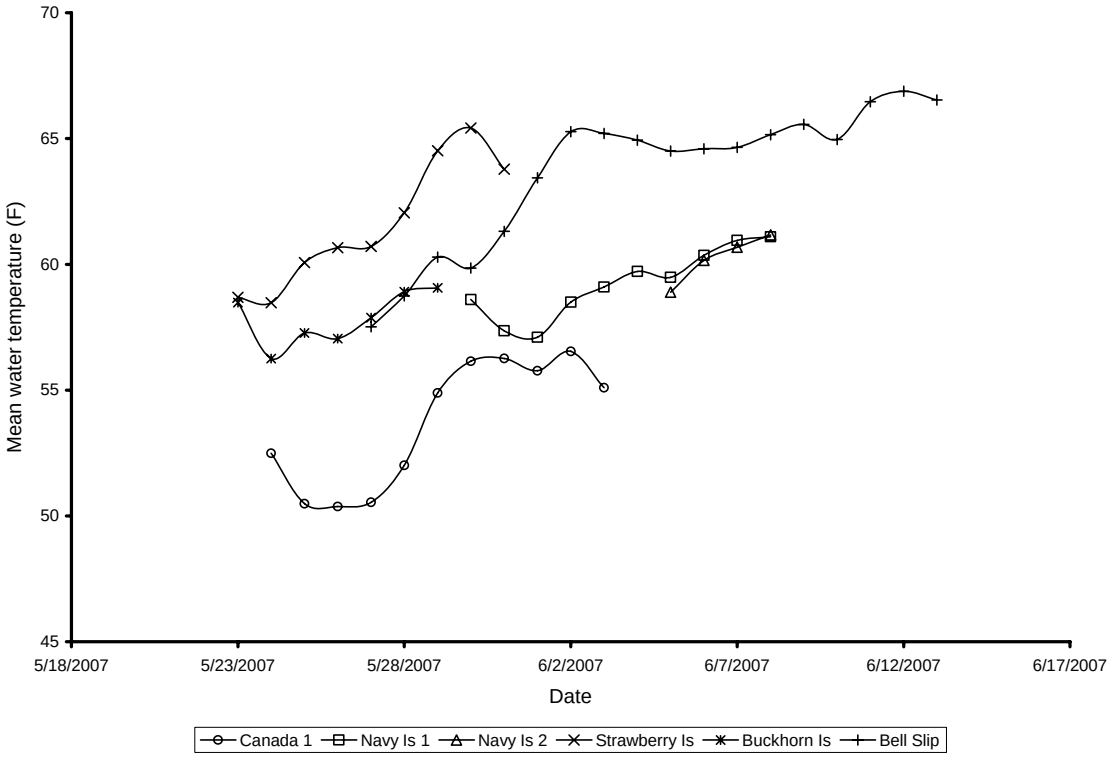

Figure U.7. Mean daily water temperatures (°F) recorded by thermographs deployed at trap-net sites. Mean daily water temperatures are only reported for dates with 12 water temperature recordings.