1864

Fish Predation on Lake Trout Eggs and Fry in the Great Lakes, 1973-1978

Thomas M. Stauffer
and
Wilbert C. Wagner

Fisheries Research Report No. 1864
February 22, 1979

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

Fisheries Research Report No. 1864

February 22, 1979

FISH PREDATION ON LAKE TROUT EGGS AND FRY IN THE GREAT LAKES, 1973-1978[1]

By Thomas M. Stauffer and Wilbert C. Wagner

Abstract

During lake trout spawning predation on eggs was very light. Round whitefish (745) and burbot (20) contained 1 and 29 lake trout eggs per fish, respectively, but there was less than 0.1 egg per stomach in lake trout (821), longnose suckers (456), lake chubs (103), white suckers (37), and lake whitefish (24). The apparent scarcity of fish other than lake trout in multisized mesh gill nets at spawning time also suggested that predation was light. Sculpins ate a few eggs in the 1- to 3-week period after lake trout spawning. In contrast to predation on naturally deposited eggs, predation on artificially deposited eggs was severe, at least during the 24-hour period after deposition. In these collections lake trout (8) contained 515 eggs per fish, round whitefish (41) 44, and longnose suckers (9) 16. Alewives (49) did not contain eggs.

Predation on fry was practically nil while they were on a spawning reef and while they migrated away from the reef during May-July. Although burbot (97) contained 0.2 fry per stomach, the number of fry per stomach was less than 0.02 for mottled sculpins (796), slimy sculpins (669), yellow perch (188), round whitefish (110), trout-perch (106), coho salmon (65), and rainbow smelt (49).

---

[1] Contribution from Dingell-Johnson Projects F-31-R and F-35-R, Michigan.

Introduction

Large numbers of planted lake trout (see Table 1 for scientific names) have survived to maturity and spawned in the Great Lakes, yet survival of naturally reproduced trout has been low to nonexistent (Great Lakes Fishery Commission 1976). Various theories have been advanced to explain the lack of survival. These include: (1) failure of spawners to find traditional spawning reefs where young will survive, (2) mortality due to contaminants such as DDT and PCB's, (3) eutrophication effects, and (4) piscine predation on eggs and fry. The objective of this report is to determine the amount of piscine predation on lake trout eggs and fry in the Great Lakes.

Prior studies of predation on lake trout eggs have been limited mostly to small lakes. Martin (1956), DeRoche (1969), Prevost (1956), and Royce (1951) indicated that brown bullheads and/or white suckers were the principal predators on eggs in the fall. One or more of the above authors also mentioned lake whitefish, lake trout, round whitefish, golden shiners, and yellow perch as egg predators. Hacker (1956) found that an amphibian (Necturus sp.) and yellow perch preyed heavily on lake trout eggs. In Lake Superior, Dryer and King (1968) examined "several hundred" stomachs of longnose suckers, lake herring, round whitefish, burbot, and lake chubs that were caught on lake trout spawning reefs, but only one lake trout egg was found--in a longnose sucker. We could find no prior studies of predation on lake trout fry.

Methods

We collected potential egg predators from spawning reefs in Lakes Superior and Michigan during lake trout spawning in the falls of 1973-1975. Gill nets of 4-15 cm (stretch measure) mesh were set one day and lifted the next. Limited sampling in Presque Isle Harbor, Marquette, with 6-cm mesh gill nets, during spawning in 1977 and 1978, provided a few additional samples. Shortly after spawning in the falls of 1977 and 1978, we collected mottled and slimy sculpins with:

(1) egg pails set in the substrate to sample lake trout egg deposition, (2) standard minnow traps, and (3) a 1.2-m beam trawl used in daylight hours. Also in 1974, 1976, and 1977 in the fall, we collected potential egg predators with 2- to 11-cm mesh gill nets from reefs where, on the preceding day, eyed or green lake trout eggs had been broadcast over the reef at a rate of 80-540 per square meter.

Potential fry predators were sampled in Presque Isle Harbor, in April-July, 1976-1978. Lake trout fry were abundant during the sampling periods. In 1976, three fry traps (Collins 1975) caught 106 fry in 29 days. In 1977, six traps caught 134 fry in 26 days. In 1978, an estimated 134,000 ± 63,000 fry were produced on UPPCO Reef which was the principal source of fry in all years. The locations of the collection sites for potential predators are described in Table 2 in terms of their distance from UPPCO Reef. Potential predators were collected with: (1) a 5-m otter trawl used mostly at night, (2) a 1.2-m beam trawl used in daylight and at night, (3) fry traps, and (4) standard minnow traps. Fry traps were fished for several weeks before they were lifted while minnow traps were fished overnight (1976) or for several days before lifting (1978). Frequently, in both types of traps, lake trout fry were trapped along with potential predators which no doubt increased the probability of predation.

Small potential predators caught in the various types of gear were preserved whole in 10% formalin and stomachs of larger fish were removed before preservation. The stomachs were examined in the laboratory to determine the number of eggs and fry eaten.

Results

Of the potential predators collected during lake trout spawning, burbot, round whitefish, adult lake trout, longnose suckers, and white suckers had eaten lake trout eggs (Table 3). The average number of eggs per fish stomach was 29 for burbot, 1 for round whitefish and less than 0.1 for longnose suckers, lake trout, and white suckers. Lake chubs and lake whitefish contained no eggs. Sculpins, collected after lake trout

spawning, preyed on lake trout eggs (Table 4). The average number of eggs per stomach was two for mottled sculpins and one for slimy sculpins. Egg predation on the reefs seeded with lake trout eggs was much more severe (Table 5). Round whitefish were again the principal culprits on the reefs; they were present on most reefs and contained an average of 44 eggs each. Lake trout, although not numerous, had an average of 515 eggs per fish. Longnose suckers contained an average of 16 eggs per fish. Alewives, although relatively abundant, did not ingest any eggs.

Burbot were the major predators on lake trout fry in Presque Isle Harbor, but they averaged only 0.2 fry per fish (Tables 6 and 7). Yellow perch and both species of sculpins ate a few fry but fry were not preyed upon by round whitefish, trout-perch, rainbow smelt, or coho salmon.

Discussion

Predation on naturally deposited lake trout eggs was light. The only fish that ate appreciable numbers of eggs were burbot, round whitefish, and sculpins. We believe that naturally spawned eggs are deposited in areas where they settle into crevices which afford protection from most predators. Also suggesting that predation was light on natural spawning areas was the apparent scarcity of egg predators at spawning time. For example, on Lake Superior reefs the average catch of 19 overnight sets of a 364-m gill net (91 m each of 4-, 6-, 11-, and 15-cm mesh) in 1973-1975, was only 28 round whitefish, 24 longnose suckers, 5 lake chubs, 1 white sucker, 1 lake whitefish, and 2 fish of other species. Further, 41 and 46 one-hour sets of a gill net (30 × 2 m, 6-cm mesh) during lake trout spawning on UPPCO Reef in 1977 and 1978, caught only 31 and 53 fish, respectively, that were not lake trout.

In contrast, predation was severe on artificially deposited eggs. Round whitefish, lake trout, and longnose suckers ate appreciable numbers of eggs. Observations by divers indicated that many artificially deposited eggs lay exposed on the top of the substrate where they were quite vulnerable to predation.

There was very little predation on fry in Presque Isle Harbor. Predation occurred only in May and June at stations on or very near UPPCO

Reef. Fry in May and early June were smaller (26-30 mm) than in late June and July (34-43 mm) and presumably were less able to escape predation than the larger and more mobile fry. Also, fry probably were more abundant and more available to predators on or near UPPCO Reef than at stations away from the reef.

Table 1.--Common and scientific names of fishes in this report.

Common name	Scientific name
Alewife	Alosa pseudoharengus
Lake herring	Coregonus artedii
Lake whitefish	Coregonus clupeaformis
Coho salmon	Oncorhynchus kisutch
Chinook salmon	Oncorhynchus tshawytscha
Round whitefish	Prosopium cylindraceum
Rainbow trout	Salmo gairdneri
Brown trout	Salmo trutta
Brook trout	Salvelinus fontinalis
Lake trout	Salvelinus namaycush
Splake	Salvelinus fontinalis × S. namaycush
Rainbow smelt	Osmerus mordax
Northern pike	Esox lucius
Lake chub	Couesius plumbeus
Golden shiner	Notemigonus crysoleucas
Spottail shiner	Notropis hudsonius
Longnose sucker	Catostomus catostomus
White sucker	Catostomus commersoni
Brown bullhead	Ictalurus nebulosus
Trout-perch	Percopsis omiscomaycus
Burbot	Lota lota
Yellow perch	Perca flavescens
Walleye	Stizostedion vitreum vitreum
Mottled sculpin	Cottus bairdi
Slimy sculpin	Cottus cognatus

Table 2.--Location, depth and bottom type of predator collection stations, Presque Isle Harbor and vicinity, Lake Superior.

Station	Location and distance (m) from UPPCO Reef	Depth (m)	Bottom type
UPPCO Reef	. . .	1-9	Rock-rubble
UPPCO Discharge	Southeast and south (30-420)	1-9	Crushed rock
1	Across outer end of UPPCO Reef (0-305)	3-7	Mostly sand, except on UPPCO Reef
2	Off end of ore dock (366-610)	9-12	Mostly rock-rubble with mud and woody debris
3	Off end of UPPCO Reef (0-549)	4-12	Sand, woody debris, mud and rock-rubble
4	South of UPPCO Reef along shore (610-1220)	3-6	Mostly sand, some large gravel
6	Marina mouth and south (255-549)	3-11	Rock-rubble, sand, mud and woody debris
7	South of UPPCO Reef, along shore (1525-2135)	4-7	Sand
8	South of UPPCO Reef, along shore (2440-3050)	2-7	Sand

Table 3.--Number of lake trout eggs eaten by fish (number examined in parentheses) collected on reefs when lake trout were spawning, Lakes Superior and Michigan, 1973-1978.

Lake and year (number of reefs)	Species and range in length (cm)					
	Lake trout[a] (20-95)	Round whitefish (20-48)	Longnose sucker (12-50)	White sucker (25-50)	Burbot (14-64)	Miscellaneous[b]
Lake Superior						
1973 (2)	16 (66)	50 (110)	1 (17)	0 (1)	0 (4)	0 (24)
1974 (8)	2 (361)	1 (128)	0 (233)	0 (6)	0 (4)	0 (38)
1975 (7)	1 (313)	1 (303)	20 (205)	0 (17)	0 (5)	0 (70)
1977 (2)		209 (17)		1 (6)	275 (2)	0 (1)
1978 (2)		665 (26)		0 (1)	297 (5)	0 (1)
Lake Michigan						
1973 (2)	4 (59)	0 (42)		0 (2)		0 (10)
1974 (1)	0 (10)	2 (54)		0 (2)		0 (8)
1975 (1)	0 (12)	0 (65)	0 (1)	0 (1)		0 (5)
Grand total	23 (821)	729 (745)	21 (456)	1 (37)	572 (20)	0 (157)

[a] Spawners plus a few immature trout.

[b] Lake chub, 103; lake whitefish, 24; rainbow smelt, 6; walleye, 5; lake herring, 4; alewife, 4; coho salmon, 3; brown trout, 5; rainbow trout, 1; brook trout, 1; chinook salmon, 1.

Table 4.--Number of eggs eaten by sculpins (5-11 cm, total length) collected in Presque Isle Harbor in November-December, after completion of lake trout spawning, 1977-1978.

Species	Gear, location, and year					Total
	Egg pails		Minnow traps		Beam trawl	
	UPPCO Reef 1977	UPPCO Reef 1978	UPPCO Reef 1978	UPPCO Discharge 1978	UPPCO Discharge 1978	
Mottled sculpin						
Number of eggs		15	8	5	6	34
Number examined		6	3	5	7	21
Slimy sculpin						
Number of eggs		19	0		15	34
Number examined		9	1		18	28
Unidentified sculpins						
Number of eggs	14					14
Number examined	4					4

Table 5.--Number of eggs eaten by fish collected from reefs during a 24-hour period after green or eyed lake trout eggs had been planted on the reefs, Lakes Michigan and Huron, 1974, 1976, and 1977.

Lake, reef, and species examined	Fish examined			Number of eggs eaten
	Length range (cm)	Number	Percentage with eggs	
Lake Michigan				
Irishman Ground				
Round whitefish		13	38	423
Alewife	16-20	7	0	0
Rainbow smelt	14	1	0	0
Lake Huron				
R-4				
Lake herring	30-41	4	0	0
Northern pike	69	1	0	0
Jamsen				
Spottail shiner	9-10	2	0	0
Burbot	22	1	0	0
Williams				
Round whitefish	28-40	18	56	580
Lake herring	30-39	5	0	0
Splake	62	1	100	4
White sucker	42	1	0	0
Northern pike	91	1	0	0
Pomeroy				
Alewife	14-19	42	0	0
Round whitefish	31-43	10	80	821
Longnose sucker	36-45	9	33	145
Lake trout	51-66	8	38	4117
Lake chub	14-15	3	67	29
Burbot	60	1	100	4

Table 6.--Number of lake trout fry eaten by fish (number examined in parentheses) caught with an otter trawl in Presque Isle Harbor, Lake Superior, 1976.

Stations, and dates of collections	Species and size range (cm)						
	Mottled sculpins (5-12)	Slimy sculpins (5-11)	Yellow perch (3-21)	Round whitefish (11-34)	Trout-perch (4-11)	Burbot (6-43)	Miscellaneous[a] (7-18)
Stations 1, 3							
6-31 May	0 (77)	0 (38)	0 (38)	0 (4)		11 (6)	0 (4)
1-30 June	4 (199)	1 (126)	2 (56)	0 (16)	0 (8)	8 (21)	0 (5)
1-13 July	0 (137)	0 (50)	0 (7)		0 (5)	0 (19)	0 (1)
Stations 2, 6							
6-31 May	0 (17)	0 (52)	0 (14)	0 (30)		0 (3)	0 (53)
1-30 June	0 (117)	0 (109)	0 (30)	0 (21)	0 (19)	0 (13)	0 (7)
1-13 July	0 (35)	0 (44)	0 (39)	0 (1)	0 (18)	0 (6)	0 (1)
Stations 4, 7, 8							
17-31 May	0 (1)	0 (22)	0 (1)	0 (21)	0 (1)		0 (2)
1-30 June	0 (17)	0 (104)		0 (15)	0 (24)	0 (2)	0 (38)
1-21 July	0 (8)	0 (40)		0 (2)	0 (30)	0 (1)	0 (3)
Total	4 (608)	1 (585)	2 (185)	0 (110)	0 (105)	19 (71)	0 (114)

[a] Coho salmon, 65; rainbow smelt, 49.

Table 7.--Number of lake trout fry eaten by fish (number examined in parentheses) caught in a trawl and traps in Presque Isle Harbor, Lake Superior, 1976-1978.

Gear, location, and dates	Species and size range (cm)				
	Sculpins			Burbot	Other[a]
	Mottled (5-12)	Slimy (5-11)	Unidentified (5-12)	(8-41)	
Beam trawl					
UPPCO Reef	4	0			0
24 May 1976	(8)	(4)			(2)
UPPCO Reef	0	0		1	
21-22 June 1976	(100)	(45)		(15)	
Station 4	0	0			
9-21 June 1976	(6)	(5)			
UPPCO Reef	1	0			
16-23 June 1977	(45)	(24)			
Fry traps					
UPPCO Reef	0				
19 May-17 June 1976	(14)				
UPPCO Reef			5	0	0
2 May-26 June 1978			(78)	(2)	(4)
UPPCO Discharge			3	0	0
28 April-26 May 1978			(170)	(2)	(4)
Minnow traps					
UPPCO Reef	0			0	0
13-19 June 1976	(3)			(2)	(1)
Station 7	0	0		0	0
8-27 July 1976	(12)	(6)		(4)	(1)
UPPCO Discharge			2	0	
26 May-12 June 1978			(97)	(1)	
Total	5	0	10	1	0
	(188)	(84)	(345)	(26)	(12)

[a] Yellow perch, 3; trout-perch, 1; lake trout, 8.

Literature cited

Collins, John J. 1975. An emergent fry trap for lake spawning salmonines and coregonines. Prog. Fish-Cult. 37(3): 140-142.

De Roche, Stuart E. 1969. Observations on the spawning habits and early life of lake trout. Prog. Fish-Cult. 31(2): 109-113.

Dryer, William R., and George R. King. 1968. Rehabilitation of lake trout in the Apostle Islands region of Lake Superior. J. Fish. Res. Board Can. 25(7): 1377-1403.

Great Lakes Fishery Commission. 1976. Annual report for the year 1974. Great Lakes Fishery Commission, Ann Arbor, Michigan, 75 pp.

Hacker, Vernon A. 1956. Biology and management of lake trout in Green Lake, Wisconsin. Trans. Am. Fish. Soc. 86: 71-83.

Martin, Nigel V. 1956. Reproduction of lake trout in Algonquin Park, Ontario. Trans. Am. Fish. Soc. 86: 231-244.

Prevost, Gustave. 1956. Use of artificial and natural spawning beds by lake trout. Trans. Am. Fish. Soc. 86: 258-260.

Royce, William F. 1951. Breeding habits of lake trout in New York. U.S. Fish Wildl. Serv., Fish. Bull. 59(52): 59-76.

Report approved by W. C. Latta

Typed by M. S. McClure