

Further evaluation of the
lake trout (*Salvelinus namaycush*)
spawning habitat in Otsego Lake

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INTRODUCTION

Since the late 1800s, lake trout populations have been augmented in Otsego Lake, through DEC stocking efforts, in hopes of establishing a self-sustaining fishery (Sanford 1984). While lake trout spawning activity in Otsego Lake has been historically documented (Royce 1943) evidence of such activity in recent years has been sparse, despite investigative efforts (Lord 1999; Lord and Cornwell 2000; Cornwell 2000; 2001). In the fall of 2002, evidence of spawning consisted of the discovery of several eggs at one site seeming to have suitable characteristics.

Lake trout spawning habitat in Lake Ontario and Lake Michigan consists of large cobble substrate with interstitial spaces and little to no organic or silt debris at 4-6 meters depth (Jude et al. 1981; Krueger 1988; Marsden et al. 1988; Marsden 1994; Marsden et al. 1995). Spawning habitat within Otsego Lake, however, consists primarily of clean gravel substrate with small interstitial spaces in less than 1 meter of water. The average catch of fry per trap day (0.94) in Otsego Lake for 2003 (Tibbits 2004) was higher than that reported from Lake Michigan (0.51) and Lake Superior (0.88) but lower than the average catch per effort in m² per trap day reported from Lake Champlain (1.92) (Marsden et al. 1995).

Availability of appropriate spawning habitat may limit successful recruitment in Otsego Lake. Spawning habitat may be reduced due to increasing organic debris and silt deposition within the interstitial spaces where lake trout spawn (Manney et al. 1989; Krueger 1994; Marsden et al. 1995; Fitzsimons 1995). Preliminary SCUBA surveys indicated that a lack of suitable substrate in Otsego Lake may limit successful reproduction to only small, isolated sites (Tibbits 2003). In the spring of 2004 larval traps were used to evaluate lake trout recruitment within Otsego Lake. Subsequent research has indicated successful spawning activity and recruitment at the Bissells Fill site. Further evaluation of this site and three other sites are the focus of this report.

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METHODS

Spawning area identification

Potential spawning areas for 2004 larval recruitment were determined using historical information (Royce 1943), electro-fishing surveys (Cornwell 2001) and the behavior of sonic tagged fish. Electro-fishing was conducted in October of 2002 to estimate walleye (*Sander vitreus*) fall fingerling survival and growth from prior stocking events (Cornwell 2000). A Smith-Root® electro-fishing boat with an external anode and cathode running between 320-500 DC volts at 6-8 amps was used for approximately 32 hours of nighttime effort. Lake trout that spawn near-shore often encounter this electrical field; their presence in these areas was noted as possible spawning sites and time of spawn.

Concurrent with work on larval traps, a behavioral study on lake trout was initiated. Work included inserting acoustic transmitters in six adult trout in September 2002. Tracking their movement in-shore during the fall to a site having suitable substrate provided insight into potential spawning sites. To follow and locate the fish, a small johnboat and a hydrophone (Smith-Root Inc.) and receiver (type TA25™) were used. A Garmin GPS II Plus and an Explorer™ compass were used to identify locations. A triangulation method was used to plot each fish's position in the lake on Delorme 5.0 software. The depth at which each fish was located in was determined by a Polar Vision Strike Master Digital Sonar Depth Finder™. Once potential spawning locations were located, SCUBA surveys were conducted which revealed the presence of several lake trout eggs. This area was subsequently used to investigate the extent of spawning (using egg traps) and recruitment (using fry traps). Egg and fry collections followed methodologies outlined in Tibbits (2003).

Spawning area description

Spawning in Otsego Lake seems to be limited to only small isolated sites centered between Bissells Fill and Five-Mile Point (Figure 1) (Tibbits 2003). One of the identified spawning sites, estimated to encompass 267 m², was located on the west shore, south of Five-Mile Point (W74° 54.163; N42° 45.622) and north of Bissell's Fill (W74° 54.141; N42° 45.550). A total of three sites were chosen between Bissell's Fill and Five-Mile Point using three transects from shore for each site. These sites were approximately of the same dimension as the site identified in 2003 (Tibbits 2003). Each transect was sampled at 3 points, corresponding to near shore, silt line, and bedrock line designations. For each point, substrate depth, type, size, and water depths were evaluated. An experimental fourth site (North of Site 1) was used to determine spawning time and duration. This site was not evaluated for its spawning potential, but rather, the amount of spawning activity.

Much of the substrate at the Bissell's Fill site is artificial fill and largely consists of boulder and stones of various sizes (i.e., rip rap). Substrate type was broken into five categories: silt (fine bedload), gravel (ave. dimensions = 49 x 26 x 23 mm), pebble (ave =

dimensions 68 x 45 x 35 mm), cobble (ave. dimensions = 288 x 172 x 110 mm) and boulder. A visual observation was used to determine an approximate percentage of substrate type, after measurements were taken for each substrate type.

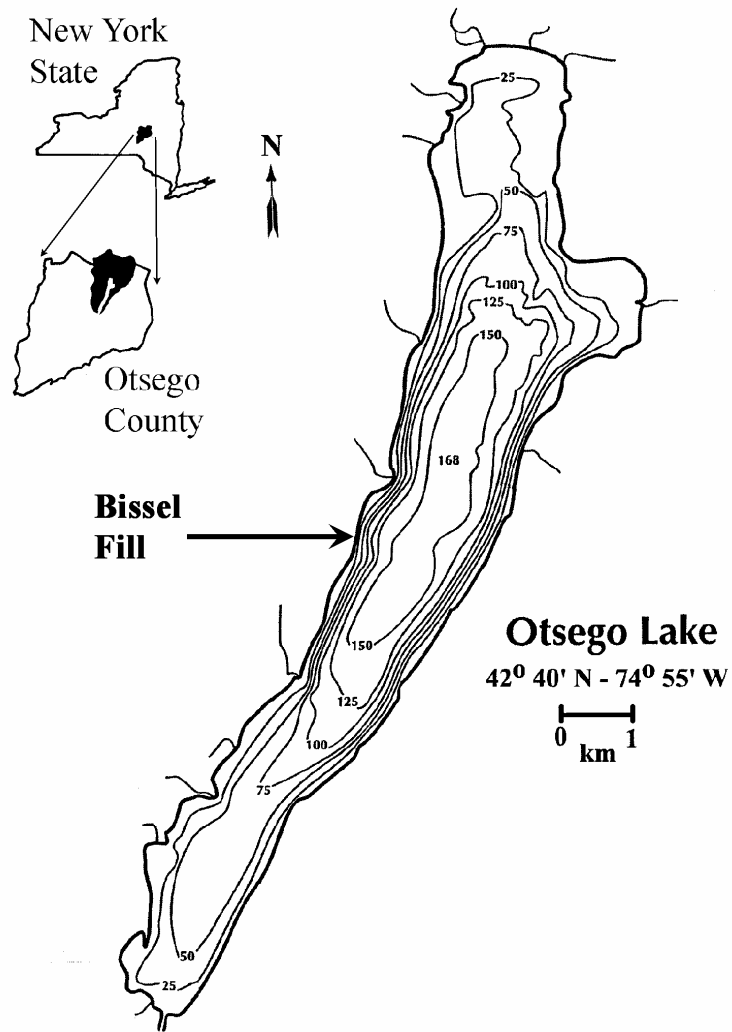


Figure 1. A general location of Bissell Fill indicating spawning areas for the spring and fall of 2004 - 5.

Table 1-3 describe substrate conditions of each study site; highlighted areas indicate the point where the primary spawning activity took place. A relatively flat grade (>5 % slope) from shore leads to a drop off about 100 m from shore, creating a shelf. These shelves are often used as staging areas during pre-spawn and daylight hours during the spawn. Lake trout could be seen at night with a spotting light, spawning in the near-shore area with other lake trout cruising over the shelf. The near-shore area is washed by wave action sweeping planktonic organisms and other decaying organic matter away, making it suitable for lake trout to spawn on.

RESULTS

The mean density of eggs between the sites 1-3 was 527 eggs/m²; assuming that density across the entire spawning area (810/m²) gives a total of 440,000 eggs (Table 4). The majority of these eggs were deposited before November 2, 2004 however, some eggs were found after Dec. 2, 2004 indicating lake trout in Otsego lake will spawn into December.

Fry caught per trap day gave catch per unit effort (CPUE). CPUE divided by 0.21 (trap size in m²) gives fry emergence/m²/day. The total of fry/m²/ day is then multiplied by each trap period or number of days per each trap set to indicate fry/m²/ trap period. This is done since each trap period is not identical. The summation of these catch rates was 110.34 fry/m² for the season. This multiplied by the total area sampled (810m²) results in the total number of fry (90,000) produced that year between sites 1-3 (Figure 5).

Table 1. Site 2, 2003 spawning site descriptions of substrate type, substrate (%), depth and water level for each point at each transect.

Points	Transect 1	Transect 2	Transect 3
Near- shore	32 % gravel	24 % gravel	35 % gravel
Subs. D. = 23 cm	60 % pebble	64 % pebble	55 % pebble
Water D. = 34 cm	5 % cobble	10 % cobble	5 % cobble
	3 % boulder	2 % boulder	5 % boulder
Silt	40 % gravel	60 % gravel	65 % gravel
Subs. D. = 4.5 cm	60 % pebble	35 % pebble	30 % pebble
Water D. = 124.2 cm	Heavily silted	Heavily silted	5 % boulder
			Heavily silted
Bedrock	Silt/bedrock	Silt/bedrock	Silt/bedrock
Depth = N/A	Boulders	Boulders	Boulders

Table 2. Site 2, 2004 spawning site descriptions of substrate type, substrate (%), depth and water level for each point at each transect.

Points	Transect 1	Transect 2	Transect 3
Near- shore	45% gravel	20% gravel	10% gravel
Subs. D. = 24 cm	50% pebble	25% pebble	70% pebble
Water D. = 32.4 cm	5% cobble	30% cobble	10% cobble
	0% boulder	25% boulder	10% boulder
Silt			
Subs. D.= 5 cm	45% gravel	50% gravel	55% gravel
Water D. = 124 cm	55% pebble	50% pebble	45% pebble
	silt	silt	silt
Bedrock			
Depth = N/A	silt	silt	silt

Table 3. Site 3, 2004 spawning site descriptions of substrate type, substrate (%), depth and water level for each point at each transect.

Points	Transect 1	Transect 2	Transect 3
Near- shore	8% gravel	13% gravel	15% gravel
Subs. D. = 31.5 cm	22% pebble	8% pebble	60% pebble
Water D. = 25 cm	40% cobble	54% cobble	10% cobble
	30% boulder	25% boulder	15% boulder
Silt			
Depth = 4.8 cm	40% gravel	35% gravel	50% gravel
Water D. = 116 cm	60% pebble	65% pebble	50% pebble
	silt	silt	silt
Bedrock			
Depth = N/A	silt	silt	silt

Table 4. Lake trout egg densities for the Bissell Fill sites 1-3 and experimental site 4.

Test Site	# eggs	# traps	Eggs / trap	Eggs / m²	Eggs / site
1	87	2	43.5	621	165807
2	118	3	39.3	561	149787
3	85	3	28	400	106800
4) Nov 2	291	2	146	2085	16685
4) Dec. 2	7	2	4	57	457
Total				4000	440,000

Table 5. 2004 Lake trout larval catch rates by site in CPUE and fry per trap day in meters².

Site 1	Total # traps	Total # Fry	CPUE	meters sq.	fry/m ² /trap day
4/23/2004	4	4	0.166	0.793	4.758
4/30/2004	4	5	0.179	0.851	5.957
5/08/2004	4	10	0.313	1.488	11.904
5/15/2004	4	10	0.357	1.701	11.907
5/21/2004	4	0	0	0	0
Site 2					
4/23/2004	4	0	0	0	0
4/30/2004	4	1	0.036	0.17	1.19
5/08/2004	4	7	0.219	1.042	8.336
5/15/2004	4	3	0.107	0.51	3.57
5/21/2004	4	0	0	0	0
Site 3					
4/23/2004	4	0	0	0	0
4/30/2004	4	2	0.071	0.34	2.38
5/08/2004	4	0	0	0	0
5/15/2004	4	1	0.036	0.17	1.19
5/21/2004	4	0	0	0	0
Site 4					
4/23/2004	2	4	0.333	1.587	9.522
4/30/2004	2	5	0.357	1.701	11.907
5/08/2004	2	13	0.813	3.869	42.559
5/15/2004	2	3	0.214	1.02	7.14
5/21/2004	2	0	0	0	0

DISCUSSION

Lake trout spawning was documented in 2003 when eggs were recovered from Bissell Fill north to Six Mile Point, establishing lake trout spawning success for the first time since the early 1950's. An active lake trout spawning site is usually found on clean cobble substrate with little to no siltation in 5-6m of water (Manney et al. 1989; Marsden and Krueger 1991; Perkins and Krueger 1994; Marsden et al. 1995; Michael et al. 1995). Otsego Lake lake trout eggs were found in as little as 30 cm to 1 meter depths having stone-pebble size substrate having little siltation. Below a meter in water depth, the substrate is silted with virtually all interstices were filled with organic and/or inorganic matter. These are very shallow water depths and substrate size is small compared to that of some the Great lakes lake trout spawning sites (Jude 1981; Marsden et al. 1988; Marsden 1994; Perkins and Krueger 1994; Marsden et al. 1995).

While stocking occurs annually, Otsego Lake lake trout population is believed to be enhanced through natural reproduction each year. Overall, lake trout recruitment rates

in Otsego Lake are comparable to many of the Great Lake's lake trout recruitment rates. The State of New York stocks approximately 5,000 8-10" lake trout into Otsego Lake annually. The 2002 New York DEC Region IV bi-annual lake trout gill net survey indicated a 3:1 ratio of wild to stocked lake trout within Otsego Lake; this is similar to the proportion of non-clipped (wild) lake trout vs. those clipped, as reported in recent angler diary programs (McBride 2005). That would imply that approximately 15,000 wild lake trout are recruited to age 1 annually. If spawning is limited to the three sites studied thus far, and the estimate of 90,000 fry emerging annually is accurate, then this would imply a 15+% survival rate to year 1. That rate would drop, however, if the spawning areas encompassed greater areas reported here, or if additional sites existed around Otsego Lake.

Gravel and pebble size substrate made up 90 % of the suitable lake trout spawning habitat (Table 1-3). Lake trout do not protect their eggs and therefore rely on these interstitial spaces between rocks for the eggs to fall into and be protected from most egg predators. Spawning on relatively small substrate in less than 0.5 meter of water is not typical for lake trout and may suggest that there is a paucity of spawning habitat within Otsego Lake. Egg predation can be very significant in areas of high predator densities (Marsden 1994; Perkins and Krueger 1994; Marsden et al. 1995). However, what about areas of low predator numbers but little substrate protection? Does this scenario allow for higher consumption of eggs by fewer predators because of easy availability? Noted in 2004, several common carp (*cyprinus carpio*) were found feeding in the spawning sites in the shallows during day light hours. Some of the other possible egg predators in Otsego Lake include crayfish, slimy sculpins, alewives and darters. Furthermore, if the eggs are not being protected by the substrate, then are the eggs being swept away by currents and deposited elsewhere, possibly in heavily silted areas? These scenarios have not been evaluated, though intuitively, given the substrate size and depths, both seem likely.

Consideration must be given to the potential for over-winter egg mortality due to ice scouring and fluctuating lake levels. Larger lakes tend to have higher degrees of scouring as ice expands over the course of the winter. Otsego Lake typically encounters displacement of near-shore substrate due to ice scouring at distances of greater than 2 meters from the shores edge. Typical winter ice depths have been recorded to be as high as 46+ cm; lake trout spawning sites for 2003 were recorded to be in as little as 30 cm. Prior to the onset of spring runoff, the lake level is typically lowered to reduce the risk of flooding. Typical lake levels are adjusted from year to year, conditional with winter snow levels. On 15 October 2002 (approximate date of spawning) Otsego Lake levels were up 11 cm, providing increased littoral areas on which to spawn. However, as of January 14, 2003 Otsego Lake was down 4 cm for a total loss of 15 cm of water depth from 15 October 2002. Therefore, the potential for land locked eggs and/or an ice-scouring event to occur over the critical lake trout spawning habitat is likely.

Suggestions to enhance this shoreline through artificial substrate or cleaning the natural substrate may improve the existing habitat and create more suitable spawning habitat. Lake trout will often use artificial substrate if native habitat is removed or not

suitable as recognized by the fish (Marsden et al. 1995). Larger substrate size will also allow for better egg and larval protection. The protection of adult lake trout could be sought through management regulations such as a closing of the fishing season during the reproductive months (October- December).

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