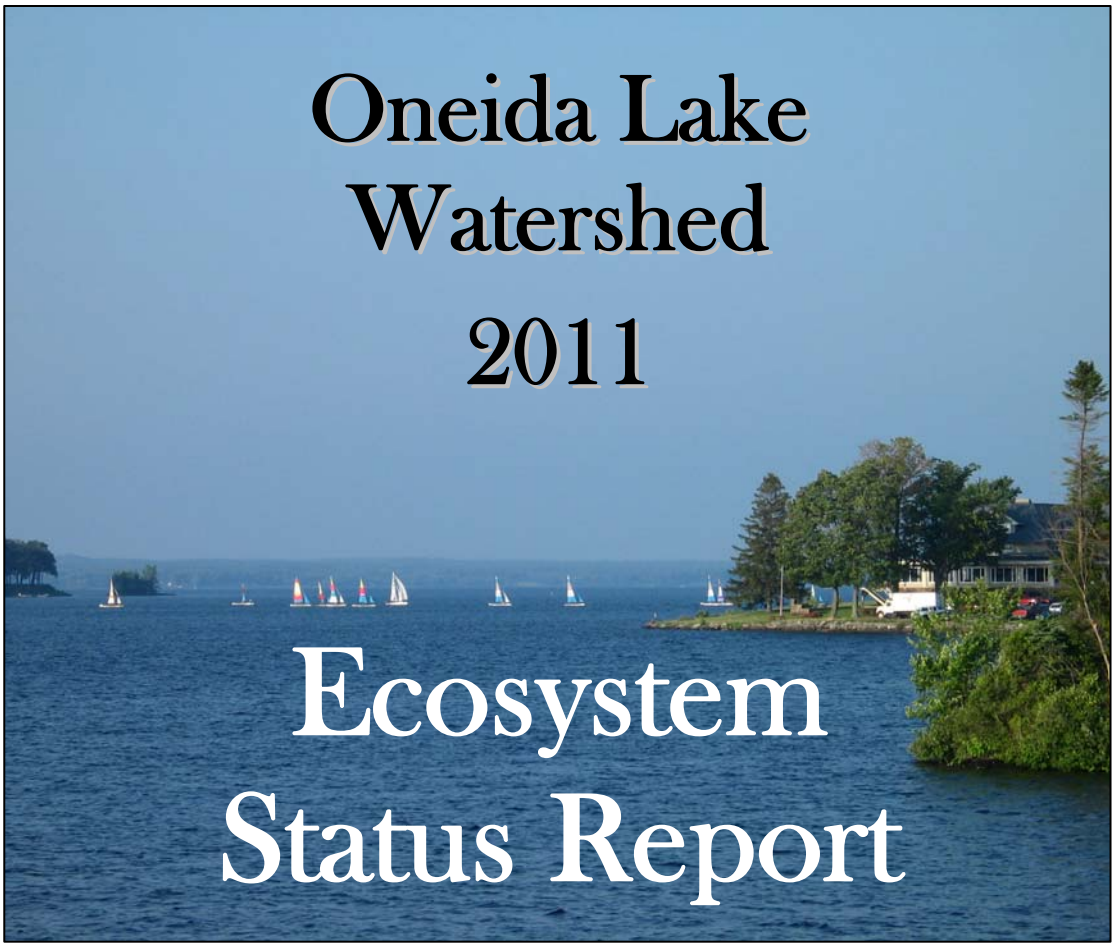
CENTRAL NEW YORK REGIONAL PLANNING
AND DEVELOPMENT BOARD



Oneida Lake Watershed 2011 Ecosystem Status Report

October 2011

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I. INTRODUCTION

Report Goals and Objectives

The Oneida Lake Watershed Ecosystem Status Report presents a summary of current conditions and historical trends for several parameters throughout the lake and its watershed. The report was written for agency and municipal representatives, community decision-makers, and lake users. Information about the lake and watershed parameters was compiled by the Central New York Regional Planning and Development Board (CNYRPDB), with data contributed by the Cornell Biological Field Station (CBFS), the New York State Department of Environmental Conservation (NYSDEC), and the additional contacts that are presented in Figure 2. Researchers at the CBFS have been collecting information on Oneida Lake since the early 1900s and serve as a valuable source of scientific data. Water quality and temperature data in this report is based on information presented in a CBFS report titled, *"The Fisheries and Limnology of Oneida Lake 2000-2009"* that contains a comprehensive summary of physical, chemical, and biological characteristics in the lake.

Chapters on the following pages contain information on the environmental setting, human influences (population, land use, recreation, agriculture, and construction), lake characteristics (phosphorus, transparency, ice cover and water temperature), double-crested cormorants, and invasive species. These parameters (or indicators) were selected for this report based on the following criteria:

- The indicators have ecological or social relevance.
- The information was available from partnering institutions and didn't require additional monitoring.
- The information was easily measurable and statistically sound.
- Measurable goals had been established on some of the indicators, such as phosphorus levels and cormorant populations.
- Several of the indicators help to explain the impacts of management actions such as stormwater control, agricultural Best Management Practices, and cormorant hazing.

The Oneida Lake watershed is large and complex which made it impractical to establish definitive cause-response scenarios between land-based conditions and lake water quality. For example, no attempt was made to correlate building trends (displayed in the report as "disturbed acres") with lake water quality or to associate building trends with the level of stormwater pollution loading.

Oneida Lake and Its Watershed

The Oneida Lake watershed, covering 872,722 acres (or 1,364 square miles), encompasses portions of six counties, and 69 cities, towns, and villages. All the surface and ground water from precipitation and snowmelt within that entire region drains into Oneida Lake. Natural and human influences within the watershed have a direct influence on the water quality and aquatic ecology in the lake.

Table 1: Oneida Lake Physical Characteristics
After Mills et al. 1978

Latitude	43” 12.5' N	
Longitude	75” 55' W	
Elevation	112 m	367 ft
Drainage area	3579 km^2	1382 mi^2
Surface area	206.7 km^2	79.8 mi^2
Shoal area	53.1 km^2	20.5 mi^2
Length	33.6 km	21 mi
Width, Maximum	8.8 km	5.5 mi
Width, Mean	6.1 km	3.8 mi
Depth, Maximum	16.8 m	55.1 ft
Depth, Mean	6.8 m	22.3 ft
Shoal	4.3 m	14.1 ft
Volume	1.4×10^9 m^3	3.7×10^{11}
Hydraulic retention	239 days	

Oneida Lake was originally formed from Lake Iroquois that was impounded by a glacier approximately 12,000 years ago. The first major development occurred in the early 1800s and the region eventually evolved to support logging, sand businesses, basket making, salt production, and glass industries.

Human influences, diverse land use, geology, and soil types impact water quality in the lake and its tributaries. Erosion-resistant sandstone is found primarily in the northern areas of the watershed where approximately 67% of the lake surface water volume originates. The shale and limestone that are found in the southern watershed produce erodible soils. Soil erosion, combined with higher population densities and agricultural land use, contribute to a substantial percentage of sediment and nutrient loading to the lake.

Oneida Lake and its tributaries support thriving fisheries and numerous recreational opportunities that provide a significant year-round boost to the local economy. There are 850 miles of trout streams in the watershed, including 141 miles of stocked streams. A summary of physical characteristics is found in Table 1 and a map of the watershed is found in Figure 1.

Figure 1: Oneida Lake Watershed

Lake and Watershed Issues

Over 75 agencies, organizations, and municipalities contributed to the "*Oneida Lake State of the Lake and Watershed*" report that was completed in 2003. Many of these groups also worked together to develop a comprehensive list of recommendations for the priority lake and watershed issues of concern that are summarized in the "*Management Strategy for Oneida Lake and Its Watershed*" (published in 2004). Since that time, organizations throughout the five-county watershed have been involved in protection and restoration projects based on those recommendations.

According to researchers at the Cornell Biological Field Station (CBFS), Oneida Lake has undergone "fundamental changes in physical characteristics and productivity at the lower trophic levels." Monitoring data shows that Oneida Lake was once classified as eutrophic, a condition that refers to a highly productive or nutrient-rich state. Due to effective reductions in nutrient loading during the past decade however, it now possesses healthy characteristics of a mesotrophic lake, referring to an intermediate stage of nutrient availability and biological productivity.

Watershed characteristics and land use planning are important components when understanding ongoing improvements in lake water quality. Oneida Lake is experiencing fluctuations in nutrient levels and fish populations, increasing water temperatures, longer recreational seasons, and impacts from invasive plants and animals that have altered the biological characteristics and recreational uses. Improved sewage treatment facilities, laws that regulate the content of detergent and lawn fertilizer, and greater public awareness have contributed to declining phosphorus levels. Improved management practices on farms and stricter control of stormwater runoff have further reduced the level of nutrient and sediment loading to the lake. Many of these trends are documented in this report.

Figure 2: Ecosystem Status Report Data Sources

CBFS *– Cornell Biological Field Station*

CNYRPDB – *Central New York Regional Planning & Development Board*

FSA *– Farm Service Agency*

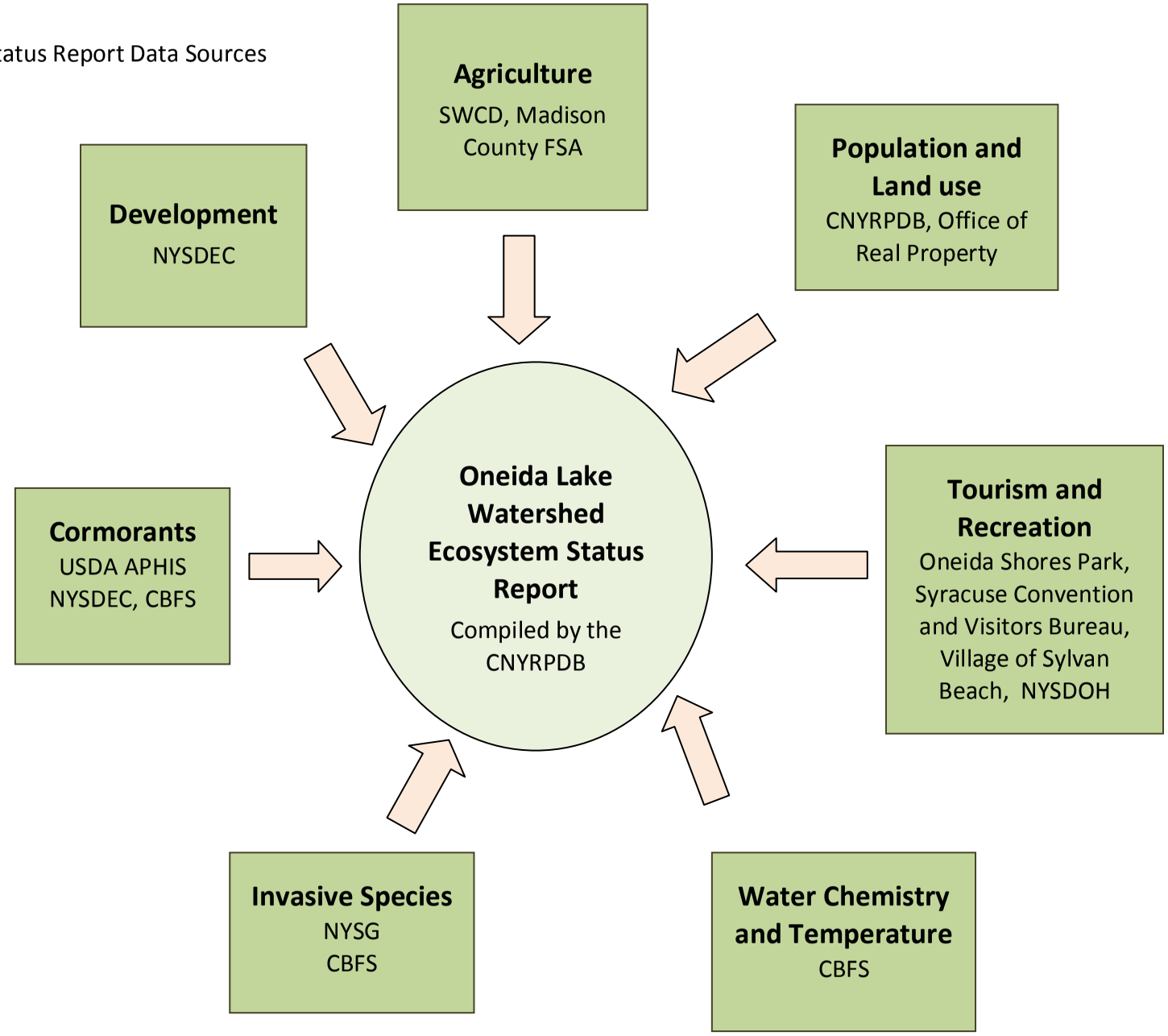
NYSDEC *- New York State Department of Environmental Conservation*

NYS DOH *– New York State Department of Health*

NYSG *– New York Sea Grant*

SWCD *– Soil and Water Conservation District*

USDA APHIS *– United States Department of Agriculture Animal and Plant Health Inspection Service*



II. HUMAN INFLUENCES

Population

Portions of six counties and 69 municipalities are located within the Oneida Lake watershed. According to the U.S. Census Bureau, approximately 441,168 people lived in the watershed in the year 2010. Population was selected as a Status Report indicator because regional totals impact lake water quality, tourism, development, and economic characteristics. Population trends are normally influenced by conditions related to the economic setting, climate, quality of life, and job opportunities.

The City of Rome in Oneida County and the City of Syracuse in Onondaga County are significant population centers. Onondaga County, located in the southwestern portion of the watershed, is the most densely populated with 598.5 persons per square mile of land area in 2010. At 5,834 persons per square mile, Syracuse is the single most densely populated municipality in the watershed. Lewis County, located in the northern portion of the watershed, is the least densely populated county with 11.7 persons per square mile. The Lewis County Town of Montague, with a population density of 1.7 persons per square mile, is the least densely populated municipality in the watershed.

Of the five major watershed counties, Oswego County watershed municipalities experienced the highest net population increase of 25.6 percent between 1980 and 2010 (Table 2). Similarly, Madison County municipalities within the watershed experienced a net population increase of 13.1 percent between 1980 and 2010. Growth in these two counties can be partially attributed to urban sprawl in the municipalities that are located close to Syracuse, and the preference to live in an area with relatively good water quality, open space, academic resources, and recreational opportunities. Population rates were also higher in the shoreline communities that provide lake access and convenient transportation.

Watershed municipalities in Lewis County, Oneida County and Onondaga County experienced net population losses of 7.2, 10.1 and 1.9 percent respectively between 1980 and 2010. Table 2 shows Census population totals for municipalities by county in the Oneida Lake watershed for 1980, 1990, 2000 and 2010.

Table2: Population Changes for Municipalities in the Oneida Lake Watershed

County Totals for Watershed Municipalities	*1980 Pop. (#)*	*1990 Pop. (#)*	*2000 Pop. (#)*	*2010 Pop. (#)*	*1980-1990 Change (%)*	*1990-2000 Change (%)*	*2000-2010 Change (%)*	*1980-2010 Change (%)*
Lewis County	*5258*	*5128*	*4946*	*4879*	*-2.5*	*-3.5*	*-1.3*	*-7.2*
Madison County	*52069*	*55703*	*56229*	*58893*	*7*	*0.9*	*4.7*	*13.1*
Oneida County	*86984*	*89062*	*80519*	*78228*	*2.4*	*-9.6*	*-2.8*	*-10.1*
Onondaga County	*280175*	*278180*	*267969*	*274845*	*-0.7*	*-3.7*	*2.6*	*-1.9*
Oswego County	*19366*	*22666*	*24335*	*24323*	*17*	*7.4*	*-.05*	*25.6*

Source: U.S. Census Bureau

Land Use

The Oneida Lake watershed covers 872,722 acres (1,364 square miles) of land area in Lewis, Madison, Oneida, Onondaga, Oswego, and Cortland counties. Approximately 15,000 acres (23 square miles) of land in the watershed within Madison and Oneida counties is owned by the Oneida Indian Nation and is primarily used for commercial and residential purposes. Over 441,168 people live in the watershed and thousands more use the lake and tributaries each year for boating, fishing, swimming, and other forms of recreation. The health of local lakes and streams is a priority for continued strength of the local economy.

Agricultural activity is concentrated in the southern portion of the watershed, especially in Onondaga, Madison, and Oneida counties. Commercial and industrial activities and residential land uses are primarily centered in and around the cities and villages. There is a predominance of wild, forested, conservation lands, public parks, public and community service, and recreation and entertainment property in the Tug Hill Upland region (Lewis County and northern Oneida and Oswego counties). Isolated occurrences of this land use category can also be found throughout the watershed.

Table 3 shows the percentage of land in the Oneida Lake watershed by general land use categories in 2002 and 2009. The percentages are based on the total number of acres in each property class. The land use data is derived from the county and New York State Office of Real Property Service's (NYS ORPS) database. For the purposes of this report, the NYS ORPS property type classification codes have been used and grouped into five general land use categories, summarized as follows:

- Agricultural – Property used for the production of crops or livestock.
- Residential – Property used for human habitation. Living accommodations such as hotels and motels are in the commercial category.
- Vacant Land – Property that is not in use, is in temporary use, or lacks permanent improvement.
- Commercial / Industrial – Property used for the sale of goods and/or services, or the production and fabrication of durable and non-durable man-made goods.
- Wild / Forested / Conservation Lands / Public Parks / Public Services / Community Services / Recreation and Entertainment – Reforested lands, preserves, private hunting and fishing clubs, property used to provide services to the general public, property used for the well-being of the community, or property used by groups for recreation, amusement or entertainment.

Some land uses are mapped as "unknown" because the property classification codes have not been recorded in the database or because a link could not be established between the real property data and the digital tax map.

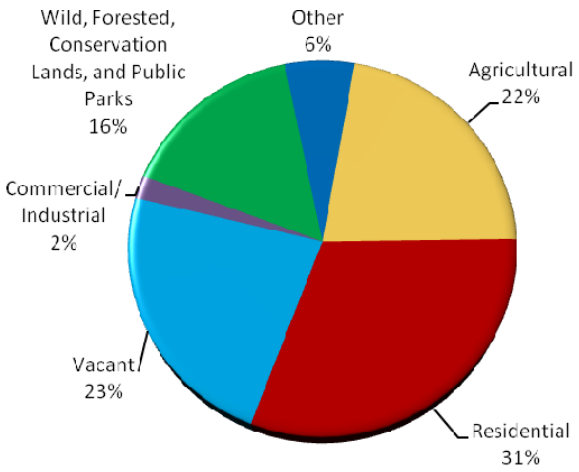
Parcel data in 2009 was compared to similar categories from 2002 in order to observe changes in land uses throughout the watershed (Table 3). Notable changes were seen in agricultural land use (which dropped from 29% in 2002 to 22% in 2009), and the residential land use that increased from 27% in 2002 to 31% in 2009. Figure 3 displays land use category percentages in 2009.

Table 3: Percent Land Area of Properties in the Oneida Lake Watershed by Land Use Category, 2002 and 2009

	Agricultural	*Residential*	*Vacant Land*	*Wild, Forested, Conservation Lands, and Public Parks*	*Commercial/ Industrial*	*Unknown/ Other*
2002 Watershed Land Use Percentage	***29%***	***27%***	***22%***	***17%***	***2%***	***3%***
2009 Watershed Land Use Percentage	***22%***	***31%***	***23%***	***16%***	***2%***	***6%***

Sources: The 2002 data was calculated by the Herkimer Oneida Counties Comprehensive Planning Program from data provided by the NYS ORPS. The 2009 data was calculated by the CNYRPDB with data provided by GIS parcel data obtained from each individual county's ORPS.

Figure 3: Watershed Land Use 2009



Sources: The 2002 data was calculated by the Herkimer Oneida Counties Comprehensive Planning Program from data provided by the NYS ORPS. The 2009 data was calculated by the CNYRPDB with data provided by GIS parcel data obtained from each individual county's ORPS.

Recreation

A variety of water-based recreational opportunities are available throughout the Oneida Lake watershed and they have played a major role in the social and economic development of the region. Recreation was selected as a Status Report indicator because water quality impacts recreation activities such as fishing and boating. A healthy lake with good water quality will generally produce optimal conditions for boating, swimming, and fishing – all priority sports in the Oneida Lake region. This, in turn, influences the local economy because of jobs generated, hotel, motel, and restaurant use, and the purchase of boat and fishing licenses. According to the 2007 New York Statewide Angler Survey, Oneida Lake is the second most-fished body of water in New York State, outranked only by Lake Ontario which is nearly 100 times larger. Three other Central New York water bodies are ranked in the top ten: Seneca and Cayuga Lakes, and the Salmon River.

Captain Tony Buffa operates a fishing charter business on Oneida Lake
Hhttp://www.captaintonybuffafishingcharters.com/
Photo credit: Mike Lynch

Local residents and tourists from New York and neighboring states spend millions of dollars each year while visiting the Oneida Lake watershed. For this reason, the integrity of the lake and watershed has a direct impact on the economic livelihood of local municipalities. In the Tug Hill region, for example, local homeowners and out of town visitors enjoy fishing and hunting and many landowners sell fishing and hunting leases to clubs that provide sportsmen access to forestland. The money raised by these leases helps offset tax assessments against the property, making it easier for businesses to maintain ownership of large tracts in the northern part of the watershed. Throughout the watershed, tourism benefits extend to many additional businesses such as lodging, restaurants, and retail stores. Table 4 shows the number of jobs generated from travel and tourism in the Oneida Lake watershed counties in 2008.

Table 4: Jobs Generated From Travel and Tourism in the Oneida Lake Watershed in 2008

County	Jobs Generated
Madison	690
Onondaga	9,260
Oswego	1,050
Oneida	7,360
Lewis	230

Source: New York State Department of Labor, Quarterly Census of Employment and Wages program

"Oneida Lake and the Syracuse area have become a major player in the world of tournament fishing."
(County Executive, Joanie Mahoney)

Fishing Tournaments

Angling on Oneida Lake generates revenues of over 12 million dollars annually (Connelly and Brown 2009) and provides a substantial boost for the local and statewide economy each year. World renowned bass fishermen gathered at Oneida Shores Park in 2009. The event was the fourth consecutive year the BASS Tour had been held in Syracuse and more prize money was awarded here than any other city in the country during that time span. According to the Syracuse Convention and Visitors Bureau, the Bassmasters Open Championship was scheduled on Oneida Lake in 2011 and was expected to generate $2.2 million in travel spending.

Twenty six marinas are located on Oneida Lake and many of them sponsor fishing tournaments. Tables 5 and 6 provide information on fishing tournaments and the estimated economic impact at Onondaga County's Oneida Shores Park during 2008, 2009, and 2010.

Table 5: Tournament Fishing at Oneida Shores Park, Onondaga County, 2008 to 2010

2008	2009	2010
34 Tournaments **1,230 boats** **2,510 anglers**	**32 Tournaments** **1,244 boats** **2,488 anglers**	**33 Tournaments** **1,120 boats** **2,155 anglers**
1 Bassmaster Elite Series Tournament 100 boats 250 anglers	1 Bassmaster Elite Series Tournament 100 boats 100 anglers	1 BLF / FLW Outdoors 85 boats 70 anglers
1 Bass Fishing League (BFL)/FLW Outdoors Tournament 55 boats 110 anglers	1 BFL / FLW Outdoors Tournament 125 boats 250 anglers	1 American BASS Anglers Weekender Series 50 boats 100 anglers
1 Angler's Choice TOC 60 boats 120 anglers	1 Angler's Choice TOC 100 boats 200 anglers	9 out of state tournaments 250 boats 500 anglers
13 out of state tournaments 450 boats 900 anglers	9 out of state tournaments 197 boats 394 anglers	18 regional tournaments 650 boats 300 anglers
10 regional tournaments 445 boats 890 anglers	16 regional tournaments 520 boats 1,040 anglers	4 local tournaments 80 boats 95 anglers
6 local tournaments 120 boats 240 anglers	4 local tournaments 102 boats 204 anglers	

Data source: Onondaga County Parks

Table 6: Estimated Economic Impact at Oneida Shores Park, Onondaga County

2008		2009		2010	
Bassmaster Elite	$2,400,000	Bassmaster Elite	$2,500,000	Bassmaster Elite	-
Out of State Trnmts	$609,147	Out of State Trnmt	$264,000	Out of State Trnmts	$292,640
Regional Tournaments	$104,130	Regional Tournaments	$121,680	Regional Tournaments	$134,088
BFL/FLW Outdoors Trnmt	$74,450	BFL / FLW Outdoors Trmt	$83,775	BFL/FLW Outdoors Trmt	$56,967
Angler's Choice TOC	$81,220	Angler's Choice TOC	$134,000	Angler's Choice TOC	-
Local Tournaments	$28,080	Local Tournaments	$23,870	Local Tournaments	$ 21,483
Grand Total	**$3,297,027**	**Grand Total**	**$3,127,325**	**Grand Total**	**$505,178**

Data source: Onondaga County Parks

Restricted Use

Swimming on Oneida Lake is a popular form of recreation but beaches are occasionally closed for swimming due to elevated levels of coliform bacteria in the water. Some beaches, such as the one at the David C. Webb Memorial Park (also known as Taft Bay Beach) in the Oswego town of Constantia was also closed in 2010 because of high levels of blue-green algae. Restricted use was selected as a Status Report indicator because lake water quality has a direct impact on recreational use, and data on beach closures is readily available. To safeguard public health, county health officials test the lake water on a routine basis from Memorial Day to Labor Day.

Elevated levels of e-coli bacteria in Oneida Lake can be attributed to several factors, including warm water temperature, fecal matter from warm-blooded animals, stormwater runoff, and the lack of precipitation and wind to circulate the water. Over the past several years, local officials have been especially concerned with geese populations on the lake and have restricted recreational activities because of elevated bacteria levels from this growing problem. Human activity is not considered to be a contributing factor relative to the high coliform bacteria levels at Oneida Shores County Park. Some forms of bacteria can cause gastrointestinal symptoms but complaints have been rare. Anyone concerned about these symptoms is advised to contact their health care provider.

Several major beaches are located in the four counties that border Oneida Lake. The summary on the following page describes the location and occurrence of beach closings in 2010.

Onondaga County:

- Oneida Shores (Brewerton) was closed for three days in 2010 due to high e-coli counts.
- Joseph F. William Memorial Park and Beach (Cicero) reported no beach closings.

The integrity of Oneida Lake and its watershed has a direct impact on the economic livelihood of local municipalities.

Oswego County:

- David C. Webb Memorial Park, also known as Taft Bay Beach, was closed on August 10, 1010 and then approved to reopen for bathing on August 23, 2010 after performing a satisfactory algal toxin strip test.

Madison County:

- Lewis Point Beach (operated as part of Lewis Point Campgrounds by Sunset Properties) - 2010 was the first year in recent history that a Madison County beach was closed. The Lewis Point beach was ordered closed following high fecal coliform levels present in surveillance samples collected by the county health department. The beach was tested in August and remained closed for the rest of the season. The use of the beach was minimal at that time of year and operators elected to close rather than continue sampling. According to the Health Department, the primary conditions suspected of contributing to the elevated bacteria levels were the shallow water in the bathing area (< 2 feet average) and relatively low water turnover from winds and bay conditions.

- Chapman Beach Park (operated by the Town of Sullivan Parks and Recreation)
  The County Health Department indicated that no water quality problems were reported at Chapman Park Beach in 2010. The beach closed in mid-August when lifeguards return to college.

Oneida County:

- The Sylvan Beach Village office reported that the beach was closed for approximately two days in August 2010 due to elevated e-coli counts.
- The Verona Beach office reported that Verona Beach didn't close in 2010.

Agriculture

Agriculture plays an important role in the upstate New York economy, especially in the areas south of Oneida Lake where productive soils are located. Agriculture was selected as a Status Report indicator because of the impact that it can have on lake water quality. Poor farming practices and steep terrain can potentially accelerate the level of nutrient and sediment loading to a lake and its tributaries.

Photo credit: New York Agricultural Landowner Guide, American Farmland Trust Hnewyork@farmland.org

Between 2002 and 2007, the number of farms in Madison County increased by 1 percent but farm totals decreased in the remaining counties (Table 7). The largest decrease (15 percent) was documented in Lewis County. The average farm size increased in both Madison and Oswego counties by 10 and 4 percent respectively (Figure 4). Statewide, the number of farms in 2007 declined by 2 percent while 39 other states reported an increase in the number of farms during the same period. Agriculture showed a 4 percent gain nationwide. A farm (as defined by the Census) is any place from which $1,000 or more of agricultural products were, or normally would be, produced and sold during the Census year.

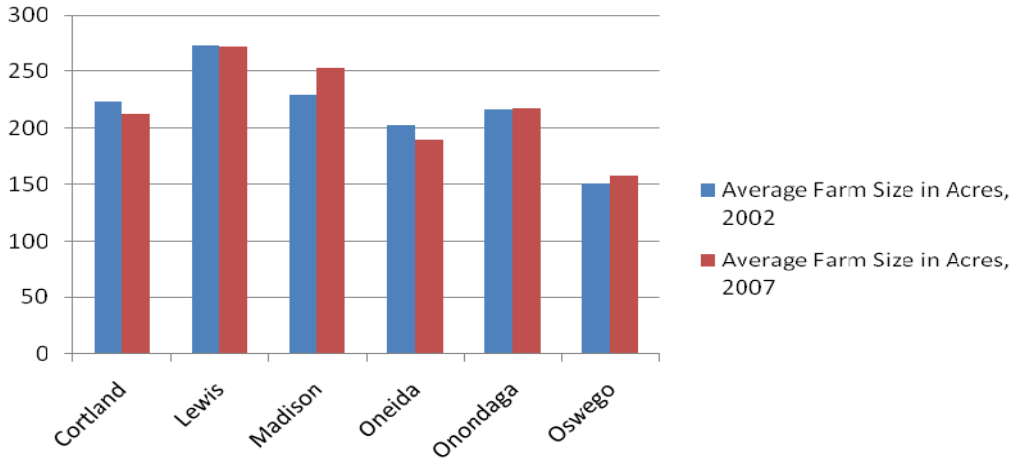
Most of the farms in the watershed are dairies that are located in Madison, Oneida, and Onondaga counties. The farm operations have an average herd size of 159 cows and produce crop rotations of corn and hay for livestock feed. Non-dairy operations within the watershed include a thriving vegetable trade as well as sheep, beef, and equine industries.

Madison County has a greater percentage of land in farming (45%) than other counties in the watershed (Figure 5). Madison County experienced an increase in the number of acres devoted to farming between 2002 and 2007 (12%), while acreage totals in the other watershed counties decreased (Table 7). Overall, the total number of acres of land in farms for all counties in the watershed has shown a gradual decrease between 2000 and 2009 (Figure 6). According to data from the NYS Office of Real Property Services, approximately 10 percent of the total land area in the Oneida Lake watershed was classified as agricultural in 2009, exhibiting a significant decrease compared to 29 percent in 2002.

Much of the Oneida Lake watershed is characterized by productive soils and favorable physiographic conditions – features that contribute to crop diversity and good market outlets for agricultural products. While these conditions can be beneficial to a farming business, they can also present management challenges. Soils on steep slopes in the southern Oneida Lake watershed are subject to erosion, and heavy rainfall and snowmelt contribute to runoff from barnyards and cropland where manure is spread. During periods of heavy precipitation, sediment and nutrients flow down the tributaries into Oneida Lake.

Farmers within the watershed can be faced with low profitability, high taxes, high costs of land and machinery, unstable milk prices, and urban sprawl. Most of the farmers work with their Soil and Water Conservation Districts and voluntarily participate in programs to reduce nonpoint source pollution which minimizes negative impacts on local water resources.

Figure 4: Average Farm Size by County, 2002 and 2007



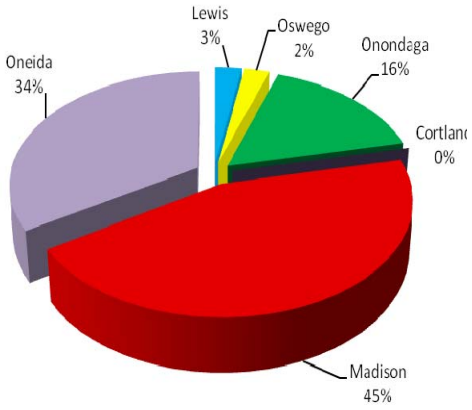
Source: 2007 Census of Agriculture – County Data New York USDA National Agricultural Statistics Service

Table 7: Number of Farms, Land in Farms, and Percent Change by County, 2007 and 2002

Madison County	2007	2002	percent change
Number of Farms	744	734	+ 1
Land in Farms	188,320 acres	168,264 acres	+ 12
Average Size of Farm	253 acres	229 acres	+ 10
Onondaga County	2007	2002	percent change
Number of Farms	692	725	-5
Land in Farms	150,499 acres	156,284 acres	-4
Average Size of Farm	217 acres	216 acres	0
Oswego County	2007	2002	percent change
Number of Farms	639	682	-6
Land in Farms	100,195 acres	103,156 acres	-3
Average Size of Farm	157 acres	151 acres	+4
Oneida County	2007	2002	percent change
Number of Farms	1,013	1,087	-7
Land in Farms	192,232 acres	220,486 acres	-13
Average Size of Farm	190 acres	203 acres	-6
Lewis County	2007	2002	percent change
Number of Farms	616	721	-15
Land in Farms	167,249 acres	196,774 acres	-15
Average Size of Farm	272 acres	273 acres	0

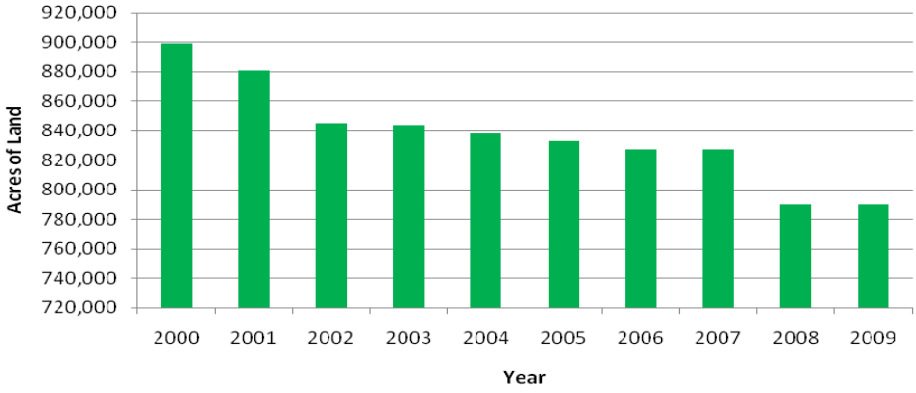
Data source: 2007 Census of Agriculture – County Data New York
USDA National Agricultural Statistics Service

Figure 5: Agriculture Percent of Watershed by County in 2007



Source: Offices of Real Property

Figure 6: Acres of Land in Farms for Counties in the Oneida Lake Watershed, 2000 to 2009



Source: National Agricultural Statistics Service

Construction

Stormwater is water from rain or melting snow that doesn't soak into the ground. It flows off the land surface into storm sewers and ditches, eventually making its way into lakes, rivers, and streams. Stormwater runoff flows over bare soil and paved surfaces such as parking lots and rooftops while picking up pollutants along the way. The quality and quantity of the runoff is affected by land use, topography, the season of the year, and weather conditions.

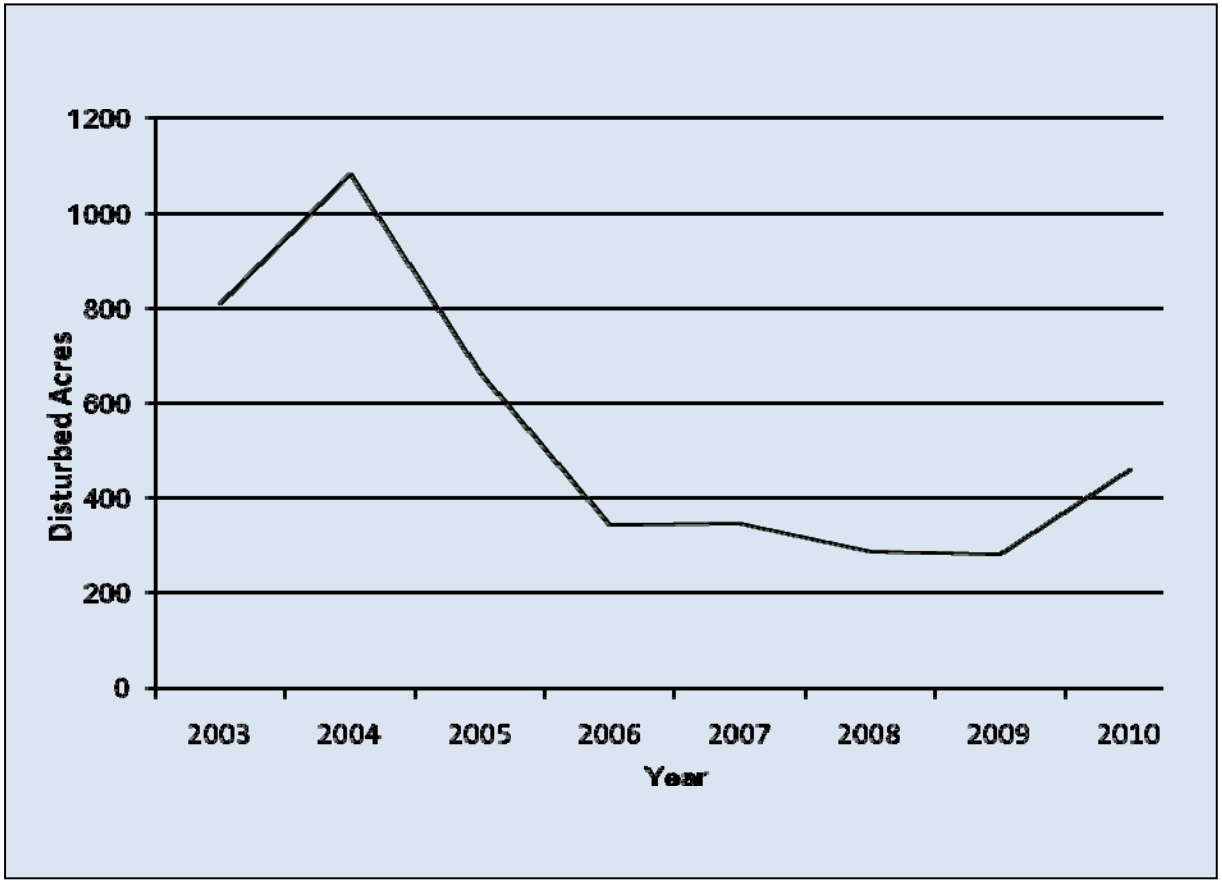
Control of stormwater runoff is a priority throughout the watershed, especially for shoreline communities along Oneida Lake that have a larger percentage of impervious surfaces compared to less populated areas. Poor water quality from stormwater runoff can impact fisheries and habitat for plants and animals that depend on clean water for survival. Pollutants carried by stormwater can also affect recreational uses of waterbodies by making them unsafe for swimming, boating and fishing.

Many communities in the Oneida Lake watershed control stormwater runoff at construction sites and/or through implementation of erosion and sediment control local laws, site plan reviews, comprehensive plans, subdivision regulations, and environmental protection overlay districts. To reduce stormwater runoff from construction sites, the Federal Clean Water Act (administered in New York State by the NYSDEC) mandates that construction plans demonstrate how the developer will deal with erosion and sedimentation. Developers of projects that will disturb one or more acres of land must obtain coverage from New York State under the Stormwater Construction Permit.

Erosion and sedimentation from new development were selected as Status Report indicators because of the potential impact on lake water quality. The most effective way to monitor development trends is to record the total number of “disturbed acres” from construction activity in the counties that border the lake. The term “disturbance” refers to activities that result in the exposure or movement of soil. This can include clearing, grubbing, excavation, grading, demolition, stockpiling, borrow or any other such activity.

The graph in Figure 7 shows the trend in the total number of disturbed acres from new construction in the counties that border Oneida Lake (Onondaga, Madison, Oneida, and Oswego) from 2003 to 2010.

Figure 7: Number of Disturbed Acres in the Oneida Lake Watershed, 2003 to 2010



Data source: NYSDEC

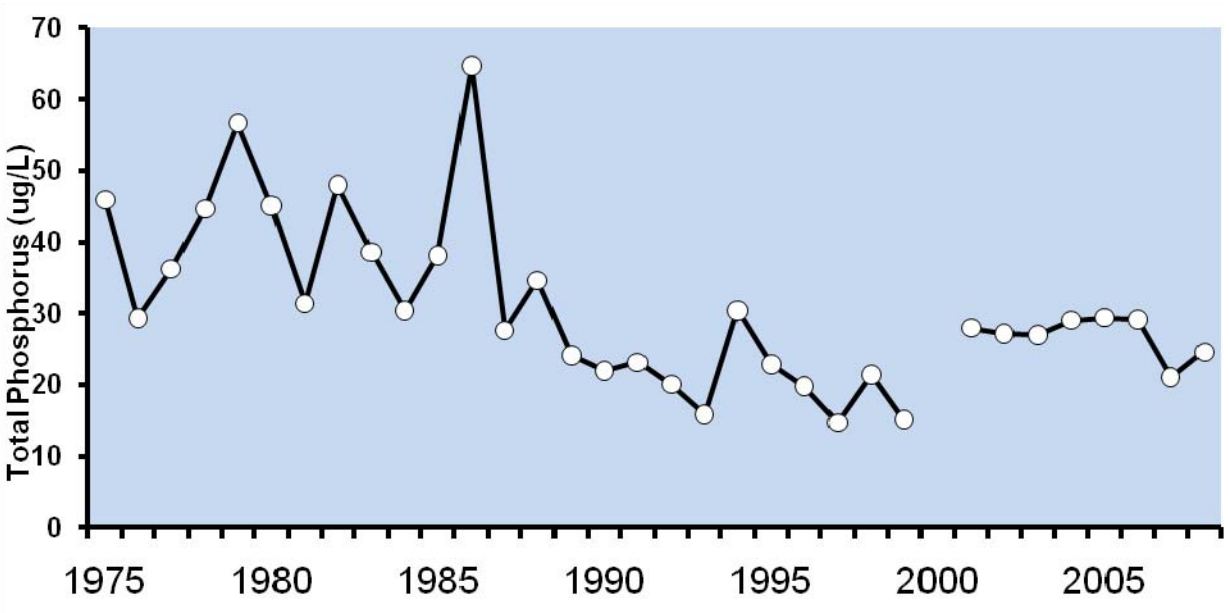
III. LAKE CHARACTERISTICS

Phosphorus

Phosphorus is one of the primary nutrients necessary for plant and animal growth, and in most cases, it is the nutrient that limits algal growth in lakes. In 1973, New York State banned the use of phosphorus in household detergents which helped to reduce phosphorus loading to the lake. In addition, changes in agriculture and construction management practices and reductions in stormwater runoff have also helped to reduce phosphorus losses throughout the Oneida Lake watershed. Levels of total phosphorus (TP) in Oneida Lake have been measured on a routine basis by the Cornell Biological Field Station since 1975.

By the late 1980s, total phosphorus concentrations were reduced by nearly one-half of what they were in the late 1970s. Total phosphorus concentrations averaged 40 to 60 μg/L in the 1970s and early 1980s and were reduced to between 20 and 30 μg/L in the 1990s (Figure 8). A decline in algae production in the mid 1980s also coincided with the lower phosphorus levels. Recommendations stated in the "*Management Strategy for Oneida Lake and its Watershed*" indicate that phosphorus levels be maintained at a mean May through October level of 20μ/l for the benefit of fish populations and overall lake productivity.

Figure 8: Total Phosphorus in Oneida Lake, 1975 to 2008



(Data source: Cornell University Biological Field Station)

Transparency

Water transparency, or clarity, is important in aquatic habitats because it influences the level of sunlight penetration and plant growth in a lake. Aquatic plants are important because they provide food and protective cover for aquatic organisms and the root systems stabilize the shoreline and reduce erosion.

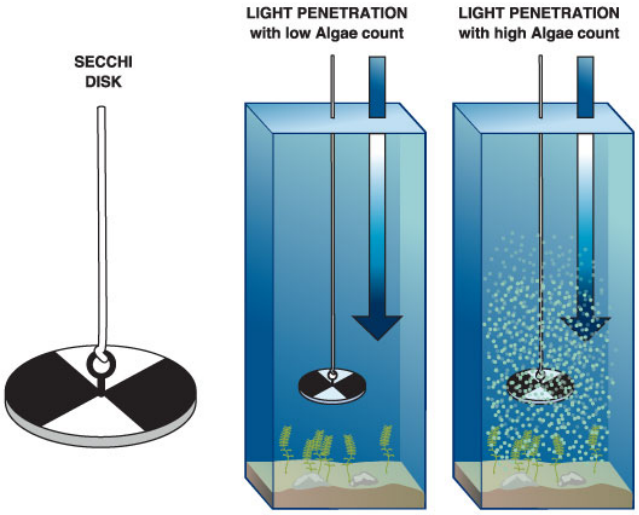


Figure 9: A Secchi disc measurement is obtained by lowering a black and white disc on a calibrated line to a depth at which it is no longer visible, and then raising it to a point where it is just visible.
(Credit: "Flow: Fisheries Learning On The Web")

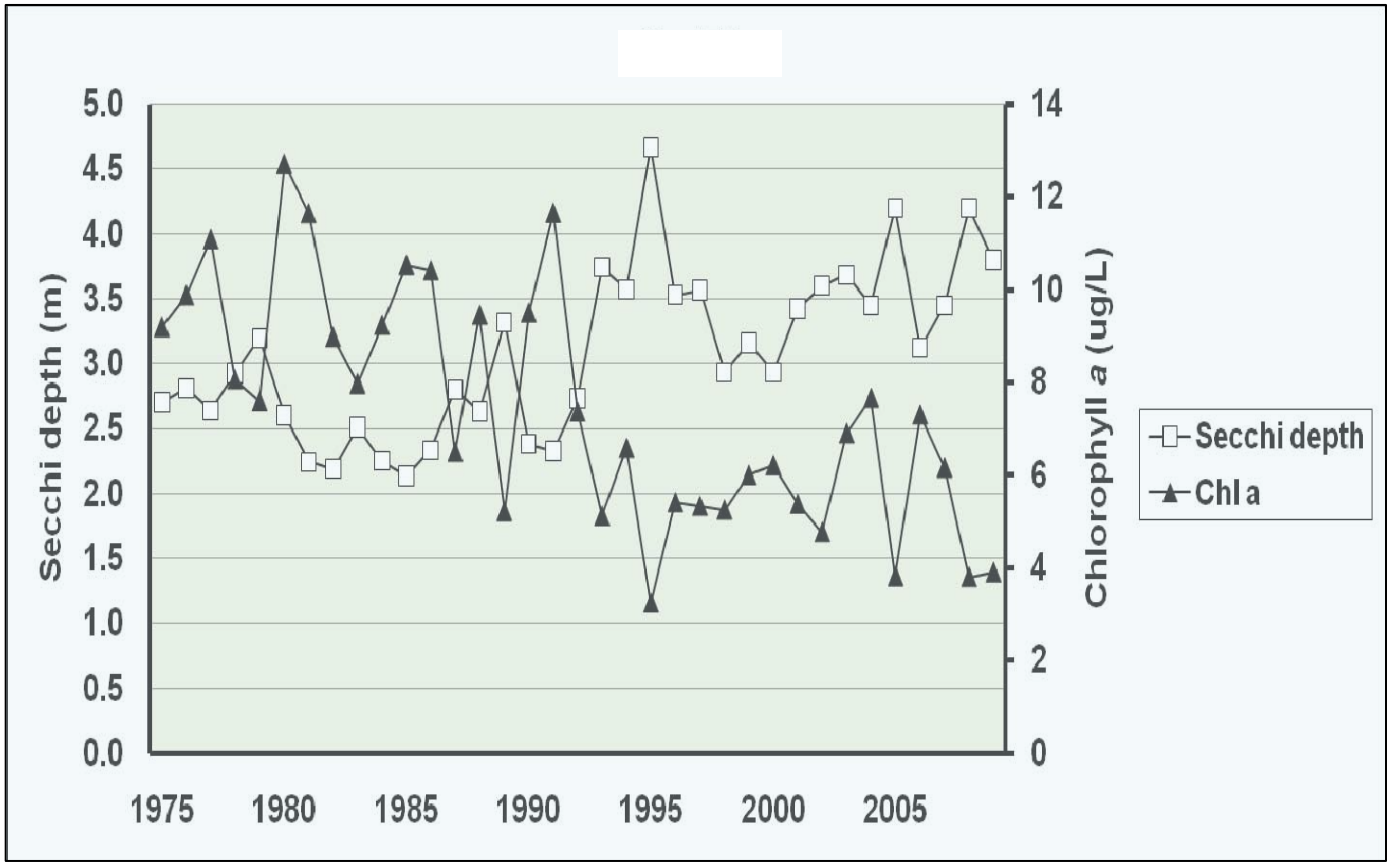
Turbid or cloudy lake water with low transparency can occur when soil particles and other material are present in the water column. Low transparency is influenced by several factors:

- Rain, wind, waves, animals and human activities can stir up particles in the water. Cloudy lake water is common after a storm and is especially apparent at the base of streams entering the lake.
- Soil runoff from construction sites or eroding shorelines decreases water transparency. As water from precipitation and snowmelt drains into the lake, it often transports sediment and pollutants along the way.
- Stormwater runoff can also carry nutrients such as phosphorus and nitrogen. The nutrients promote the growth of algae which decreases water transparency.

Turbidity blocks the sunlight that plants need to produce food, cover, and oxygen for fish and other aquatic life. Sediments or other particles floating in the water can also absorb heat from the sun which warms the water and decreases dissolved oxygen.

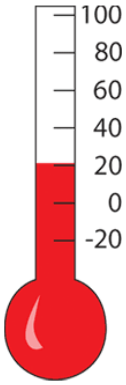
Secchi disc transparency, a standard measurement of water clarity, has been measured in Oneida Lake since 1964 by researchers at the Cornell University Biological Field Station. They also routinely test for chlorophyll *a,* an indicator of algal growth. The annual cycle of Secchi disc transparency and chlorophyll *a* are displayed in Figure 10. Since the introduction of zebra mussels, Oneida Lake has experienced record water clarity. The year with the clearest water on record in Oneida Lake was 1995, four years after zebra mussels were detected in the lake. Since the establishment of the zebra mussel, the number of clear water days (defined as those days with an average chlorophyll a level of less than 3.0 µg/L) has increased from nearly 80 days to over 120 days (Cornell University Biological Field Station).

Figure 10: Secchi Depth and Chlorophyll a on Oneida Lake



Data source: Cornell Biological Field Station

Ice Cover and Water Temperature



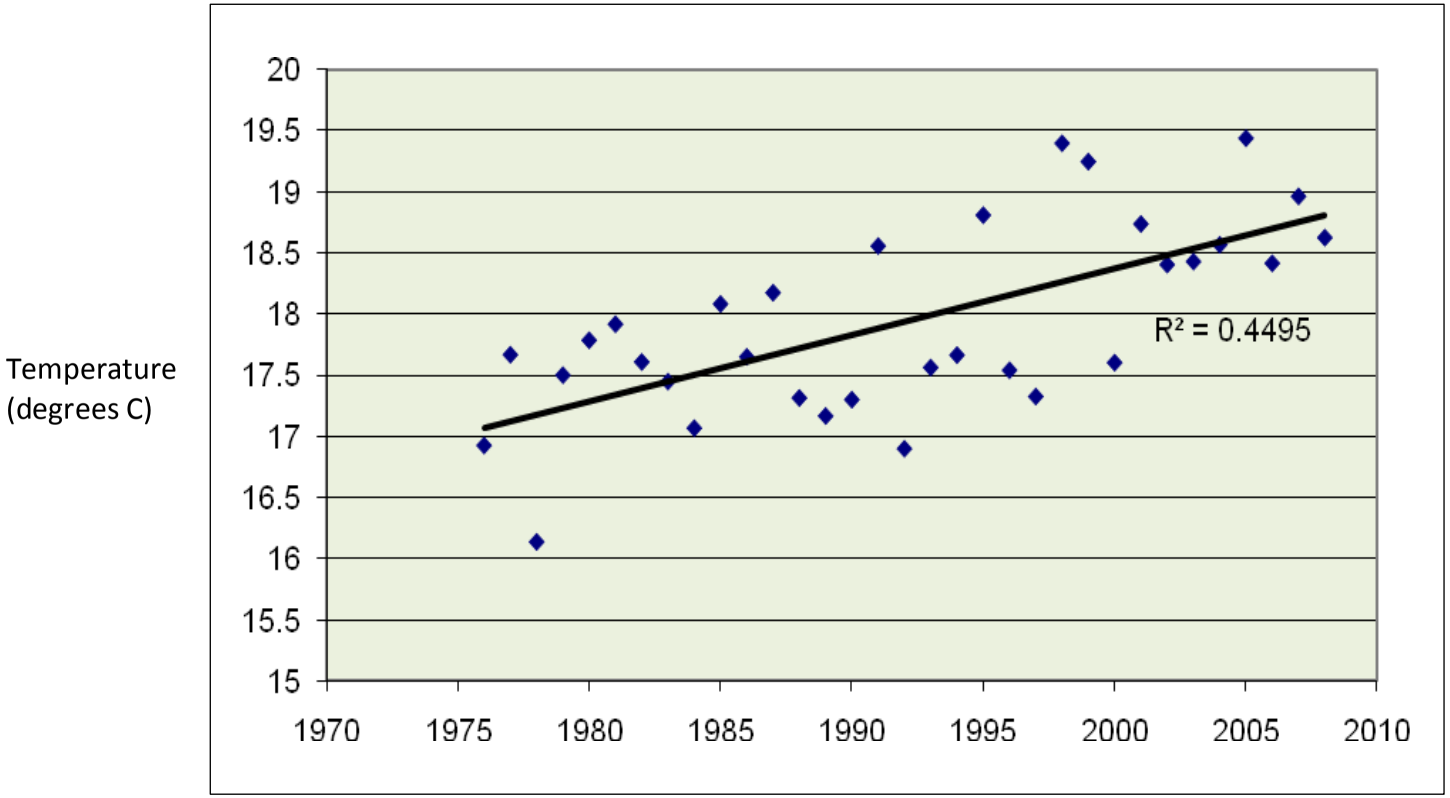
Ice formation on Oneida Lake usually begins in December and complete ice cover on the lake occurs in late December or January. According to the Cornell Biological Field Station, the earliest and latest ice-in dates from 1975 to 2001 occurred on December 3, 1976 and January 31, 1998, respectively. For the first time in recorded history, complete and sustained ice cover did not occur during the winter of 2002. Average ice residence time from 1975 to 2000 was 95 days. Minimum and maximum residence times were 55 and 121 days during the winters of 1997-98 and 1977-78, respectively.

Records of ice break-up (ice-out dates) have been maintained by the Oneida Fish Culture Station in Constantia on the north shore of Oneida Lake since 1846. According to the Field Station, ice thickness reached as much as 120 cm in the mid to late 1970s, and within the last decade, maximum ice thickness has averaged about 31 to 36 cm.

Recent trends in ice duration and summer water temperatures do not exhibit the same significance as observed over the long term, but both measurements of the lake's physical conditions reflect warmer conditions than when data collection first started. The average ice duration for the period 2000-2009 was 89.9 days, excluding the winter of 2002 when secure ice never formed. Average ice duration from 1975-1984 was 102.5 days. The average June-August water temperatures during the last decade were 1.2^{o}C higher than for the decade of 1975-1984.

June to August water temperatures at 2 meter depths during 2009 averaged 21.7^{o}C (71.1^{o}F), virtually identical to the long-term average. Summer water temperatures in Oneida Lake have increased significantly over the full duration of record (1968-2009), but have not shown a significant trend over the past decade. Average temperature records from 1975 to 2009 are displayed in Figure 11.

Figure 11: Average May-October Water Temperature, Oneida Lake at Shackelton Point



Data source: Cornell Biological Field Station

IV. DOUBLE-CRESTED CORMORANTS

Double-crested cormorants continue to be a concern for the Oneida Lake community primarily because of the impact on fish populations. Cormorants feed on young walleye and yellow perch and were the primary cause for the fishery decline on Oneida Lake observed during the 1980s and 1990s (CBFS). This decline contributed to a loss of jobs and angling-related revenue in the counties that border the lake. Secondary impacts of cormorant populations include damage to vegetation on the islands where resident birds nest, and increased competition for food and habitat with other colonial nesting birds such as the common tern.

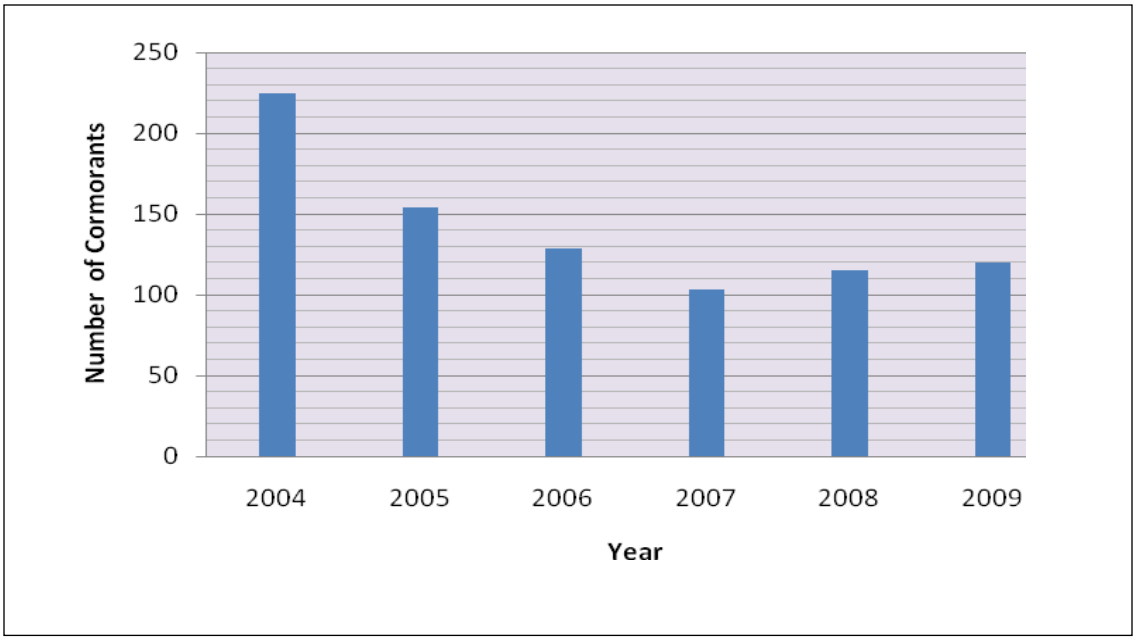
Cormorants were first observed in Oneida Lake in 1984. Bird populations on the lake increased gradually over the next two decades, reaching a high of 2,700 per day during the fall migration period and an adult summer resident population of approximately 900 birds (NYSDEC). A cormorant control program, managed as a partnership between the NYSDEC and the US Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS), was initiated on Oneida Lake in 1998.

The hazing program was conducted each year during the spring, summer, and fall. Cormorant use of the lake decreased significantly, leaving larger walleye and yellow perch populations that were available to anglers. The average number of migrating birds on the lake during the sping and fall migration period dropped to less than 200 per day from 2005 to 2008 and the summer resident population was consistently less than 150 birds per day. The NYSDEC established cormorant population goals of 100 adults and 20 active nests with no successful hatching. The average cormorant population counts for Oneida Lake are presented in Figure 13. This data was collected by the USDA APHIS from 2004 to 2009.

The hazing program on Oneida Lake was discontinued in 2010 due to lack of federal funding. Anglers and local business owners feared that the anticipated increase in the cormorant population and the subsequent decrease of walleye and yellow perch would once again have negative impacts on tourism and the local economy. The NYSDEC then implemented a cormorant hazing program in the fall of 2010 with the help of 59 volunteers that had been recruited by the Oneida Lake Association and the New York B.A.S.S Chapter Federation. Volunteers invested 229 hours on the lake and successfully hazed 4,763 cormorants. In addition, DEC staff spent 90 hours in hazing activities, successfully impacting 1,070 birds.

Figure 12: Double-Crested Cormorant
(Photo credit: Peter Wallack)

Figure 13: Oneida Lake Average Cormorant Population Counts 2004 to 2009



Source: USDA APHIS

Table 8: Cormorant Notes of Importance

Year	Average Cormorant Population	Notes of Importance
2004	225	2004 was the first year that hazing was conducted year round (spring to fall) instead of only in the fall, as in previous years. The program had two full-time staff members.
2005	154	Funding was available for four additional staff, which improved the effectiveness of the hazing.
2006	129	Staff and funding remained stable in 2006.
2007	103	Staff and funding remained stable in 2007.
2008	115	Reduced funding caused a 35% reduction of staff hours and hazing from 2007 levels.
2009	120	Further funding cuts caused a 20% reduction of staff hours and hazing from 2008 levels.
2010	unknown	Funding was eliminated and no hazing or surveying was done. The Cornell Field Station continues to do some cormorant population counts.

Source: USDA APHIS

V. INVASIVE SPECIES

Aquatic Invasive Plants

Aquatic invasive plants are a continuing problem on Oneida Lake because they out-compete native plants, spread rapidly, and restrict recreational activities such as boating and swimming. Aquatic invasive plants can spread from lake to lake when plant fragments attach to boat propellers, paddles, or clothing. Some of the most problematic exotic and invasive plant species, such as water chestnut, Eurasian watermilfoil and purple loosestrife, can be purchased over the Internet and shipped throughout the United States which makes them very difficult to control. A priority goal for the Oneida Lake community is early detection of new infestations and rapid control strategies in order to preserve the integrity of the Oneida Lake ecosystem. The following list of invasive plants are commonly found in and around Oneida Lake. Additional information about these plants can be found at the New York Invasive Species Clearinghouse website: http://nyis.info/About.aspx or at the Oneida Lake Education Initiative website: http://www.oneidalakeinfo.org/

European frog-bit, *Hydrocharis morsus-ranae*

European frog-bit is a free-floating aquatic plant that originated in Europe and Asia. The dark, heart shaped green to purple leaves can be found along slow moving sections of freshwater rivers and lakes, in addition to swamps and marshes. This emergent perennial produces tiny, white flowers in the summer. Reproduction takes place when the buds of the plant break off and sink to the bottom. European frog-bit is an aquatic nuisance plant mainly because it forms dense canopies on the water's surface which prevents sunlight penetration into the water column.

Eurasian water milfoil, *Myriophyllum spicatum*

Eurasian water milfoil is native to Europe and Asia. It was first identified in Lake Erie in 1952 and spread rapidly throughout New York State. Milfoil can grow to lengths of 20 feet and reproduces by seed or fragmentation. The plant out-competes native vegetation and forms dense canopies, blocking sunlight penetration to the lake bottom. It also interferes with boating, swimming and fishing and decaying plant material reduces oxygen levels in the water column. When the plant material is uprooted and washed onto the shore, decaying plant material is unattractive and produces a foul odor.

Water chestnut, *Trapa natans* is native to Asia and was detected in Oneida Lake in 1999. Plants can grow up to 20 feet long and produce floating, triangular shaped leaves. Water chestnut normally grows in slow moving, shallow bays and coves where the dense vegetative canopies restrict light penetration through the water column. Plants produce a seed that has sharp spines and a thick husk. Dense stands of water chestnut plants interfere with boat navigation, fishing, swimming, and other recreational activities. When the plant material washes on shore, it produces foul odors during decomposition. Control strategies included mechanical, chemical, and hand-pulling.

Common reed, *Phragmites australis*

Common reed was introduced to the United States during the late 1800s. As with most invasives, the plant forms dense monocultures that out-compete and replace native wetland plant communities. This changes the way the ecosystem functions and negatively affects native wildlife. Common reeds can grow up to 15 feet tall. The plants reproduce by seed and through below-ground rhizomes. Dense stands are typically found in wet, marshy habitats along the Oneida Lake shoreline.

Purple loosestrife, *Lythrum salicaria*

Purple loosestrife was introduced to North America in the early 1800s and stands are now commonly found in wetlands and ditches and along the Oneida Lake shoreline. In areas where purple loosestrife dominates, native cattails (*Typha latifolia*) are usually absent. The loss of cattail stands means the loss of prime habitat for waterfowl and other marsh animals. In addition, the replacement of the native cattail by introduced purple loosestrife negatively impacts other smaller organisms including the survival and development of American toad tadpoles (*Bufo americanus*) through a combination of direct toxicity and shifts in algal communities.

Starry stonewort, *Nitellopsis obtusa*

Starry stonewort is native to Europe and western Asia and was introduced to Oneida Lake in 2005. The microalgae form a thick mat on the lake bottom, preventing the growth of other plants. Stoneworts anchor themselves to the bottom with hair-like filaments called rhizoids that absorb nutrients and stabilize the plants. Stonewarts are often found floating among masses of coontail and duckweed and can tolerate low nutrient and light levels. Plants can be found at depths of 3-20 feet in lakes or slow moving rivers.

Japanese knotweed, *Polygonum cuspidatum*

Japanese knotweed is from Eastern Asia and was introduced into the United States for ornamental and erosion control purposes in the 1870s. The plant has bamboo-like stems and can grow as tall as 15 feet. Knotweed thrives in disturbed areas and can spread rapidly creating monoculture stands that threaten native plant communities. Japanese knotweed can tolerate deep shade, high temperatures, high soil salinity and drought. It is commonly found along streams and rivers, in low-lying, disturbed areas such as rights-of-way.

Aquatic Invasive Animals

The following list describes the aquatic invasive animals that pose a threat to aquatic life in the Oneida Lake. These summaries were compiled from information found on the New York Invasive Species Clearinghouse website: http://nyis.info/About.aspx and the Onieda Lake Education Initiative website: http://www.oneidalakeinfo.org/.

Alewife, *Pomolobus pseudoharengus*

Alewife are native to Atlantic coast drainages from Labrador to South Carolina. They have been present in Oneida Lake since at least 1916 but have never become abundant. Alewife, sometimes referred to as sawbellys, have a greenish or bluish back and silvery sides with faint dark stripes. Adults are usually about 6 inches long but can grow to 10 inches and their lifespan is six or seven years. In freshwater systems such as the Great Lakes, they are important prey for popular game fish like salmon and trout. In Oneida Lake, alewife are uncommon and provide only very limited food for predators like walleye.

Amphipod, *Echinogammarus*

Amphipods are native to eastern Europe and western Asia and were introduced to the United Stated in ballast water discharged by transoceanic ships. They were first discovered in Oneida Lake in 2002 and currently occupy shallow water habitats. Amphipods, also known as "scuds" or "sideswimmers", are tiny relatives of crayfish and adults are about ¼ inch long. They live on or near the lake bottom, feeding on microscopic plants, animals, and debris. Amphipods are excellent food for many Oneida Lake fish.

Carp, *Cyprinus carpio*

Carp prefer warm streams and lakes with muddy bottoms. They are bottom feeders that eat mostly zebra mussels, zooplankton, invertebrates, and aquatic plants, and can easily be spotted by the cloud of mud they stir up while feeding. Carp are originally from Eurasia and were first brought to New York as a food fish. A few carp from a Newburgh, NY pond escaped into the Hudson River and became established in the early 1830s. They can tolerate polluted water but prefer clean water. Carp taken from clean waters are excellent to eat and are commercially marketed live or smoked.

Eurasian rudd, *Scardinius erythrophthalmus*

Eurasian Rudd were brought to the United States in the late 1800s or early 1900s for use as a baitfish. Abundance of rudd in Oneida Lake is low and they are observed infrequently. Rudd can be found in lakes, rivers, marshes, canals and ponds. They prefer weedy habitats and have the potential to become a nuisance due to their consumption of aquatic plants. Despite this fact, rudd are largely carnivorous, feeding on aquatic crustaceans, snails and insects.

Faucet snail, *Bithynia tentaculata*

The faucet snail was first identified in Oneida Lake in 1915 and became abundant by the 1960s. It feeds by grazing on algae on submersed surfaces but prefers suspension feeding—a method where algae are filtered from the water. The snail serves as an intermediate host for trematodes (intestinal parasites) that have been implicated in the deaths of waterfowl in the Mississippi Basin since 2002. The snail is a newcomer to that area, having arrived in the late 1990s. If the snail population is heavily infected with trematodes, birds may ingest a lethal dose within 24 hours of feeding.

Gizzard shad, *Dorosoma cepedianum*

Gizzard shad are quiet water fish that live in lakes, bays, and sluggish rivers. They prefer clear water, though they can tolerate high turbidity areas. Gizzard shad are filter feeders, and are one of New York's few freshwater fish that eat mostly plant material, phytoplankton, and algae. They were first documented in Oneida Lake in the 1950's. They disappeared shortly after their initial introduction, but were reintroduced through the flooding events that came with Hurricane Agnes. Today, gizzard shad are an important food source for many gamefish and are vital to the walleye here in Oneida Lake. If not kept under control, populations can grow rapidly and may become a problem. Most anglers consider them a nuisance species.

Round goby, *Neogobius melanostomus*

The round goby is a freshwater fish native to central Eurasia. They feed on mollusks, crustaceans, worms, fish eggs, small fish, and insect larvae. Goby are aggressive and have an opportunistic feeding behavior. Their ability to survive in degraded environmental conditions has also increased its competitive advantage over native species and populations of native aquatic life often decline. Round goby have been found in the Oswego River system, but have not been identified in Oneida Lake at this time. Besides out competing native species, round gobies are a known carrier of type E botulism. Additionally, by heavily feeding on invasive (zebra and quagga) mussels, round gobies may increase the bioaccumulation of toxins in upper levels of the food chain (fish such as smallmouth bass and walleye).

Rusty crayfish, *Orconectes rusticus*

Rusty crayfish are native to streams in Ohio, Kentucky, and Indiana and were likely introduced to Oneida Lake by anglers who used them as fish bait. They can also be purchased from biological supply companies and could have been later released into local waters from home or school aquaria. Rusty crayfish were first noted in Oneida Lake in 2005. They are aggressive and may out-compete native crayfish for food and habitat. Due to their higher metabolic rate, they consume more food than native crayfish. Their ability to displace native crayfish combined with their larger size may result in less food availability or shifts in diet for fish such as black bass.

Sea lamprey*, Petromyzon marinus*

The sea lamprey is an eel-shaped fish with a skeleton made of cartilage. Its mouth, which looks like a suction cup, is filled with sharp teeth. Sea lamprey are marine fish that spawn in fresh water and are found mostly in coastal streams and rivers. However, some populations have become landlocked (no path to the ocean), and are found in lakes during their adult life. In New York, landlocked sea lamprey can be found in Lakes Ontario, Erie, Seneca, Cayuga, Oneida, and Champlain. It is a parasitic fish and attaches to prey by using its teeth and suction-disk mouth. A file-like tongue is then used to puncture the skin and drain the body fluids. Sea lamprey cause detrimental effects to fisheries and ecosystems. Populations can be controlled by lampricides. In the Oneida Lake tributaries, this treatment has been done every 5-7 years since 1984.

White perch, *Morone americana*

White perch can live in fresh or saltwater habitats, though they prefer brackish coastal waters. In New York, white perch live in many of the state's rivers (e.g. St. Lawrence, Seneca, Mohawk, Hudson) and lakes (e.g. Oneida and Chautauqua Lakes, Great Lakes Erie and Ontario). They feed on fish, fish eggs, invertebrates, and zooplankton. In Oneida Lake, white perch consume yellow perch, emerald shiners, snails, amphipods, caddisflies, and other invertebrates. White perch were first documented in Oneida Lake in 1951 and became abundant in the 1970's. They are now the 2nd most abundant Oneida Lake fish.

Zebra mussel*, Dreissena polymorpha*

Zebra mussels are native to the Black, Caspian, and Aral Seas of Eurasia. They were first detected in 1988 in Lake St. Clair and within five years had spread to all the Great Lakes and through the Mississippi basin. They were first discovered in Oneida Lake in 1991. Zebra mussels arrived in the ballast water of transoceanic ships and have spread by attaching themselves to boat hulls, by unintentional transport in recreational watercraft and gear, and by natural dispersal. They attach themselves to rock, wood, steel, concrete, vegetation, and even each other. Each mussel can filter over one quart of water each day, resulting in increased water clarity. Since the establishment of zebra mussels, Oneida Lake has experienced record water clarity. The year with the clearest water on record in Oneida Lake was 1995, four years after the establishment of zebra mussels. In Oneida Lake, clearer water has allowed submerged aquatic plants to grow at depths of 15 feet or more in some locations. A consequence of zebra mussels in Oneida Lake has been the extirpation of three native clam species.

Quagga mussel, ***Dreissena rostriformis bugensis***

Quagga mussels were first observed in Lake Erie in 1989 and are thought to have been introduced from ballast water. The shell is striped but is a lighter shade than zebra mussels. Quaggas colonize on hard surfaces, reproduce rapidly, and populations are difficult to control. They can clog intake pipes and screens, reducing the capacity and efficiency of power and water treatment plants. They have the capacity to filter large amounts of water. This alters the food web by removing phytoplankton, limiting the food supply of zooplankton, and increasing water transparency.

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