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RESEARCH COMPLETION REPORT *

IDENTIFICATION OF THE SOURCES AND AMOUNT OF LAKE TROUT EGG AND FRY MORTALITY ON A REEF IN LAKE ONTARIO

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Identification of the Sources and Amount of Lake Trout Egg and Fry Mortality on a Reef in Lake Ontario

Final Report to the Great Lakes Fishery Commission

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INTRODUCTION

The research described in this report is focussed on the estimation of mortality rates of eggs and pre-emergent lake trout fry in Lake Ontario, and the biotic causes of mortality. We concentrated our research on a reef north of Stony Island where lake trout fry have been captured in previous years. Our specific research objectives were as follows:

1. To quantify the mortality of lake trout eggs and fry through swim-up on a single reef in Lake Ontario.
2. To estimate the proportion of pre-emergent fry mortality caused by predation.
3. To identify the major predators of lake trout eggs and fry.

METHODS

Two types of egg collectors were deployed on Stony Island reef in the fall of 1987 to quantify egg deposition and to determine whether lake trout select substrate types on which to spawn. (1) Four lines of 25 plastic pans, approximately 21x33x5cm deep and 3.3m apart, were set into the substrate by divers and filled with substrate material. The pans were designed to passively collect lake trout eggs during spawning, then be retrieved by divers after the end of spawning. The lines of pans were set on four types of substrate ranging from sand to large cobble; one transect crossed the area where fry were found in 1986. (2) Four lines of 25 egg nets each were deployed adjacent to the lines of pans. The nets consist of an 20cm diameter ring with a net cone attached to it; the nets are deployed from the surface in gangs, and recovered from the surface (Horns et al. in prep.).

To measure over-winter egg mortality, we used egg pails described by Stuaffer (1981). Forty-five pails were set into the substrate and filled with substrate material, then capped with mesh lids. Each trap was seeded with 100 lake trout eggs from Allegheny hatchery on 4 November. Pails were set into two different substrate types in order to examine differences in egg survival between substrate types. By removing covers from half of the pails after the end of spawning, we could assess egg loss due to predation versus egg loss due to other causes.

We also conducted gill netting and trawling around Stony Island reef in the spring of 1988 to capture potential predators of lake trout fry. We set horizontal gill nets on the reef on 5/17/88 and 5/23/88, when we knew emergent fry were present

on the reef. We used two gangs of monofilament nets with 100' of 1.5" stretch mesh and 100' 1" stretch mesh, and a single 100' multifilament net with 0.75" stretch mesh. All three gangs were set in a NE-SW direction across the spawning reef in 12-36' depth. The nets were set just before sunset, and lifted 1.5 - 2 hours later. All fish captured were preserved immediately in formalin for later stomach content analysis. On 5/17/88 and 5/23/88 we trawled around Stony Island reef using a 16' otter trawl with a 1/2" stretch mesh cod end liner. Large fish captured with the trawl were cut open immediately for stomach content examination. The contents of the trawl were also examined for lake trout fry.

RESULTS

Severe winter weather conditions on Lake Ontario resulted in the loss or destruction of most of our sampling equipment. All of the egg collection pans were pulled out of the substrate before spawning began. Several pail traps were damaged or lost by the end of the spawning period. Due to winter storms we were unable to remove the pail covers at the end of lake trout spawning. Only three intact pails were recovered in the spring of 1988; many of the remaining pails were found in deep water off the edge of the reef. Of the pails we recovered, one pail contained two dead sac fry, and one contained a single dead sac fry. All three pails contained an indefinite number of dead eggs and pieces of eggs covered with fungus.

The egg nets were frequently overturned during storms, and one transect was lost. In the three transects which were recovered successfully, plus three loose egg nets recovered by divers, we captured 2145 eggs (Table 1). One thousand and eight of the eggs captured in these nets were placed in a hatchery at Cornell University; 548 eggs survived to eye-up, and 520 hatched (52% of the eggs placed in the hatchery).

We captured 153 fish in gill nets, of which the majority were alewives (Table 2). No fish of any species were found in their stomachs. A single smallmouth bass was captured using the trawl; there were no fry or eggs in its stomach. No lake trout fry were captured using the trawl; however, two dead eggs (possibly lake trout) were recovered in the trawl.

DISCUSSION

Egg deposition

We successfully captured lake trout eggs during spawning using an experimental egg net design (Horns et al. in prep.). This technique, with modifications, will provide an inexpensive and simple method for assessment of spawning activity. However, our results also indicated that methods which have been used successfully to capture and incubate lake trout eggs on deep or protected reefs in the other Great Lakes are not suitable for use on the shallow, exposed reef off Stony Island. The density of eggs captured using egg nets ranged from 0 - 10,605 eggs/m^2 (Table 1). Because the nets protect eggs from predation and drifting due to currents, these deposition estimates are probably higher than historical estimates of eggs counted in the substrate. Results from our egg captures also suggest that lake trout deposit their eggs non-randomly with respect to substrate type. Approximately 93% of the eggs captured were spawned on large cobble (15-22cm diameter) with deep interstices (Figure 1). Only three eggs were captured on

sandy substrate. Divers noted large numbers of eggs under large rocks and jammed into crevices between rocks in areas of large substrate. Few eggs were noted in areas of gravel, and none were observed on sand.

In the fall of 1988 we initiated new research to further investigate substrate specificity of spawning by lake trout (funded by GLFC). To avoid the problem of nets being turning upside-down in storms, we are also developing and testing a new egg net design.

Egg predation

We did not find evidence of predation on fry. We were unable to collect data on egg loss from egg pails, due to destruction of most of the pails. There was no evidence of egg predation by any of the species captured by gill netting (Table 2). However, a large number of alewives were documented to occur over the reef in the spring in the exact area where fry were being captured. The potential exists that alewife may be a predator of emergent lake trout fry.

Divers' observations during the spawning period suggest that lake trout eggs on unprotected substrate (sand, shallow gravel) are highly susceptible to movement by currents. Such drifting is a potential source of high egg mortality through physical abrasion or predation. In addition, large numbers of sculpins were seen in areas of high egg concentrations. We captured a sculpin in a fry trap in April, 1988, which had a lake trout fry in its stomach.

Egg mortality

Our work in 1987-88 clearly indicates that we need to develop new techniques to study egg mortality on shallow reefs. One method which appears to be viable is the egg incubator used by Eshenroder in Lake Superior (Eshenroder et al. 1988). We are currently doing a small pilot study to test these incubators on Stony Island reef.

LITERATURE CITED

Eshenroder, R. L. (ed) 1988. A proposal for a bioassay procedure to assess impact of habitat conditions on lake trout reproduction in the Great Lakes. Great Lakes Fishery Commission special publication 88-1.

Horns, W. W., J. E. Marsden, and C. C. Krueger. in prep. An inexpensive method for quantitative assessment of lake trout egg deposition in the Great Lakes. Submitted to the North American Journal of Fisheries Management.

Stauffer, T. M. 1981. Collecting gear for lake trout eggs and fry. Prog. Fish-Cult. 43:186-193.

Table 1. Lake trout eggs collected in egg nets on Stony Island reef in 1987.

Date nets set	Date nets lifted	Substrate type	# Nets	Total eggs[a]	# Live eggs[b]	Max. eggs/net
10/13	11/13	cobble	24	261	129	71
10/13	11/13	sand, silt	21	3	0	1
11/13	11/24	cobble	23	1830	1023	333

[a]An additional 3 nets which had become detached from their lines were recovered on 11/10/87 on sandy substrate. The nets contained 12, 14, and 25 eggs respectively.
[b]live eggs = eggs which were alive when the egg nets were opened, approximately six hours after removal from the lake.

Table 2. Fish captured in gill nets on Stony Island reef in spring, 1988.

Date	Gill net mesh	Alewife	Trout perch	Yellow perch	Spottail shiner	Rock bass	Total
5/17/88	1"+1.5"	5					5
	1"+1.5"	49	5	1	2		57
	1"+1.5"	26	3		3		31
	.75"	20		1			21
Total		**100**	**8**	**2**	**5**	**0**	**114**
5/23/88	1"+1.5"	4	4	1	3		12
	1"+1.5"	1	3	3			7
	.75"	18	1			1	20
Total		**23**	**8**	**4**	**3**	**1**	**39**
Grand Total		**123**	**16**	**6**	**8**	**1**	**153**
Av. length		**15.6**	**11.4**	**14.8**	**11.3**	**15.6**	
S.D.		**2.1**	**0.9**	**1.5**	**0.5**	**0.0**	

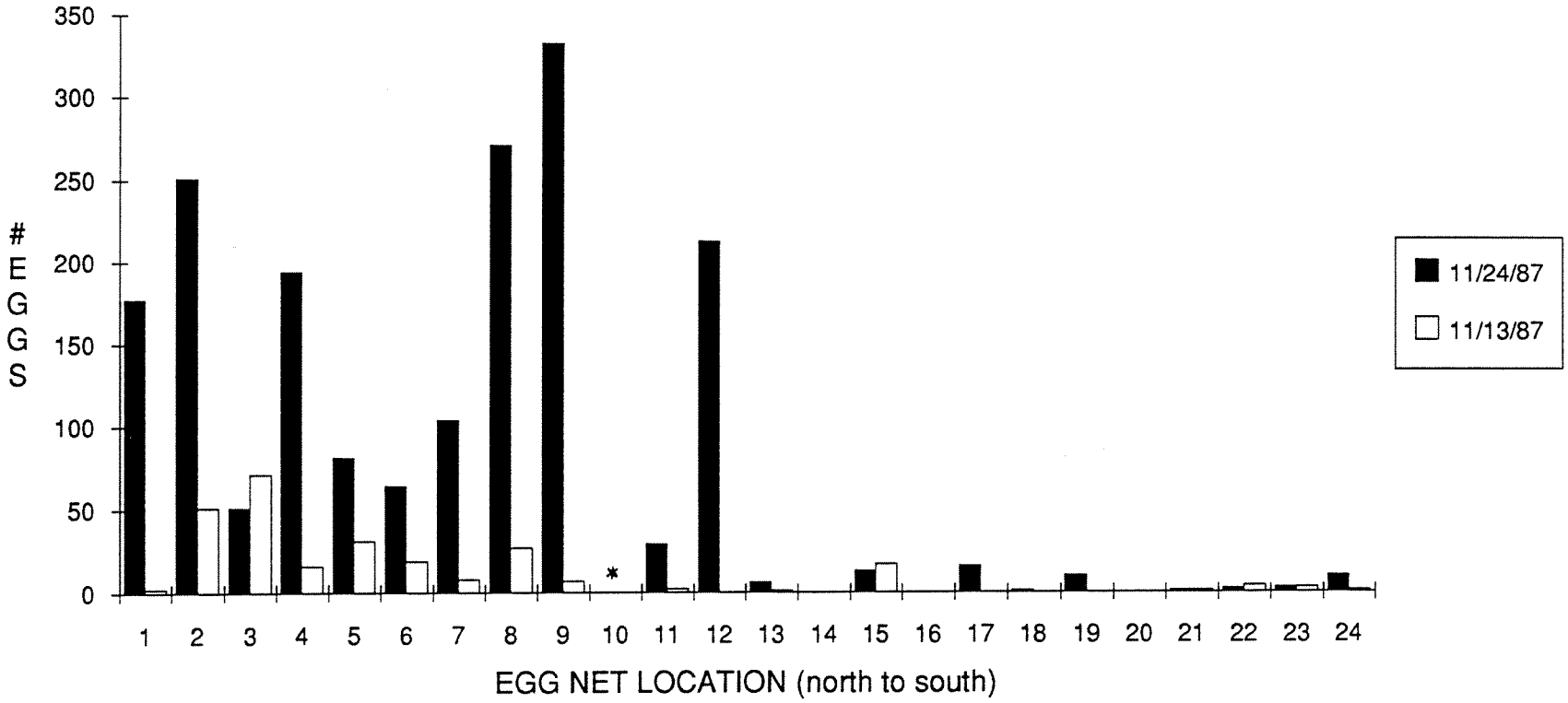

Figure 1. Lake trout eggs captured on Stony Island reef, Lake Ontario, 1987. Substrate under the northern half of the transect was large cobble; the southern half (approximately from net #13) was small gravel. * indicates a lost net on the 11/24/88 lift.