Status of the Longear Sunfish, *Lepomis megalotis*, in Western New York, USA

Final Report

for

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to the

Bureau of Wildlife
New York State Department of Environmental Conservation
635 Broadway
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by

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Executive Summary

Background

Widespread throughout the southern and eastern portions of the Mississippi River and Great Lakes drainages, the longear sunfish (*Lepomis megalotis*) is at the eastern edge of its range in western New York and eastern Quebec. Historically, longear sunfish occurred in three watersheds (Map 1a), Oneida Lake's outlet to the Oswego River, tributaries and bays of southwestern Lake Ontario (Johnson Creek, Jeddo Creek, Oak Orchard Creek, Marsh Creek, Braddock Bay and West Creek), and a tributary of the Niagara River, Tonawanda Creek. Intensive sampling since 1999 in historical waters shows that longear sunfish now have a sustained population in only one area, a 2.3 mi section of Tonawanda Creek just upstream from its junction with the Erie Canal; therefore, it is threatened in New York State.

Continued suburban sprawl and intense agricultural practices likely promote deleterious effects upon longear sunfish habitat resulting in high silt loading, excessive nutrients and highly variable flows. An additional deleterious factor may be the recent establishment of two invasive species, the native (to New York) green sunfish and the exotic round goby.

This project was initiated in 2004 to **1)** Collect and analyze habitat information in the Tonawanda and Johnson Creek watersheds and to identify locations that might be suitable for re-establishing longear sunfish, **2)** Collect fish throughout the watersheds and describe the distribution and the status of longear sunfish, and **3)** Cooperate with the DEC to develop a recovery plan for the longear sunfish in New York State.

Results

Objective 1

From existing data and data collected in this project, create GIS maps of the Tonawanda and Johnson Creek watersheds [that show] suitable longear sunfish habitats and locations of longear sunfish. Sampling will also extend to other prospective and historical areas in these counties.

The longear sunfish is reported to inhabit small to mid-size warm water streams and to prefer shallow slow reaches with good water clarity and cover, particularly dense submergent aquatic vegetation. It is said to avoid strong currents and silt. Therefore, habitat suitability for longear sunfish at the 364 sites evaluated was judged by four, literature-based physical criteria: predominant substrate composition and presence (suitable habitat) or absence (unsuitable habitat) of emergent/submergent aquatic vegetation, in-stream wood and bank cover. Sampled sites were ranked from 1 (low quality: only one criterion met) to 4 (high quality: all four criteria met). Sites meeting all four of the high quality criteria were found in lower Tonawanda Creek (N= 4, from the Rt. 93 Bridge in the Town of Royalton to the Niagara River), Johnson Creek (N= 16, from the Rt. 271 Bridge in the Town of Hartland to Lake Ontario), and Oak Orchard Creek (N= 10, from the Erie Canal to Lake Ontario).

Objective 2

In the field, identify and count all fish species inhabiting the areas sampled, especially longear sunfish, pumpkinseeds, their hybrids, and redfin shiners. Measure, weigh and mark longear sunfish or hybrids, and estimate their population sizes by mark-recapture.

Longear sunfish—. During the 2005 sampling season, 29,545 fish (67 species) were recorded, including 23 longear sunfish (Map 2d), 891 pumpkinseed, one possible longear-pumpkinseed hybrid, and 63 redfin shiners (six in Tonawanda Creek; 57 in Johnson Creek, plus two more in 2004; Maps 2e, 3d). Due to the low sample size of longear sunfish, it was not possible to conduct a mark-recapture study. No fin-clipped longear sunfish were recaptured during three attempts in September 2005. However, based on their relative ease of capture in lower Tonawanda Creek by boat electro-fishing during the spawning season (June- August), it is reasonable to guess that several hundred longear sunfish gathered for spawning in a 2.3 mile section of the stream. No longear sunfish were caught in Johnson and Oak Orchard Creeks, although they were common historically and one was caught in Johnson Creek in 2003.

Redfin shiner—. Redfin shiners were caught in one section of lower Tonawanda Creek (N = 6; Map 2e). Most (83%) were captured in the main stem of lower Johnson Creek downstream from Lyndonville Dam to near the mouth at Lake Ontario (N = 59; Map 3d). None were caught in Oak Orchard Creek, but sampling was limited there. Like the longear sunfish, redfin shiners used areas immediately adjacent to current, especially those with submergent aquatic vegetation or other cover such as downed trees or in-stream debris. Redfin shiners were captured over a variety of substrates, including silt, sand and gravel, in both clear and turbid water. Despite suggestions of an association in the literature, no overlap in the distributions of longear sunfish and redfin shiners was observed in this study.

Objective 3

Describe population characteristics of longear sunfish, and interpret the data to determine the status of longear sunfish populations in Tonawanda and Johnson Creeks.

Longear sunfish caught in Tonawanda Creek ranged from 78-148 mm, 10-85 g, and 3-5 years in age. Most of the captured longear sunfish were age 3 and ranged widely in length and weight; two each, ages 4 and 5, also were caught. Many captured fish appeared to be in spawning condition, and were presumably caught on their spawning grounds. No fish under age 3, the reported age of maturity for longear sunfish, was caught during the study. Among eight longear sunfish returned to the laboratory, a gravid female was put into a small aquarium with the largest male. By the following morning the female had deposited eggs on the sandy bottom and the male was fanning them. Despite aeration and water changes, within a week the embryos died in a mass of fungi.

Objective 4

Prepare a management plan and a manuscript for publication in a peer-reviewed journal.

A management plan jointly drafted by the NYSDEC and SUNY Brockport recommends: **1)** Protecting essential habitat at the location where longear sunfish were captured in Tonawanda Creek; **2)** Stocking longear sunfish fingerlings at selected locations in New York State; **3)** Developing a sampling protocol for finding and monitoring longear sunfish populations in New York State; **4)** Collecting biological data and estimating relative population abundance of longear sunfish in Tonawanda Creek and stocked populations at intervals of no less than 5 years (Investigators should also thoroughly sample all prospective release sites and adjacent areas to confirm the absence of resident longear sunfish before stocking and possible genetic introgression into native populations.); and **5)** Completing a genetic study in 2007 on fin tissue collected in 2005-2006 that includes samples from Tonawanda Creek, Michigan, Ohio and Ontario.

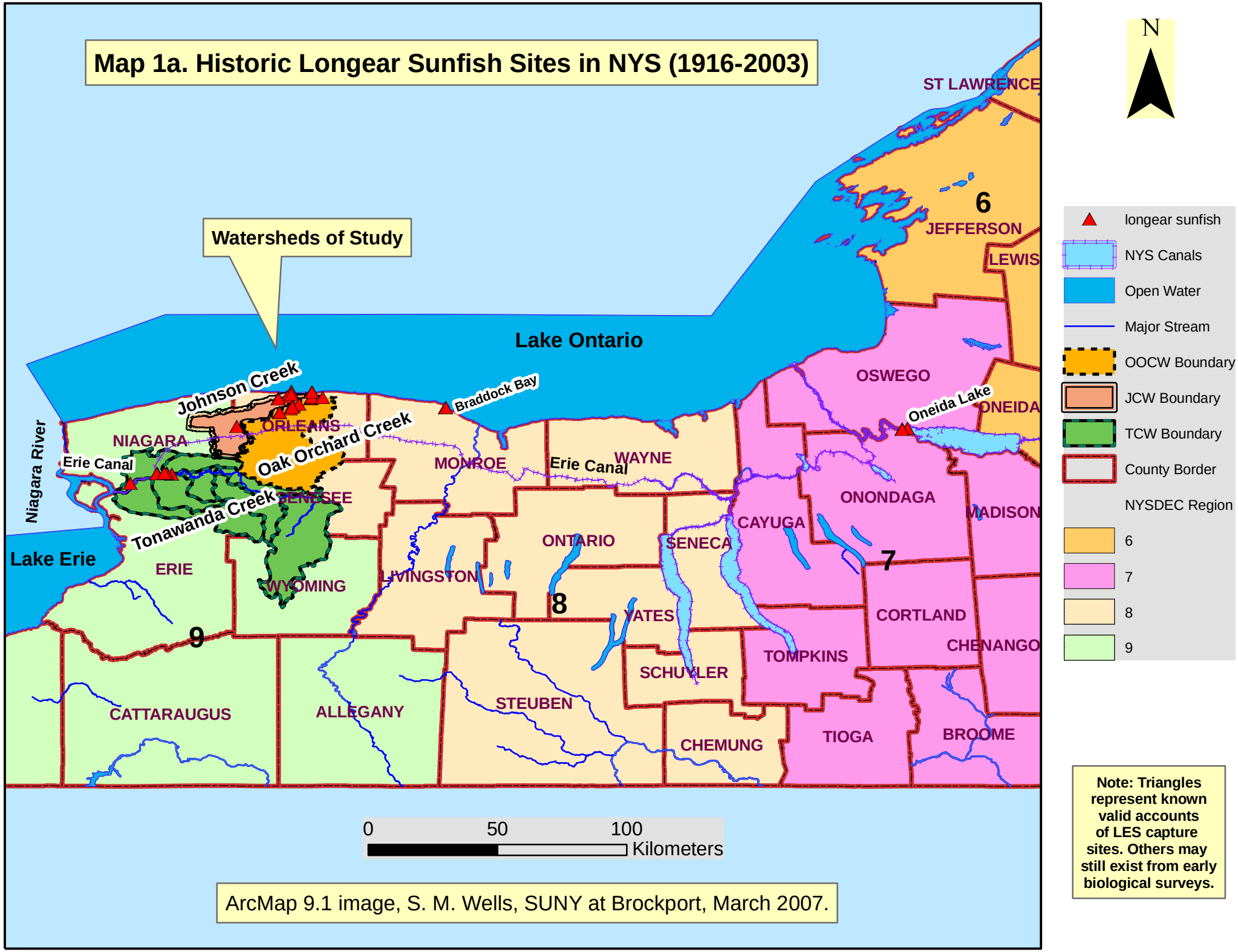
The most likely publishable outcomes are a note on the current vs. the historic status of the longear sunfish in New York State (based on the full set of project products provided in the appended report) and an article on statistical models of fish-habitat relationships in the study streams (based on author Wells' MS thesis and beyond the scope of this study).

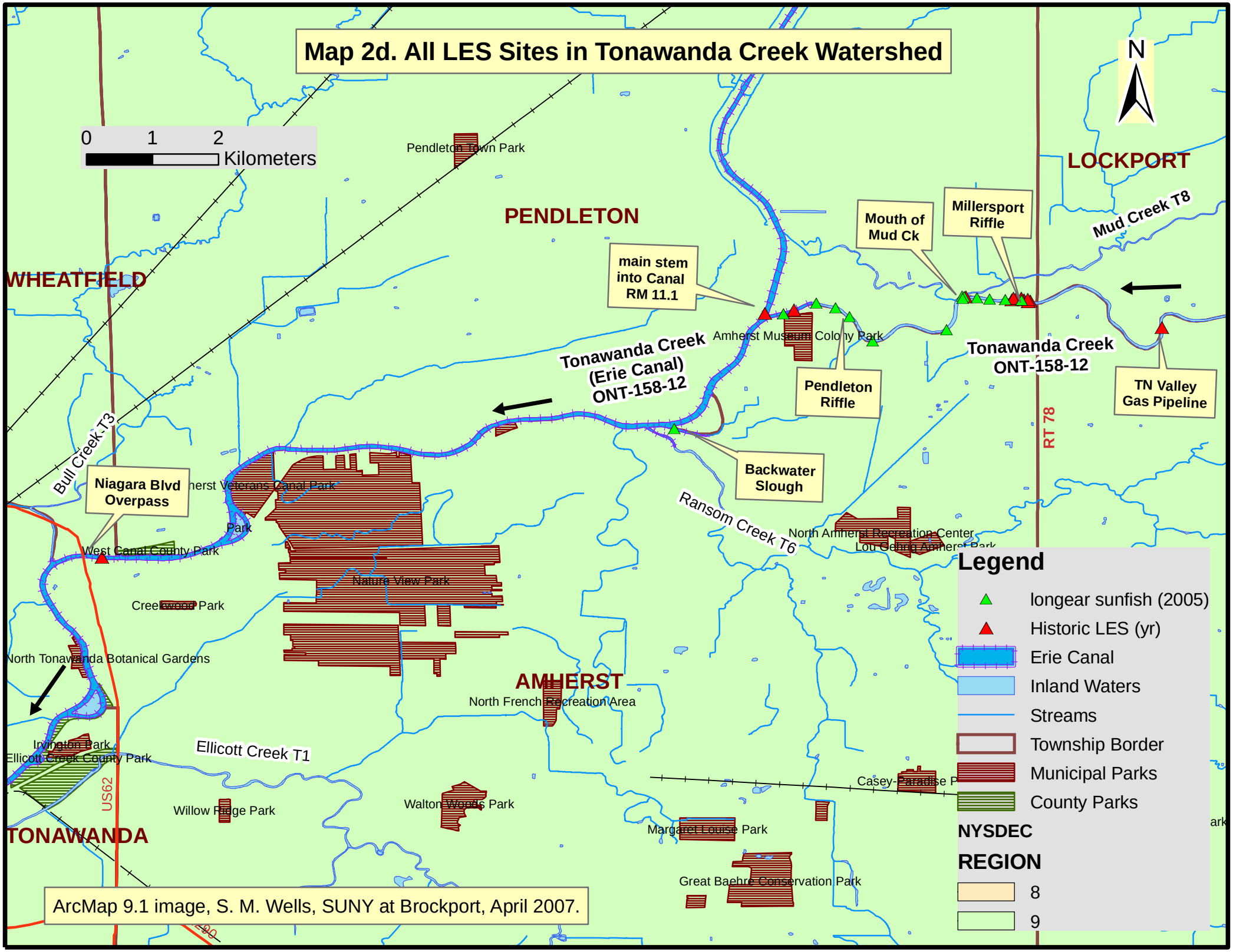
Conclusions and Recommendations

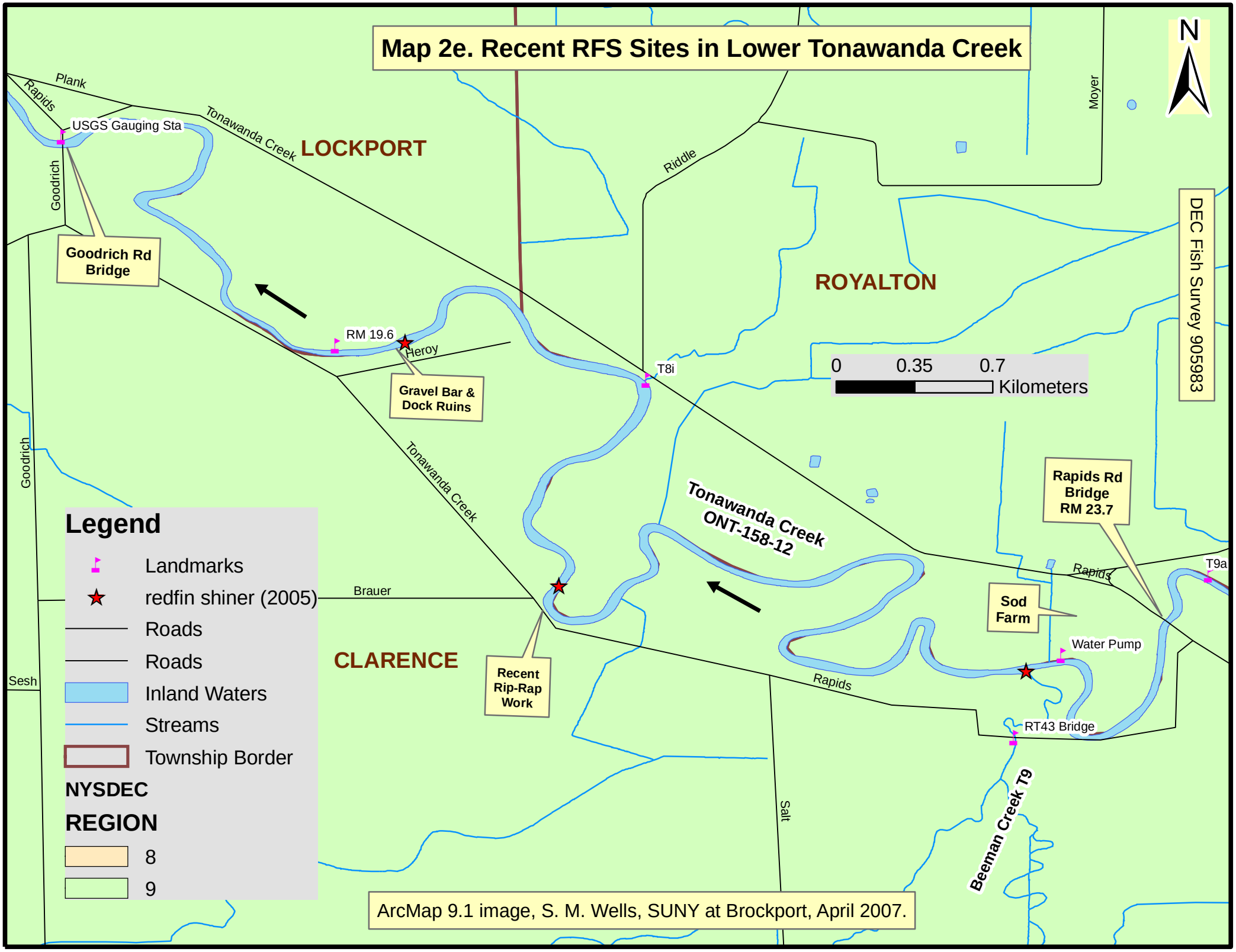
This study was only partially successful in determining suitable habitats for longear sunfish. Water clarity was so poor in lower Tonawanda Creek that it was impossible to observe the spawning beds of centrarchids. In addition, no evidence of recruitment was found. No age 1 or age 2 fish (which should have been vulnerable to the sampling methods used) or YOY (not highly vulnerable to the methods used) were caught. Either recruitment did not occur in the two years before the study or younger fish live in habitats that were not sampled. Because longear sunfish age 3 and older, but not younger, have been caught consistently in lower Tonawanda Creek since 1999, it is likely that the inability to capture sub-adults reflects insufficient knowledge of the species' habitat preferences by life history stage not an absence of recruitment. Because none have ever been caught, the habitat requirements of YOY and sub-adult longear sunfish remain unknown in Tonawanda Creek. Although there appear to be many suitable habitats for relocating or stocking longear sunfish in the watersheds studied, because of uncertainties about which habitat conditions are required to complete the life cycle, success is likely to be low until more is understood about the ecology of the species in relation to habitat characteristics in western New York streams.

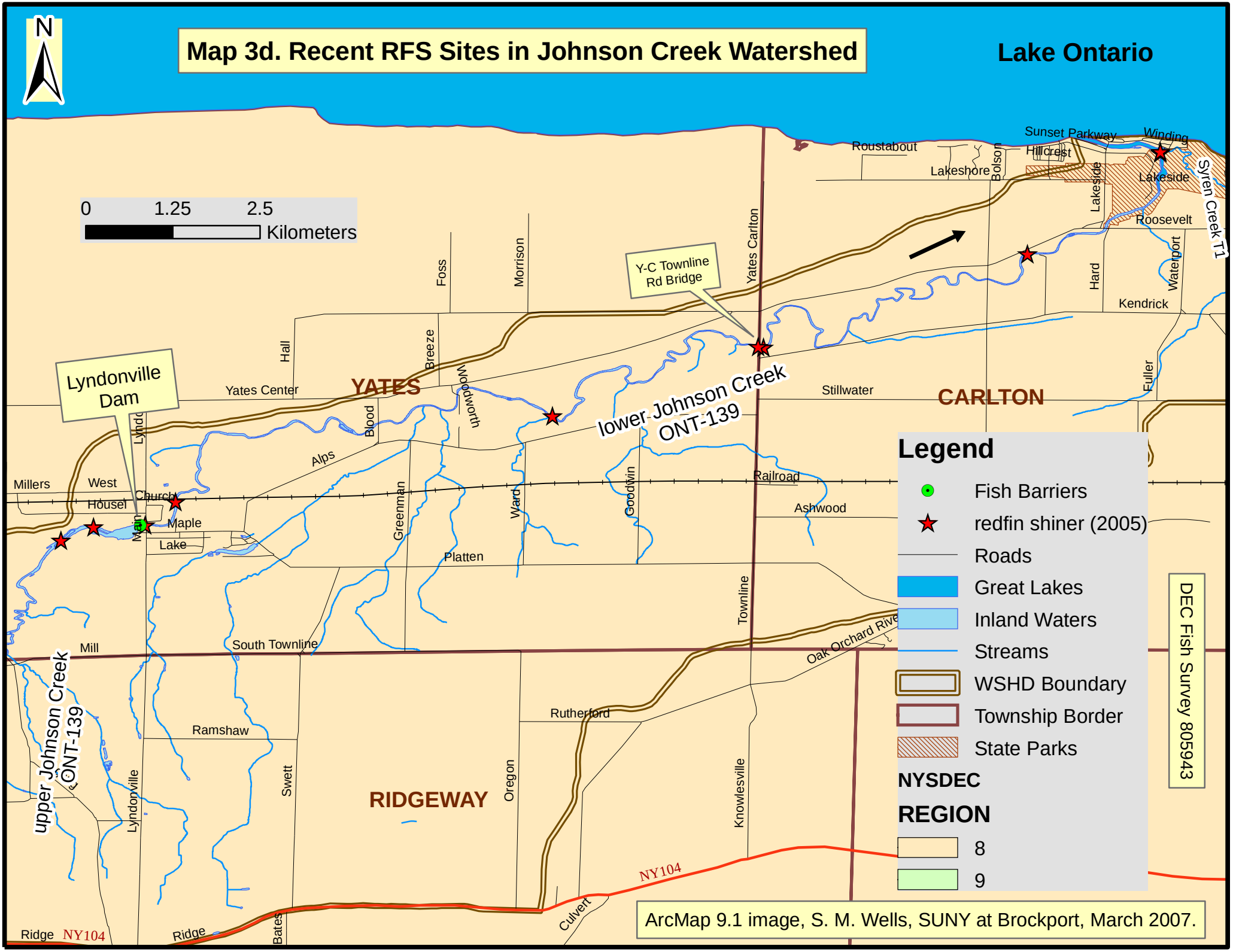
1. Intensive sampling throughout the Tonawanda, Johnson and Oak Orchard Creek watersheds in western New York in 2005 found all but one longear sunfish only in the lowermost 2.3 mi of Tonawanda Creek before it joins the Erie Canal. High priority should be given to protecting fish habitat and water quality in this reach of Tonawanda Creek.

2. Many locations with potentially high quality habitat for longear sunfish (small to fine substrate particle sizes and the presence of emergent/submergent vegetation, in-stream wood and bank cover) were identified and sampled, but very few yielded longear sunfish. Either other factors in the streams studied override preferred habitat characteristics described in the literature or there are many opportunities to reintroduce longear sunfish successfully into western New York State watersheds where they occurred historically.
3. Gravid longear sunfish (ages 3-5) but no YOY or age 1 and 2 fish were caught. It is unknown if this result was due to failed reproduction or recruitment (and an unsustainable population) or the use of different habitats by adult and non-adult fish during the reproductive season when most sampling occurred. Further attempts should be made to capture longear sunfish younger than age 3 and to describe their habitat preferences.
4. Redfin shiners were caught in one section of lower Tonawanda Creek and at 11 locations throughout lower Johnson Creek. None were caught in Oak Orchard Creek, but sampling was limited there. Despite suggestions of an association in the literature, no overlap in the distributions of longear sunfish and redfin shiner in lower Tonawanda Creek was found in this study.


Map 1a. Historic Longear Sunfish Sites in NYS (1916-2003)
Watersheds of Study
Lake Ontario
Lake Erie
Niagara River
Johnson Creek
Braddock Bay
Oak Orchard Creek
Tonawanda Creek
Erie Canal
Erie Canal
Oneida Lake
ST LAWRENCE
JEFFERSON
LEWIS
OSWEGO
ONEIDA
NIAGARA
ORLEANS
GENESEE
MONROE
WAYNE
ONONDAGA
MADISON
CAYUGA
ONTARIO
SENECA
ERIE
WYOMING
LIVINGSTON
YATES
CORTLAND
CHENANGO
TOMPKINS
SCHUYLER
STEUBEN
CATTARAUGUS
ALLEGANY
CHEMUNG
TIOGA
BROOME
6
7
8
9
N
longear sunfish
NYS Canals
Open Water
Major Stream
OOCW Boundary
JCW Boundary
TCW Boundary
County Border
NYSDEC Region
6
7
8
9
0
50
100
Kilometers
Note: Triangles represent known valid accounts of LES capture sites. Others may still exist from early biological surveys.
ArcMap 9.1 image, S. M. Wells, SUNY at Brockport, March 2007.


Map 2d. All LES Sites in Tonawanda Creek Watershed
N
0 1 2
Kilometers
Pendleton Town Park
PENDLETON
LOCKPORT
WHEATFIELD
Mouth of Mud Ck
Millersport Riffle
Mud Creek T8
main stem into Canal RM 11.1
Amherst Museum
Colony Park
Tonawanda Creek (Erie Canal) ONT-158-12
Tonawanda Creek ONT-158-12
Pendleton Riffle
TN Valley Gas Pipeline
RT 78
Bull Creek T3
Niagara Blvd Overpass
Backwater Slough
Ransom Creek T6
Park
West Canal County Park
Nature View Park
North Amherst Recreation Center
Creekwood Park
North Tonawanda Botanical Gardens
AMHERST
North French Recreation Area
Ellicott Creek T1
Ellicott Creek County Park
US62
Willow Ridge Park
Walton Woods Park
Margaret Louise Park
Great Baehre Conservation Park
TONAWANDA
Legend
longear sunfish (2005)
Historic LES (yr)
Erie Canal
Inland Waters
Streams
Township Border
Municipal Parks
County Parks
NYSDEC
REGION
8
9
ArcMap 9.1 image, S. M. Wells, SUNY at Brockport, April 2007.


Map 2e. Recent RFS Sites in Lower Tonawanda Creek
N
Plank
Rapids
USGS Gauging Sta
Tonawanda Creek
LOCKPORT
Goodrich
Goodrich Rd Bridge
Riddle
Moyer
ROYALTON
DEC Fish Survey 905983
RM 19.6
Heroy
Gravel Bar & Dock Ruins
T8i
0 0.35 0.7
Kilometers
Tonawanda Creek
Tonawanda Creek ONT-158-12
Rapids Rd Bridge RM 23.7
Rapids
T9a
Sod Farm
Water Pump
Brauer
CLARENCE
Recent Rip-Rap Work
Rapids
RT43 Bridge
Sesh
Salt
Beeman Creek T9
Legend
Landmarks
redfin shiner (2005)
Roads
Roads
Inland Waters
Streams
Township Border
NYSDEC
REGION
8
9
ArcMap 9.1 image, S. M. Wells, SUNY at Brockport, April 2007.


Map 3d. Recent RFS Sites in Johnson Creek Watershed
Lake Ontario
N
0 1.25 2.5
Kilometers
Lyndonville Dam
Y-C Townline Rd Bridge
lower Johnson Creek ONT-139
upper Johnson Creek ONT-139
YATES
CARLTON
RIDGEWAY
Yates Center
Stillwater
Ashwood
Millers
West Housel
Church
Maple Lake
Platten
South Townline
Mill
Ramshaw
Rutherford
Oak Orchard River
Railroad
Roustabout
Lakeshore
Sunset Parkway
Hillcrest
Winding
Lakeside
Roosevelt
Kendrick
Syren Creek T1
Foss
Morrison
Hall
Breeze
Woodworth
Blood
Alps
Greenman
Ward
Goodwin
Yates Carlton
Bolson
Hard
Waterport
Fuller
Lyndo
Main
Lyndonville
Swett
Oregon
Knowlesville
Townline
Culvert
Bates
Ridge
NY104
Legend
Fish Barriers
redfin shiner (2005)
Roads
Great Lakes
Inland Waters
Streams
WSHD Boundary
Township Border
State Parks
NYSDEC
REGION
8
9
DEC Fish Survey 805943
ArcMap 9.1 image, S. M. Wells, SUNY at Brockport, March 2007.

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Introduction

Widespread throughout the southern and eastern portions of the Mississippi River and Great Lakes drainages, the longear sunfish (*Lepomis megalotis*) is at the eastern edge of its range in western New York and eastern Quebec. Early biological surveys in New York State (1926-1940) indicated that the eastern subspecies (*L. m. peltastes*) was native and common in the lower reaches of several southwestern Lake Ontario watersheds, particularly in Johnson and Oak Orchard Creeks and West Creek/Braddock Bay, and once extended east to Oneida Lake's outlet to the Oswego River (1916 record) (Map 1a). Longear sunfish were first recorded in lower Tonawanda Creek and the adjacent Erie Canal in 1974, and this system has accounted for the bulk of modern records in New York State. The longear sunfish was listed as threatened (T) in New York in 1983 because at the time it was only known in a short segment of lower Tonawanda Creek, a tributary to the Niagara River north of Buffalo, and had disappeared from five historical locations until one was caught in lower Johnson Creek in 2003. More recent sampling and a review of the species' distribution in New York (Carlson 2005) indicated that it may be detectable only in lower Johnson Creek and lower Tonawanda Creek.

According to the extensive review by Carlson (2005), the longear sunfish inhabits warm water streams and prefers clear, shallow areas away from strong currents and silt. In large streams, it prefers dense weedy areas (Smith 1985). It is also known to persist in ponds and impoundments where introduced. Past and present land development (agricultural, urban/ suburban), which promotes siltation and greater discharge variation in streams, has been associated with the declines of longear sunfish in Ohio streams (Trautman 1981), and may be the leading factor that limits the longear sunfish's distribution in western New York State.

Another potentially negative impact on longear sunfish populations in western New York is hybridization with other *Lepomis* species, most notably the pumpkinseed (*Lepomis gibbosus*), as postulated by Smith (1985) and Carlson (2005). It is possible that hybridization has been a source of confusion about the presence or absence of longear sunfish in western New York State streams. Although the longear sunfish and pumpkinseed bear superficial similarities, they and their hybrids are distinctly recognizable in terms of snout length, body stoutness, pectoral fin shape, general color

and markings, and especially operculum shape, margin and color (Smith 1985). An additional deleterious influence on longear sunfish populations may be the recent establishment of two invasive species, the green sunfish (*Lepomis cyanellus*) (native to New York State) and the round goby (*Neogobius melanostomus*).

Following the recommendation of the New York State Department of Environmental Conservation's (NYSDEC) Species Account for the longear sunfish (Carlson 2005), this project was initiated in 2004 to 1) collect and analyze habitat information in the Tonawanda and Johnson Creek watersheds (Map 1b) and describe locations that might be suitable for longear sunfish, 2) collect fish in these watersheds and describe the distribution and the status of longear sunfish populations, and 3) cooperate in the development of a recovery plan for longear sunfish in New York State.

Longear sunfish biology

The longear sunfish (*Lepomis megalotis*) is a ray-finned (Class Actinopterygii), perciform (Order Perciformes), North American (Family Centrarchidae) fish. Although eight geographically distinct populations have been proposed (Jennings 1991), the two most common forms are the northern (*L. m. peltastes*) and central (*L. m. megalotis*) subspecies. Noticeable among *Lepomis* species, the body is quite stout, with a steep forehead, distinct pectoral fins, and a unique opercular flap. The pectoral fins are short with rounded tips that do not extend above the lateral line. The pelvic fins of males are often much darker than females (Hubbs and Lagler 2004), especially during the spawning season, and the gill rakers have a distinct short, blunt pattern (Trautman 1981).

Photo 1. Northern longear sunfish, *Lepomis megalotis peltastes* (by S. Wells, 2005).

Similar to the pumpkinseed, the longear sunfish displays variable and vivid (more so in breeding males) body coloration, is one of the most colorful North American freshwater fishes (Photo 1), and is a popular aquarium species. The back and sides are olive green to rusty brown; the sides are speckled with blue, yellow and orange; the ventral region may be bright orange, yellow or red in males; the sides of the head are often blue-green or turquoise; and in some populations the pupil of the eye may be encircled by a red iris. The opercular flap of the longear sunfish is highly distinctive. It is a long, wide extension of the upper operculum, typically extending upward at a 45° angle (but the angle may be variable); is very flexible, often with a frilled margin colored with red or white; and is more prominent in males and older individuals of both sexes. A related eastern New York State species, the redbreast sunfish (*Lepomis auritus*), is often misidentified as the longear sunfish, but this species has an opercular flap that is long and narrow, very rigid, usually black in color, that extends out at a 90° angle.

Fishbase reports that the maximum length, weight and age of the longear sunfish is 240 mm TL, 790 g, and 6 years (perhaps 10 years in captivity), respectively. Growth rates are highly dependent on length of growing season and food availability. An inspection of museum specimens across New York State by author Wells suggested three distinct size classes: YOY/ juveniles to 60 mm, sub-adults (60-80 mm), and adults (>80 mm) but recent observations of reared individuals indicates the species' age and growth relationship is highly variable depending on competition and food availability (D. M. Carlson, NYSDEC, pers. comm.). Age of first reproduction in the wild appears to be at age 3 when fish reach about 80 mm (many sources), but Smith (1975) demonstrated reproduction in the laboratory at only 22 weeks. Therefore, large yearlings may be capable of spawning.

The longear sunfish lives in benthopelagic freshwater habitats from 51° N - 26° N latitude in North America (Fishbase) and is common in the littoral zone where it spawns. They are nearly always found in shallow water with dense vegetation in small lakes, ponds or slow moving rivers and streams. Their diet is similar to other *Lepomis* species, consisting mostly of small aquatic invertebrates (due to relatively small mouth size), including snails, leeches, crustaceans and insect larvae. They also eat small fish and

crayfish, fish eggs and algae, as well as terrestrial drop-ins such as worms, ants, flies and other insects.

Studies on the reproduction of northern longear sunfish subspecies are few (Jennings 1991). Adults are suspected to gather and spawn from June to August in New York State. Spawning probably begins when water temperatures range from 23-25.0 ^{o}C, in clear (where available), shallow water <1 m deep (12-60 cm), and may occur more than once in a season. A soft substrate, such as sand or pea gravel, is ideal for nest building, but nests also have been observed on silt and muck bottoms. Typical of centrarchids, male longear sunfish play the key role in nest building and care of eggs and fry. Solitary or colonial nesting may occur, with smaller males predominant on colonial nests and larger males on solitary nests. Males develop vivid colors (dark red dorsally and bright orange ventrally is common; blue speckles are observed in some populations) and a more distinct shape/color of the opercular flap, presumably to attract females that choose multiple males with which to mate (Dupuis and Keenleyside 1988, Jennings 1991, Jennings and Philipp 1992a, Goddard and Mathis 1997b, Goddard and Mathis 2000). Female fecundity depends on body size and condition and ranges from 600-2,700 eggs per season. Hatching time is temperature dependent, but typically occurs about one week after egg deposition. Males guard the nest for 1-2 weeks.

Methods

Objective 1

From existing data and data collected in this project, create GIS maps of the Tonawanda and Johnson Creek watersheds [that show] suitable longear sunfish habitats and locations of longear sunfish. Sampling will also extend to other prospective and historical areas in these counties.

Based on literature descriptions of longear sunfish habitat, potential habitat suitability for longear sunfish was evaluated at 354 sites in the summers of 2004 and 2005—230 sites in the Tonawanda Creek watershed (Map Series 2; Appendix 1), 98 sites in the Johnson Creek watershed (Map Series 3; Appendix 2), and 26 sites in the Oak Orchard creek watershed (Map Series 4; Appendix 3). To promote consistency, the same person (author Wells) characterized the habitat at each sampling location. Habitat suitability for longear sunfish at each site was judged by four, literature-based physical

criteria (Table 1): predominant *substrate* composition, and presence (suitable habitat) or absence (unsuitable habitat) of emergent or submergent *aquatic vegetation*, *in-stream wood*, and *bank cover*. Sampled sites were ranked from 1 (low quality: only one criterion met) to 4 (high quality: all four criteria met). Sites that met three or four of the criteria are displayed in Map Series 2 and 3 (Tonawanda and Johnson Creek watersheds, respectively); Map Series 4 (Oak Orchard Creek watershed) shows sites that met two to four of the criteria. Depending on location, sampling sites were accessed by boat, canoe or foot, with particular emphasis on pools near bridges, impoundments, fish barriers, and tributary mouths. A hand-held Global Positioning System (GPS) receiver was used to record site locations.

Table 1. Physical characteristics recorded at each site to determine if suitable stream habitat existed for longear sunfish (*Lepomis megalotis*). Estimates of each feature were made at each sample site in 2005.

Habitat Variable	Description
AV – aquatic vegetation	submergent, emergent or floating other than algae
SS – substrate type	silt, sand, gravel or rocks (predominant types)
IW – instream wood	standing or submerged wood (dead or alive) in the water
BC – bank cover	riparian cover (natural/artificial) overhanging or shading the water

All habitat data were collected during summertime low-moderate flows in 2004-2005.

Data from field notes and GPS coordinates were transcribed into Microsoft Excel spreadsheets (Appendices 1-3). Point data for all sites were downloaded onto topographic maps using Garmin MapSource U.S. TOPO 2000 version 3.02 and copied onto the spreadsheets. Garmin maps were printed and used in the field to aid in navigation during the summers of 2004 and 2005. Once sampling was completed, all fish data were sorted and compiled for entry into the DEC's statewide fisheries database in 2006 (Appendices 4-7). ESRI ArcMap 9.1 was used extensively for spatial analyses in this study. Coordinate data were displayed by saving the entire MS Excel spreadsheet in CSV comma-delimited format and uploading the new file on a Notepad text document for X-Y input as a Geographical Information System (GIS) layer. Final map products include several GIS layers, which are colored and labeled on the legends, including 2005 fish survey sites (DEC database entries); habitat ratings (2004 with 2005 updates); rare fish locations (historical and recent for longear sunfish, LES—Photo 1 and recent for redfin

shiner *Lythrurus umbratilis*, RFS—Photo 2); and streamside landmarks and access locations. Based on the number of physical criteria met (Table 1), sample sites in each watershed were ranked, using map symbols, for potentially suitable longear sunfish habitat.

Photo 2. Redfin shiner, *Lythrurus umbratilis* (by P. Herbert, 2006).

Objective 2

In the field, identify and count all fish species inhabiting the areas sampled, especially longear sunfish, pumpkinseed, their hybrids, and redfin shiner. Measure, weigh and mark longear sunfish and hybrids, and estimate their population sizes by mark-recapture.

Fish sampling was conducted from May through September 2005 at 68, 40 and 16 sites in the Tonawanda, Johnson and Oak Orchard Creek watersheds, respectively. The only sites sampled in Oak Orchard Creek were near historical sites of capture; no sampling was conducted in the main stem upstream from the Erie Canal. Depending on size of water and accessibility, sampling was done by boat or backpack electro-fishing (15 min per site) or by beach seining (4-10 hauls depending on depth and quality of hauls re: snags, etc.). With the exception of large groups of small fish, all specimens were identified, counted, measured (nearest mm, caudal fin compressed), and weighed (nearest g, or 0.1 g for rare fish only). The soft dorsal fin was removed from all longear sunfish for mark-recapture, and fin tissue was sent to Dr. Thomas Near, Yale University, for genetic analysis. Scales of longear sunfish were collected for age and growth analysis. If a fish (some minnows and darters) could not be identified in the field, it was fixed in 10% formalin, transferred to 70% propanol after a week, and identified in the laboratory.

Several redfin shiners but no longear sunfish were saved as voucher specimens, and are currently in the possession of author Wells until their transfer to the NYS Museum.

Objective 3

Describe population characteristics of longear sunfish, and interpret the data to determine the status of longear sunfish populations in Tonawanda and Johnson Creeks.

Weight-length and length-age relationships were established for the longear sunfish captured during the study, and a weight-length relationship was established for the redfin shiners caught. Also, eight longear sunfish were returned to the laboratory for several days; spawning was observed before returning them alive to their sites of capture in lower Tonawanda Creek.

Objective 4

Prepare a management plan and a manuscript for publication in a peer-reviewed journal.

Several drafts of a management plan were exchanged among the authors and D. M. Carlson (NYSDEC, Watertown, NY). It is a work in progress (Appendix 8). Preparation of a manuscript for publication awaits author Wells' completion of his Master of Science thesis at SUNY College at Brockport.

Results and Discussion

Objective 1

From existing data and data collected in this project, create GIS maps of the Tonawanda and Johnson Creek watersheds [that show] suitable longear sunfish habitats and locations of longear sunfish. Sampling will also extend to other prospective and historical areas in these counties.

Longear sunfish—. Twenty-three adult longear sunfish (one not netted) were captured in the lower 2.3 mi of the main stem of Tonawanda Creek, and one specimen was caught 1.4 mi downstream in the Erie Canal portion of Tonawanda Creek (Maps 2k-p). No longear sunfish were caught in the Johnson (Map Series 3) and Oak Orchard (Map Series 4) Creek watersheds during the study.

Based on physical habitat characteristics recorded at the 354 sites evaluated during this study (Appendices 1-3), 191 sites with potentially suitable habitat for longear sunfish (i.e., sites meeting three or four of the high quality habitat criteria; Table 1), were

identified. In the Tonawanda Creek watershed, 113 sites with potentially suitable habitat were identified among the 230 sites that were characterized from the headwaters in Wyoming County to the Niagara River (Appendix 1, Map 2a). Seventeen of the sites characterized in the entire Tonawanda Creek watershed met all four habitat quality criteria. Only 74 sites in the lower portion of the Tonawanda Creek watershed are displayed here (Maps 2f-w), beginning at the mouth of Ledge Creek (Tributary 11, Map 2w) and continuing downstream to the confluence of Tonawanda Creek and the Niagara River (Map 2f). Four sites meeting all four high quality criteria were found in this section of lower Tonawanda Creek from RT 93 in the Town of Royalton to the Niagara River.

In the Johnson Creek watershed, 57 potentially suitable sites (i.e., sites meeting three or four of the high quality habitat criteria) were identified among the 98 sites that were characterized (Appendix 2; Maps 3e-w) from the headwaters downstream to Lake Ontario. Sixteen sites, from RT 271 in the Town of Hartland to Lake Ontario, met all four habitat quality criteria. After limited habitat characterizations in the Oak Orchard Creek watershed, extending from Lake Ontario to the southern end of Glenwood Lake at the Erie Canal (Appendix 3, Map 4i), 21 potentially suitable sites were identified among the 26 that were characterized. Ten sites met all four habitat quality criteria.

No impassable barriers were encountered in the sections of the Tonawanda Creek watershed reported on here; therefore, barriers to fish passage are unlikely to account for the lack of longear sunfish and redfin shiners captured in what appeared to be suitable habitats. In the Johnson Creek watershed, the low-head dam in Lyndonville (Map 3q) likely prevents upstream passage of *Lepomis* spp. and up- or downstream passage may be prevented by passage of the creek through culverts at the Erie Canal (Map 3u) and RT 271 (Map 3w). There are three barriers to upstream passage in the section of the Oak Orchard Creek watershed studied: Lake Alice Dam (Map 4g), Glenwood Lake Dam (Map 4i), and Medina Falls at the Erie Canal (Map 4i).

In Tonawanda Creek in the late spring and summer of 2005, adult longear sunfish were captured at stream margins in slack water <1 m deep, especially near “current breaks” above and below riffles and at stream confluences (Table 2). They were found near the only available, sparse cover, including in a large backwater slough with submergent vegetation (Map 2k), emergent and submergent vegetation along the stream

margin (Maps 2l, m, o), a small wood jam (Map 2m; large log jams could not be sampled), and a rocky-gravelly shoal (Map 2n).

Table 2. Habitat characteristics for stream-dwelling northern longear sunfish (*Lepomis megalotis peltastes*) taken from visual observations in the field and habitat preferences stated in the literature.

Habitat Factors[1]	**Literature Review**	**Upper Huron River, MI**[2]	**Tonawanda Creek**[3]
Water Clarity	clear waters mostly	normally clear at low flow	mostly turbid at all flows
Maximum Depth	found in/near shallows	found in/near shallows	found in/near shallows
Water Temperature	typically warmer areas	typically warmer areas	typically warmer areas
Relative Flow	quiet backwaters, avoids strong flow	quiet backwaters, near current	mostly adjacent to current
Substrate Composition	mainly gravel and sand	abundant clean sand, some gravel, much silt in backwater	abundant silt and clay, some sand and gravel mixed in
Aquatic Vegetation	use of mostly submergent types	in or near dense submergents	use of sparse emergents
Other features			
Spawning Habitat	over sand and small gravel mostly from June-August	over clean sands in June	over mostly silt, clay Jun-July
In-stream Wood	attracted to shoreline cover	extensive use when available	use of sparse wood cover
Bank Cover	attracted to shoreline cover		
Over-Winter Refugia	little known of winter habitat	deeper habitat available	deeper habitat available
Trends Found (2005)	avoids current, attracted to submergents, intolerant of siltation, needs soft bottom to spawn	found near and in current, in warm shallows, extensive use of submergents and wood in side or backwater areas	found near current breaks, in warm shallows, use of best available and varied cover (rocks, wood, emergents)

All habitat data were collected during low summertime flows in 2004-2005. [1]Same general habitat preferences also noted for redfin shiner (*Lythrurus umbratilis*) in the literature, as they are known to spawn over longear sunfish nests. [2]Upper Huron River included the area of Proud Lake State Park in Commerce, MI. [3]Tonwanda Creek included the lower basin only from Millersport, NY downstream to the Erie Canal confluence (Erie/Niagara Co., NY).

Historical capture sites for longear sunfish in Tonawanda Creek (Maps 2d, 2i, 2l, 2o-q) included habitat features similar to those where longear sunfish were captured in this study, but many of the historical sites did not yield longear sunfish in 2005. Most notable was the Millersport Riffle just downstream from the RT 78 Bridge (Map 2p) which is comprised of a series of small pools in a large, complex riffle that flows into a large, circular silt-bottom pool. Numerous sampling efforts at this site since 2002

captured only one adult longear sunfish at the tail of the riffle (2005). Records for this site and the confluences of Tonawanda Creek with Mud Creek (Map 2o) and the Erie Canal (Map 2l) demonstrate the affinity of the species for tributary confluences and similar physical areas. Other historical sites in the Erie Canal (Maps 2i, 2l), and at the gas pipeline crossing under Tonawanda Creek just upstream from the RT 78 Bridge (Map 2q), offer limited cover in shoreline rip-rap and uncertain possibilities for submergent vegetation later in the summer growing season.

Tonawanda Creek above the New Road Bridge (Map 2m) does not provide preferred habitat for longear sunfish: clear water, aquatic vegetation and gravelly-sandy substrate. This region of the creek has high turbidity which reduces submergent plant growth and generates substrates of mostly silt or muck, only occasionally exposing sand or gravel suitable for sunfish spawning. However, both Johnson and Oak Orchard Creeks and some areas in Tonawanda Creek above T11 (Map 2w) appear to be less disturbed by suburban sprawl and have a higher percentage of potentially preferred habitat for longear sunfish (versus lower Tonawanda Creek) even though no longear sunfish were captured at any of these sites during the study.

Redfin shiner—. Six redfin shiners were caught between river miles 19.6 - 23.6 of Tonawanda Creek (Maps 2t-u), and 59 were caught in Johnson Creek between river miles 1-12 (Maps 3e, 3g, 3i-k, 3m-n). Most redfin shiners (83%) were captured in the main stem of lower Johnson Creek at various sites downstream from Lyndonville Dam to near the mouth at Lake Ontario. Only six were captured above the Lyndonville Dam. Eighty-five percent of the redfin shiners were caught in beach seines. This small fish is hard to identify; the most noticeable feature is a dark spot located at the anterior base of the dorsal fin in both sexes (Photo 2).

Like longear sunfish, redfin shiners used areas adjacent to currents, especially those with submerged aquatic vegetation or other cover such as downed trees or in-stream debris. Redfin shiners were captured over a variety of substrates, including silt, sand and gravel in both clear and turbid water. They were never found in riffles but were usually at the margins of side channels or in slow moving runs or pool-like reaches of the streams. Seining at site 18 in lower Johnson Creek (Map 3k) resulted in 29% of all redfin shiner captures in 2005 (N = 18). An old concrete break wall constrained stream flow,

and redfin shiners at this site were captured just upstream from the wall, adjacent to the main channel in sparse, submerged vegetation.

Habitat summary—. This study was only partially successful in determining suitable habitat criteria for longear sunfish in Tonawanda Creek. Only age 3 and older longear sunfish were captured, apparently in spawning condition and only in June and July, in the lower main stem of Tonawanda Creek (Maps 2l – 2p). They may have been on spawning grounds with different habitat characteristics than areas of residence during non-spawning seasons. Because none were caught, the habitat requirements of YOY and subadult longear sunfish remain unknown in Tonawanda Creek. Although there appear to be many opportunities for relocating longear sunfish from known locations to other potentially suitable locations in the watersheds studied, because of uncertainties about which habitats are required to complete the life cycle, transplantation or stocking success is likely to be low until more is understood about the ecology of the species in relation to habitat characteristics in western New York State streams.

For the most part both longear sunfish and redfin shiners were captured at sites with habitats identified as potentially suitable (Appendices 1-3), but most sites identified as potentially suitable did not produce these species. Nevertheless, the best potential sites for reintroducing longear sunfish into the watersheds studied are those where all four habitat quality criteria were met (see symbols on Map Series 2-4).

It is commonly reported that the redfin shiner shares habitat with stream-dwelling centrarchids, and they are suspected to require the presence of sunfish nests for successful spawning (Hunter and Wisby 1961, Hunter and Hasler 1965, Scott and Crossman 1973, Smith 1979, Lee et al. 1980, Trautman 1981, Becker 1983, Cooper 1983, Matthews and Heins 1984, Smith 1985, Noltie 1988 and 1989, Eberle and Tomelleri 1990, Page and Burr 1991, Pflieger 1997, Carlson 1998, Lyons et al. 2000, Knopf 2002, Hubbs and Lagler 2004, Werner 2004). Although redfin shiners and longear sunfish have been captured together in recent years in Johnson Creek near Kuckville (Map 3f) and in Tonawanda Creek at the mouth of Mud Creek (Map 2d) (D. M. Carlson, NYSDEC, pers. comm.), no overlap in their distributions was observed in this study.

Objective 2

In the field, identify and count all fish species inhabiting the areas sampled, especially longear sunfish, pumpkinseeds, their hybrids, and redfin shiners. Measure, weigh and mark longear sunfish or hybrids, and estimate their population sizes by mark-recapture.

Table 3. Records of northern longear sunfish (*Lepomis megalotis peltastes*) collected in 2005 (N = 23). Also see maps 2d, k-p.

Date	No.	WIN	Water Body	Avg Size TL-mm / WT-	Site Location
06/23/05	1	ONT-158-12	Tonawanda Ck, Millersport, NY	133 / 67	On RB below RT 78 BR at head of first large pool below Millersport riffle
06/23/05	7	ONT-158-12	Tonawanda Ck, Millersport, NY	111 / 48	Confluence with T8 - Mud Ck and adjacent shoreline area
06/27/05	1	ONT-158-12	Tonawanda Ck, Pendleton, NY	115 / 45	Above New Rd BR on RB in long narrow channel below first riffle
06/27/05	1	ONT-158-12	Tonawanda Ck, Pendleton, NY	92 / 16	Just above Erie Canal confluence in shallow weed cover along LB
06/27/05	1	ONT-158-TC	Erie Canal, Pendleton, NY	100 / 29	Inside large backwater slough just east of Ransom Ck x Erie Canal confluence
07/08/05	4	ONT-158-12	Tonawanda Ck, Pendleton, NY	98 / 25	Just above first riffle in pool tail on both sides of creek
07/08/05	2	ONT-158-12	Tonawanda Ck, Pendleton, NY	86 / 14	Above first riffle on LB at steep clay shore of narrow channel
07/19/05	1	ONT-158-12	Tonawanda Ck, Millersport, NY	92 / 16	First long pool between two short riffles well below Millersport riffle
07/19/05	1	ONT-158-12	Tonawanda Ck, Millersport, NY	126 / 60	Second long pool above Mud Ck well below Millersport riffle
07/19/05	2	ONT-158-12	Tonawanda Ck Pendleton, NY	107 / 31	Below Mud Ck in rocky shoal area on LB of narrow channel
07/19/05	2	ONT-158-12	Tonawanda Ck, Pendleton, NY	98 / 24	Just above New Rd BR in wood debris on RB

Fish were collected by boat electro-fishing boat in the lower basin of Tonawanda Creek Watershed (Erie-Niagara Co., NY). Captured longear sunfish (22) were photographed, fin clipped, and released alive; none were archived. Additional records noted by D. M. Carlson: one specimen (TL ~ 100mm) observed at the Kuckville RT 18 BR in lower Johnson Creek (Orleans Co.) on 17 May 2004 and two specimens captured (TL 104, 113mm) and released above Mud Creek (T8) in lower Tonawanda Creek on 7 June 2006. Common abbreviations: BR = bridge, LB = left bank, RB = right bank (designated with current flow), TL = total length in mm, Wt = wet weight in g. WIN = Watershed Index Number.

Table 4. Records of redfin shiner (*Lythrurus umbratilis*) collected in 2004-2005 (N = 65). Also see maps 2e, o, t, u; 3d, e, g, i, j, k, m, n.

Date	No.	WIN	Water Body	Avg Size TL-mm / WT-g	Site Location
08/24/04	2	ONT-139	Johnson Ck, Lakeside, NY	61 / 2	Near the mouth of T1 - Syren Ck
06/03/05	11	ONT-139	Johnson Ck, Lyndonville, NY	55 / 2	Below Lyndonville Pond Dam in riffle area under RT 63 BR
06/15/05	2	ONT-139	Johnson Ck, Lakeside, NY	58 / na	Near the mouth of T1 - Syren Ck
07/05/05	1	ONT-139	Johnson Ck, Kuckville, NY	45 / 1	Half-way between RT 18 BR and Harris Rd BR above old steel BR
07/13/05	5	ONT-139	Johnson Ck, Lyndonville, NY	42 / na	Above split channel area well above Lyndonville Pond inflow
07/13/05	1	ONT-139	Johnson Ck, Lyndonville, NY	60 / na	Below split channel area well above Lyndonville Pond inflow
07/18/05	7	ONT-139	Johnson Ck, Ashwood, NY	49 / na	Below Yates-Carlton Townline Rd BR
07/18/05	10	ONT-139	Johnson Ck, Ashwood, NY	53 / na	Above Yates-Carlton Townline Rd BR
08/10/05	18	ONT-139	Johnson Ck, Lyndonville, NY	52 / 1	Just above SPDES 0024678 outflow at RxR BR east of RT 63
08/11/05	2	ONT-139	Johnson Ck, Yates Center	51 / na	Below Woodward Rd (BR out) near Alps Rd
08/04/05	2	ONT-158-12	Tonawanda Ck, Rapids, NY	115 / na	Near Beeman Ck outflow below Rapids Rd BR
08/04/05	2	ONT-158-12	Tonawanda Ck, Rapids, NY	53 / na	Near rip rap on LB off Tonawanda Ck Rd S east of Brauer Rd
08/04/05	2	ONT-158-12	Tonawanda Ck, Rapids, NY	52 / 1	Above Goodrich Rd BR in Rapids just north of Heroy Rd

Fish were collected using beach seine and electro-fishing (boat, backpack). A total of 13 redfin shiners were archived during this study, all others were released alive. One additional record noted by D. M. Carlson: one specimen captured and archived at mouth of Mud Creek (T8) in lower Tonawanda Creek on 7 June 2006. Common abbreviations: BR = bridge, LB = left bank, RB = right bank (designated with current flow), TL = total length in mm, Wt = wet weight in g. WIN = Watershed Index Number.

During the 2005 sampling season, data from 29,545 fish (67 species) were recorded (Appendices 9 and 10), including 23 longear sunfish (Tonawanda Creek only; Table 3), 891 pumpkinseed, one possible longear-pumpkinseed hybrid, and 65 redfin shiner (six in Tonawanda Creek, 59 in Johnson Creek; Table 4). In the Tonawanda Creek watershed 68 sites were sampled on 29 days in the summer of 2005. Four trips yielded longear sunfish at 11 sites; all were caught using the electro-fishing boat. Redfin shiners in 2005 were caught on a single day at 3 sites using a beach seine. In the Johnson Creek watershed, 40 sites were sampled on 19 days. Redfin shiners were caught on seven days at nine sites in 2005 using boat electro-fishing and beach seines. In 2004, two redfin shiners were caught at two sites on one day using the electro-fishing boat.

Due to low sample size, it was not possible to conduct a mark-recapture study for longear sunfish (this outcome was anticipated in the original proposal). No fin-clipped longear sunfish were recaptured in three attempts in September 2005 using boat electro-fishing (~1.6 h of power on) and seines. However, based on the relative ease of capture of longear sunfish in lower Tonawanda Creek by boat electro-fishing during the spawning season (June-July), it is reasonable to guess that several hundred members of the species gathered for spawning in that stream section.

In Johnson and Oak Orchard Creeks, no longear sunfish were caught in this study, and the few historical records for the redfin shiner noted by D. M. Carlson (NYSDEC, pers. comm.) are not shown on Map Series 3 and 4. Therefore, no comparisons of current and historical records can be made for longear sunfish in Johnson and Oak Orchard Creeks. However, redfin shiners appear to persist in the Tonawanda Creek watershed near the mouth of Mud Creek (Map 2o), as well as in one upstream section (Maps 2t-u), and at many sites in Johnson Creek (Maps 3e, 3g, 3i-3k, 3m, 3n). Redfin shiners were not detected at one previously known site in lower Murder Creek near RT 93 (Map 2w).

Figures 1-7, showing the frequency distributions of fish discussed below are in Appendix 11. The most frequently caught species ($\geq$ 5% of sample abundance) in the Tonawanda Creek watershed were bluntnose minnow (*Pimephales notatus*), fathead minnow (*Pimephales promelas*), johnny darter (*Etheostoma nigrum*), striped shiner (*Luxilus chrysocephalus*), western blacknose dace (*Rhinichthys obtusus*), and hornyhead chub (*Nocomis biguttatus*) (92% of all fish; Figure 1, Appendices 10 and 4, and DEC

Fisheries Database). The most frequently caught species in the Johnson Creek watershed were johnny darter, bluntnose minnow, creek chub (*Semotilus atromaculatus*), central stoneroller (*Campostoma anomalum*), emerald shiner (*Notropis atherinoides*), and northern hog sucker (*Hypentelium nigricans*) (93% of all fish; Figure 2, Appendices 10 and 5, and DEC Fisheries Database). The most frequently caught species in the Oak Orchard Creek watershed were common carp (*Cyprinus carpio*), striped shiner, emerald shiner, bluegill (*Lepomis macrochirus*), golden redhorse (*Moxostoma erythrurum*), and logperch (*Percina caprodes*) (96% of all fish; Figure 3, Appendices 10 and 6, and DEC Fisheries Database). However, only lower Oak Orchard Creek and impoundments were sampled, so the most frequent species are skewed toward non-stream fishes not found in the upper reaches of the watershed. Appendix 7 lists species names associated with the DEC code numbers in Appendices 4-6.

The most frequently caught species ($\geq$ 5% of sample abundance) in association with recent and historic catches of longear sunfish (Tables 3 and 5) in the Erie Canal and Ellicott sections of lower Tonawanda Creek (Maps 2l-p) were pumpkinseed, emerald shiner, bluntnose minnow, bluegill, common carp, golden shiner *(Notemigonus chrysoleucas*), largemouth bass (*Micropterus salmoides*), and common carp (95% of all fish; Figure 4). The most frequently caught species in association with redfin shiners in middle Tonawanda Creek (Table 4; Maps 2t-u) were fathead minnow, hornyhead chub, striped shiner, bluntnose minnow, and johnny darter (91% of all fish; Figure 5). The most frequently caught species in association with historical records of longear sunfish (Table 5) and current records of redfin shiners (Table 4) in lower Johnson Creek were emerald shiner, bluntnose minnow, johnny darter rock bass, largemouth bass, yellow perch, green sunfish, and common carp (96% of all fish; Figure 6). The most frequently caught species in association with historical records of longear sunfish (Table 5) in Oak Orchard Creek were striped shiner, bluegill, golden redhorse, common carp, and largemouth bass (96% of all fish; Figure 7). The fish community data at sites where longear sunfish and redfin shiners were found historically and in this study potentially can be used in conjunction with an Index of Biotic Integrity and ratings according to presence of close affiliates of the two species to help identify higher quality sites for restoration efforts.

Objective 3

Describe population characteristics of longear sunfish, and interpret data to determine status of longear sunfish populations in Tonawanda and Johnson Creeks.

No longear sunfish were caught in Johnson Creek, although one was reported near the RT 18 Bridge at Kuckville as recently as 2004 (Table 5). Longear sunfish caught in Tonawanda Creek ranged from 78-148 mm, 10-85 g, and 3-5 years in age, including a New York State record (148 mm, 84.8 g, male). Most of the captured longear sunfish were age 3 and ranged widely in length and weight (Figures 8 and 9); two each, ages 4 and 5, also were caught. Redfin shiners caught in Johnson and Tonawanda Creeks ranged from 47-62 mm and 0.8-2.6 g, and the weight-length relationship for all redfin shiners is shown in Figure 10. The weight-length relationship for longear sunfish is strong but the relationship is weaker for redfin shiner, undoubtedly due to their low weights relative to the accuracy of field weighing.

Sampling in Tonawanda Creek in 2005 provided the second documented record of longear sunfish spawning in New York State. Adams and Hankinson (1928) were the first scientists to do so (Table 5); they captured gravid fish were off of an artificial gravel deposit. Many longear sunfish captured in 2005 appeared to be in spawning condition, and presumably were caught on their spawning grounds. Among the scales collected from longear sunfish in this study, 36% were regenerated. Heavy scale loss, especially during the spawning period, is well known for centrarchids, and longear sunfish are particularly aggressive (see below).

Among eight longear sunfish returned to the laboratory in June 2005, four appeared to be male and four female (at least one pair gravid). The larger males were highly aggressive (chasing, butting, nipping, biting) toward the other fish. After one day, a gravid female was put into a small aquarium with the largest male. The male nipped at the sides of the female as she stayed up in water column. By the following morning the female had deposited eggs on the sandy bottom and the male was fanning them. The female was missing many lateral scales, presumably after abuse by the male during the overnight courtship. After three days, the eight fish were released alive at their sites of capture. Despite aeration and water changes, within a week the embryos were encased in a mass of fungi. Treatment with a dilute solution of formalin might have prevented mortality but we were not prepared for propagation.

Table 5. Credible historical records of northern longear sunfish (*Lepomis megalotis peltastes*) captured in New York State from 1916-2004 (N ~ 114). Numbers caught (No.) were not available for all sites. An *asterisk indicates assumption of at least one individual present per sample. Sizes given represent averages of total length (TL) in mm and wet weight (WT) in g. Distances in statute miles unless stated otherwise. Also see maps 1a; 2d, i, l, o, p, q; 3b, f, g, i, v; 4b, d-h.

Date	No.	WIN	Waterbody, Location	TL	Site Description	Authority[2]
7-25-1916	7	ONT-66-11-P26	Oneida Lake, Brewerton, NY[4]	81 /14	Far west end of Lake near Coville's Landing	T.L. Hankinson
7-25-1916	1	ONT-66-11-P26	Oneida Lake, Brewerton, NY[4]	96 / 25	Milton Pt Bay 1.0 mile northeast of Coville's Landing	T.L. Hankinson
6-01-1939[3]	5	ONT-139	Johnson Creek, Kuckville, NY	125 / 43	1.25 river miles below T2 near RT 67 BR	C.W. Greene, (JR Greenley)
6-02-1939	1*	ONT-139	Johnson Creek, Kuckville, NY	NA	Near RT 18 BR, 0.4 river miles above T1A	C.W. Greene, (JR Greenley)
6-03-1939	5	ONT-139	Johnson Creek, Kuckville, NY[5]	78 / 18	2.5 miles above Kuckville at RT 67 BR	T.T. Odell
6-05-1939	1	ONT-139	Johnson Creek, Kuckville, NY[5]	103 / 35	1.0 mile above Kuckville at Harris Rd BR	T.T. Odell
7-08-1940	2	ONT-139	Johnson Creek, Kuckville, NY[6]	102 / 24	3.0 miles above Kuckville at RT 67 BR	U.B. Stone
7-31-1939	10	ONT-139-1	Jeddo Creek, Middleport, NY[5]	56 / 5	0.5 miles above T9-2 (conflicting records for exact site)	C.W. Greene, (W.M. Lawrence)
7-07-1939	1	ONT-138-P166	Waterport Pond, Waterport, NY[5]	59 / 5	Along shore of point west of Waterport BR	T.T. Odell
7-07-1939	1	ONT-138-P166	Waterport Pond, Waterport, NY[5]	72 / 10	0.75 river miles west of Waterport BR	T.T. Odell
7-07-1939	2	ONT-138-P166	Waterport Pond, Waterport, NY[5]	61 / 6	Along north shore of Reservoir above Waterport Dam	T.T. Odell, (R. Odell)
7-07-1939	4	ONT-138-P166	Waterport Pond, Kenyonville, NY[5]	67 / 8	South shore 1.75 river miles above Kenyonville BR	T.T. Odell, (R. Odell)
7-7-1939	5	ONT-138-P166	Waterport Pond, Waterport, NY[5]	52 / 2	South shore 0.25 river miles below T4	T.T. Odell
7-07-1939	1	ONT-138-P166	Waterport Pond, Waterport, NY	74 / NA	South shore in bay 0.75 river miles above Waterport BR	R. Odell
7-10-1939	7	ONT-138-P166	Waterport Pond, Waterport, NY[5]	72 / 10	East shore 0.75 river miles above Waterport BR	T.T. Odell, (R.W. Odell)
7-14-1939	1*	ONT-138-P166	Waterport Pond, Waterport, NY	NA	Unspecified location in reservoir	T.T. Odell
6-6-1939	1*	ONT-138	Oak Orchard Creek, Carlton, NY	NA	0.1 river mile below T1 (Marsh Creek)	T.T. Odell

7-10-1939	9	ONT-138	Oak Orchard Creek, Carlton, NY[5]	61 / 7	At RT 18 BR near T1 (Marsh Creek)	T.T. Odell
7-10-1939	7	ONT-138	Oak Orchard Creek, Carlton, NY[5]	71 / 9	0.5 miles south of Carlton BR along RT 98	T.T. Odell
7-10-1939	9	ONT-138	Oak Orchard Ck, Pt. Breeze, NY[5]	57 / 4	Along west shore at mouth near Lake Ontario	T.T. Odell
7-10-1939	1	ONT-138	Oak Orchard Ck, Carlton, NY	114 / NA	0.25 river miles above T1 (Marsh Creek)	R. Odell
7-28-1939	7	ONT-138	Oak Orchard Ck, Carlton, NY	NA	Unspecified location in reservoir	W.F. Royce
8-06-1939	1	ONT-138	Oak Orchard Creek, Carlton, NY[5]	108 / 40	At RT 18 BR near T1 (Marsh Creek)	T.T. Odell
8-03-1939	1	ONT-138-1	Marsh Creek, Carlton, NY[5]	72 / 9	1.0 river mile above T1-1 (Beardsley Creek)	U.B. Stone, (E.A. Lachner)
7-20-1939	1*	ONT-P155A	Braddock Bay, Greece, NY	NA	Unknown (assumed near Salmon Creek inlet)	T.T. Odell
7-20-1939	1*	ONT-125-1	West Creek, Parma, NY	NA	At entrance to Braddock Bay (Salmon Creek wetlands)	R.W. Odell
10/11/1974	1	ONT-158-12	Tonawanda Creek, Millersport, NY	NA	Below RT 78 BR at Millersport riffle	W.F. Hadley
8/08/1975	1	ONT-158-12	Tonawanda Creek, Millersport, NY	105 / NA	Below RT 78 BR at Millersport riffle	C.L. Smith
7/06/1988	5	ONT-158-12	Tonawanda Creek, Pendleton, NY	NA	At New Rd BR upstream from Erie Canal	J. Evans
8/16/1988	1	ONT-158-12	Tonawanda Creek, Millersport, NY	64	Large pool below Millersport riffle	D. Bouton
6/20/1990	3	ONT-158-12	Tonawanda Creek, Millersport, NY	88 / 22	1.3 river miles above RT 78 BR near Pipeline Crossing	L.E. Guevara (E & E, Inc.)
6/05/1998	1	ONT-158-12	Tonawanda Creek, Millersport, NY[5]	95 / 21	Below RT 78 BR at Millersport riffle	D.M. Carlson
5/28/1999	1	ONT-158-12	Tonawanda Creek, Millersport, NY[5]	NA	Below RT 78 BR at Millersport riffle	D.M. Carlson
8/10/1999	1	ONT-158-TC	Erie Canal, Pendleton, NY	130	Above confluence with Tonawanda Creek	M. Weimer
8/28/2000	1	ONT-158-12	Tonawanda Creek, Millersport, NY[5]	65 / 6	Below RT 78 BR at Millersport riffle	D.M. Carlson

6/18/2001	1	ONT-158-TC	Erie Canal, Martinsville, NY	114	East of West Canal Marina rear RT 62 BR	M. Weimer, (M. Sowinski)
9/06/2001	1	ONT-158-12	Tonawanda Creek, Millersport, NY[5]	117 / 32	Below RT 78 BR at Millersport riffle	D.M. Carlson
8/29/2002	2	ONT-158-12	Tonawanda Creek, Millersport, NY[5]	105 / 21	Below RT 78 BR at Millersport riffle	D.M. Carlson
8/29/2002	1	ONT-158-12	Tonawanda Creek, Millersport, NY[5]	133 / 47	At mouth of T8 (Mud Creek)	D.M. Carlson
9/09/2003	1	ONT-158-12	Johnson Creek, Kuckville, NY	102 / 24	At RT 18 BR, 0.4 river miles above T1A	D.M. Carlson

All Data were extracted and cross-referenced using the NYSDEC fisheries database archives, early biological survey field notes, and museum specimens. Records of suspected hybrid longear sunfish crosses were included. All other records found for the species were deemed invalid due to: mis-identification; sites out of historic species range; lack of a voucher specimen; and /or lack of credible collecting authority. Other valid records of historic captures may exist elsewhere for the species in NYS. [1]Size data were obtained from preserved museum voucher specimens and fisheries database archives. Standard lengths were converted to total lengths were applicable and figures rounded to the nearest whole number. [2] Authority refers to the supervising scientist reporting survey results. A second name represents an alternate survey authority noted in the archives. [3]Collection date 1-1-1939 changed to 6-1-1939 with assumption of a typographical error. Voucher specimens locations: [4] Roosevelt Museum at SUNY ESF, Syracuse NY; [5]NYS Museum Fish Laboratory, Albany, NY; [6]Cornell U Museum of Vertebrates, Ithaca, NY. Waterport Pond previously known as Carlton Lake is now called Lake Alice. Common abbreviations: WIN = watershed index number; NA = data not available, T = tributary stream, BR = auto bridge, RT = highway route. Table last updated on 3-2-07 by SMW

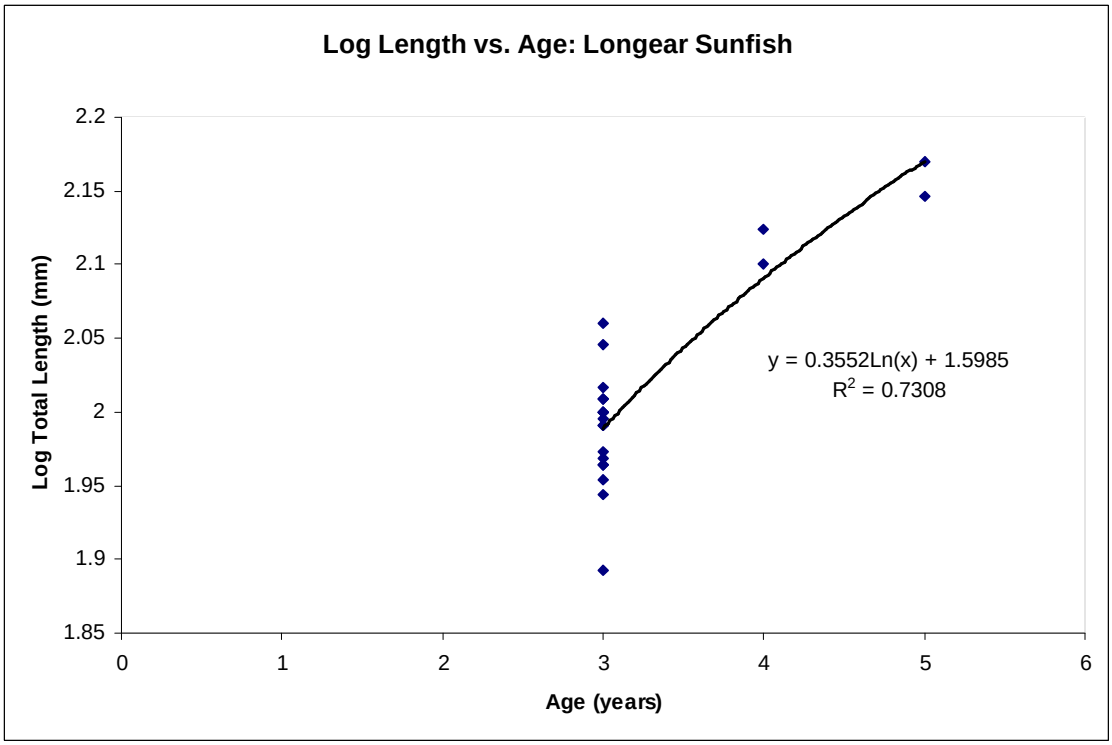

Figure 8. Total length (Log TL) vs. age of longear sunfish in lower Tonawanda Creek in 2005.

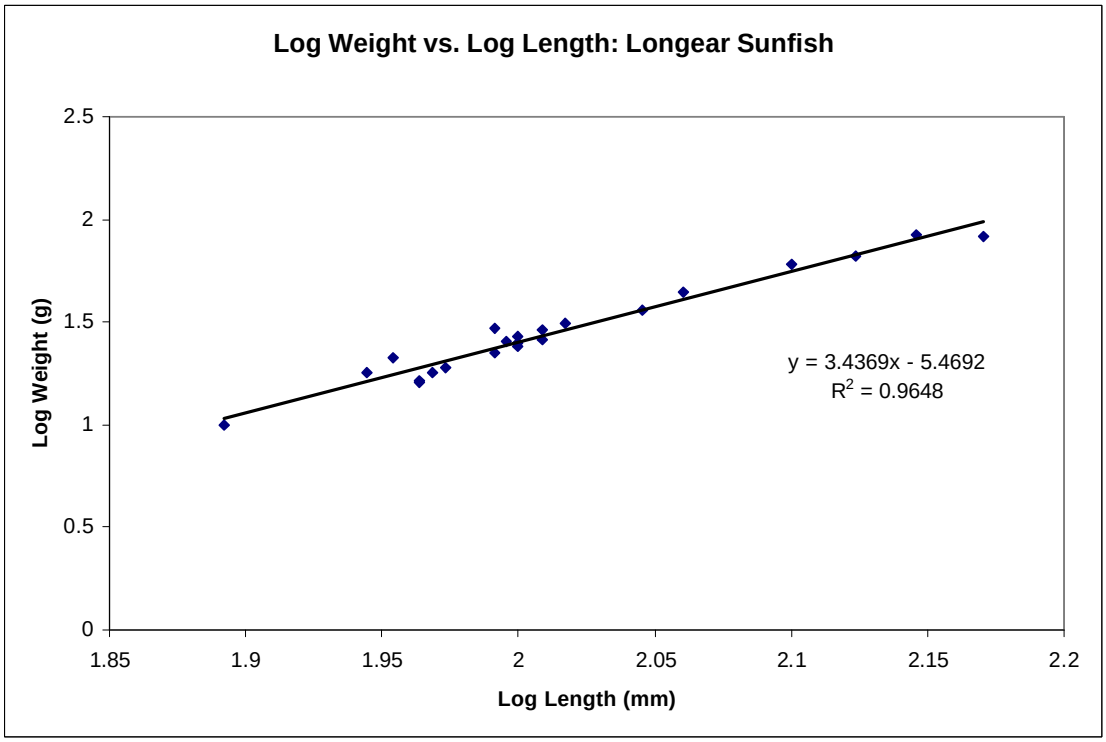

Figure 9. Weight (log W) vs. length (log L) of longear sunfish in lower Tonawanda Creek in 2005.

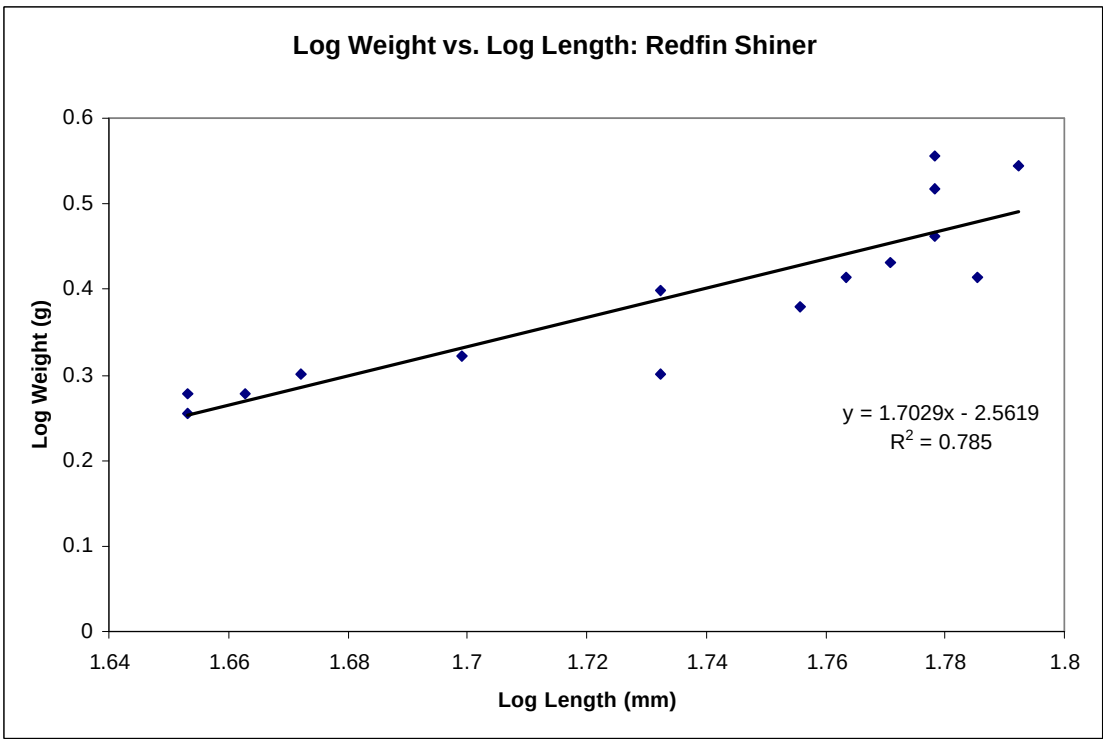

Figure 10. Weight (log W) vs. length (log L) of redfin shiner in Johnson Creek in 2004 and 2005.

Water clarity was so poor in lower Tonawanda Creek that it was impossible to observe centrarchid spawning beds. In addition, no evidence of recruitment was found in this study. No age 1 or age 2 fish (which should have been vulnerable to the sampling methods used) or YOY (not highly vulnerable to the methods used) were caught. Either recruitment did not occur in the two years before the study or younger fish live in habitats that were not sampled. However, no fish younger than age 3 have been caught in Tonawanda Creek (D. M. Carlson, NYSDEC, pers. comm.), so it is likely that inability to capture sub-adult longear sunfish reflects insufficient knowledge of the species' habitat preferences by life history stage. We recommend using bag seines in vegetated backwaters and tributary mouths to search for sub-adult longear sunfish in the future. In addition, sampling at night might improve catches (seining CPUE for brood stock in ponds is 10-15 time higher at night; D. M. Carlson, NYSDEC, pers. comm.)

The identification of YOY *Lepomis* species in the field is also problematic. Trips to Michigan waters by Carlson and Wells in 2005 revealed that YOY longear sunfish, even when abundant, are difficult to distinguish from bluegill and pumpkinseed YOY.

Objective 4

Prepare a management plan and a manuscript for publication in a peer-reviewed journal.

A management plan was drafted and delivered to the NYSDEC in the summer of 2006 when it was decided that the DEC and SUNY Brockport would complete the plan collaboratively (Appendix 8 is the current version). Key recommended actions include:

1. Identify and protect essential habitat at locations where longear sunfish were captured in Tonawanda Creek.
2. Stock longear sunfish fingerlings in Marsh Creek (ONT 138-1) one mile above its mouth at Oak Orchard Creek; Johnson Creek (ONT 139) at Kuckville above RT 18; Cayuga Creek (E-1-5) in Buffalo by Slate Bottom Creek; Oneida Lake (ONT 66-11-P26) near Bridgeport, NY; and in baitfish ponds at the Perch River Wildlife Management Area.
3. Develop a sampling protocol for finding and monitoring longear sunfish in NYS, and collect biological data and estimate relative population abundance of longear sunfish from Tonawanda Creek and other stocked populations at intervals of no less than 5 years. To avoid genetic contamination of native populations, investigators should thoroughly sample all prospective release sites and adjacent areas to confirm the absence of resident longear sunfish before stocking.
4. To address the issue of population similarities and differences, complete a genetic study in 2007 on fin tissue collected in 2005-06 that includes samples from New York (Tonawanda Creek), Michigan, Ohio and Ontario.

Preparation of a manuscript(s) for publication awaits completion of co-author Wells' thesis and a determination if the results are suitable for publication in a peer-reviewed outlet. The most likely publishable outcomes are a note on the current relative to the historic status of the longear sunfish in western New York (based on the full set of project products provided in this report) and an article on statistical models of fish-habitat relationships in the study streams (based on author Wells' thesis and beyond the scope of the original study).

Conclusions and Recommendations

1. Intensive sampling throughout the Tonawanda, Johnson and Oak Orchard Creek watersheds in western New York in 2005 found all but one longear sunfish only in the lowermost 2.3 mi of Tonawanda Creek before it joins the Erie Canal. High priority should be given to protecting fish habitat and water quality in this reach of lower Tonawanda Creek.

2. Many locations (N = 191) with potentially high quality habitat for longear sunfish (small to fine substrate particle sizes and the presence of emergent/submergent vegetation, in-stream wood, and bank cover) were identified and sampled, but very few yielded longear sunfish. Either other factors in the streams studied override preferred habitat features described in the literature or there are many opportunities to reintroduce longear sunfish into western New York State watersheds where they occurred historically.

3. Gravid longear sunfish (ages 3-5) but no YOY or age 1 and 2 fish were caught. It is unknown if this result was due to failed reproduction or recruitment (and an unsustain-able population) or the use of different habitats by adult and non-adult fish during the reproductive season when most sampling occurred. Further attempts should be made to capture longear sunfish younger than age 3, especially in the spring and fall seasons and at locations identified as having potentially high habitat suitability.

4. Redfin shiners were caught in one section of middle Tonawanda Creek and at 11 locations throughout lower Johnson Creek. None were caught in Oak Orchard Creek, but sampling there was limited. Despite suggestions of an association in the literature and previous surveys, no overlap in the distributions of longear sunfish and redfin shiners in lower Tonawanda Creek was found in this study. Analyses of the fish collections with an Index of Biotic Integrity and ratings according to presence of close affiliates of longear sunfish may help to identify higher quality sites for restoration efforts. This activity will be completed by the NYSDEC.

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Maps

Series 1—NYS watersheds with historical records of longear sunfish

Series 2—Tonawanda Creek watershed

Series 3—Johnson Creek watershed

Series 4—Oak Orchard Creek watershed