

Habitat Conditions: Data Visualization Tool (DVT) and Fish Space

The fish space metric is useful for tracking changes in habitat based on dissolved oxygen (DO) and temperature, two variables that are necessary, but not sufficient in Onondaga Lake to maintain a year-round population of coldwater fish species. Fish species identified in Onondaga Lake are categorized by thermal guild:

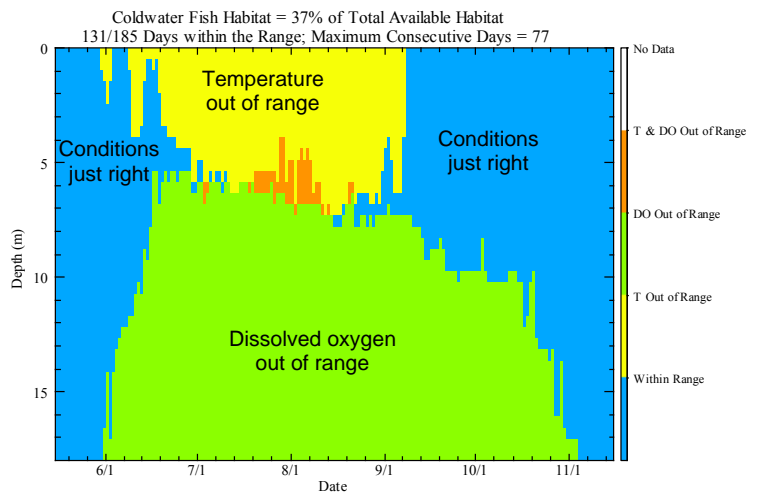
<u>Warmwater</u>		<u>Coolwater</u>		<u>Coldwater</u>
Banded killifish	Freshwater drum	Logperch (Cool/Warm)	Northern pike	Lake sturgeon (Cold/Cool)
Black bullhead	Gizzard shad	Alewife	Shorthead redhorse	Brown trout
Black crappie	Largemouth bass	Brook stickleback	Smallmouth bass	Rainbow trout
Bluegill	Longnose gar	Golden shiner	Tessellated darter	Trout perch
Bowfin	Pumpkinseed	Greater redhorse	Tiger muskellunge	
Brook silverside	Quillback	Johnny darter	Walleye	
Brown bullhead	Rock bass	Longnose dace	White sucker	
Carp	Rudd	Northern hog sucker	Yellow perch	
Channel catfish	White perch			
Emerald shiner	Yellow bullhead			
Fathead minnow				

Available habitat for the coldwater fish community is calculated as a percent of the theoretical total, using volume-days as the measurement. For example, if half the lake’s water volume had suitable DO and temperature conditions for half of the selected time period, the metric is 25% for a given year. The 6-month period from May 15 through November 15 (185 days) is used because it encompasses the summer season when the upper waters of the lake can reach temperatures that are potentially stressful to the coldwater fish community. Moreover, the Onondaga County monitoring probes are deployed over this period and high frequency data are available. Two metrics illustrate this approach: 1) coldwater fish habitat (Table A, Figure A); and 2) coolwater fish habitat (Table B, Figure B). In both graphics, the blue color represents depth and temporal location of water temperatures and DO concentrations suitable for coldwater and coolwater fish habitat, respectively. Yellow shows where and when temperatures are out of range, and green shows where and when DO is out of range. Orange represents conditions where both temperature and DO are out of the range suitable for fish habitat.

Table A. Habitat availability for coldwater fishes in Onondaga Lake from 2000 to 2011 based on default DVT criteria¹.

Year	Coldwater Habitat		
	% Available Habitat ²	Total # Days In Range ³ (max 185 days)	# Consecutive Days In Range ³ (max 185 days)
2000	33	145	50
2001	33	140	72
2002	30	95	49
2003	31	125	47
2004	32	161	67
2005	34	115	59
2006	39	131	80
2007	36	138	65
2008	40	124	67
2009	47	156	80
2010	45	142	71
2011	37	131	77

Figure A. Coldwater Fish Habitat in Onondaga Lake in 2011.



1 Default DVT criteria: temperature $\leq 22^{\circ}\text{C}$ and $\text{DO} \geq 6 \text{ mg/L}$ between May 15 and November 15.

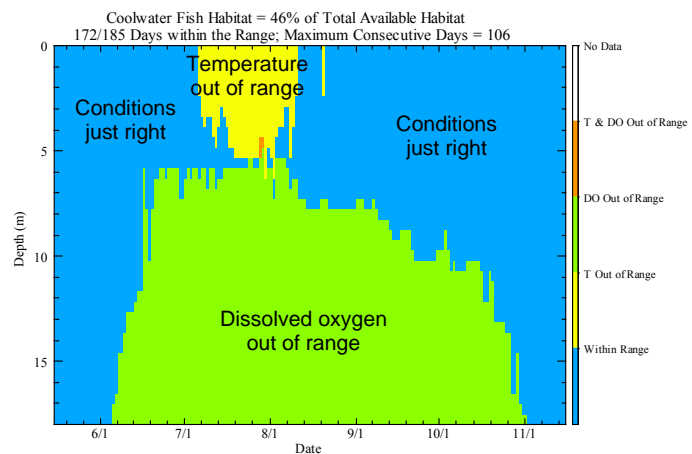
2 Assumes entire volume of the lake (May 15 to November 15) is available.

3 Number of days where temperature and DO are within range in at least a 1 meter vertical section of the lake.

Table B. Habitat availability for coolwater fishes in Onondaga Lake from 2000 to 2011 based on default DVT criteria¹.

Year	Coolwater Habitat		
	% Available Habitat	Total # Days In Range ² (max 185 days)	# Consecutive Days In Range ² (max 185 days)
2000	46	185	185
2001	46	185	185
2002	40	153	67
2003	39	172	87
2004	45	185	185
2005	43	162	89
2006	47	179	101
2007	49	184	102
2008	53	185	185
2009	56	185	185
2010	55	180	95
2011	46	172	106

Figure B. Coolwater Fish Habitat in Onondaga Lake in 2011.



1 Default values: temperature $\leq 25^{\circ}\text{C}$ and $\text{DO} \geq 5 \text{ mg/L}$ between May 15 and November 15.

2 Number of days where temperature and DO are within range in at least a 1 meter vertical section of the lake.

The following graphics (Figures C and D) illustrate the temporal fluctuations of dissolved oxygen and temperature using high-resolution data obtained from the in-situ monitoring buoy at the South Deep station of Onondaga Lake.

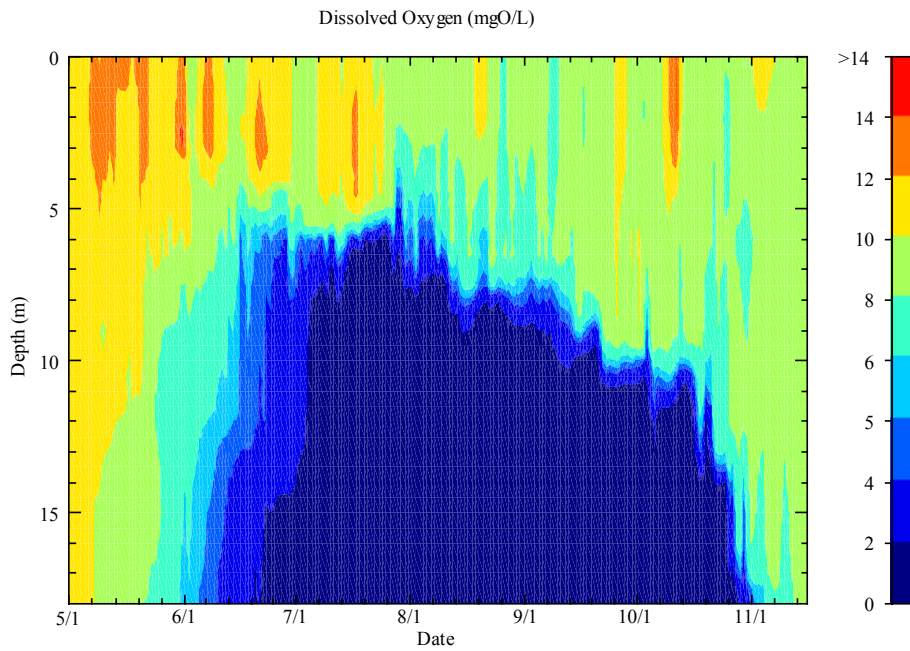


Figure C. Contour of Dissolved Oxygen at Onondaga Lake South Station in Year 2011.
Note: Concentrations are daily averaged.

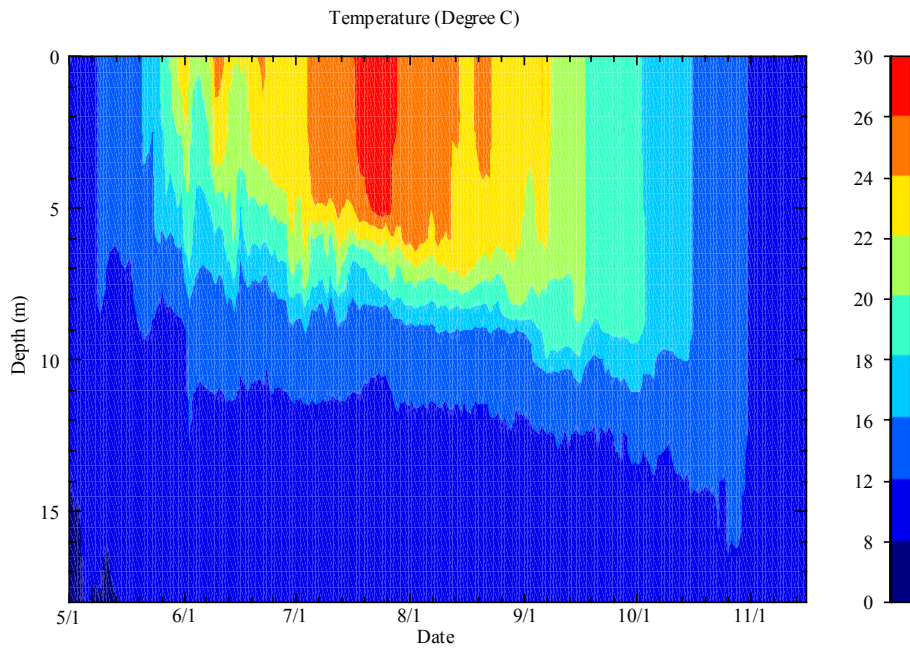


Figure D. Contour of Water Temperature at Onondaga Lake South Station in Year 2011.
Note: Concentrations are daily averaged.