



## Executive Summary

### 2021 Creel Survey Results

- Mean targeted walleye catch rates in June and July were 0.36 and 0.42 walleye per hour, considered a very good fishery in New York State. Open water harvest of walleye was 39,000 fish, about 10,000 fish below the 2011-19 average harvest.
- Oneida Lake's second most popular group of sport fish are the black bass; smallmouth and largemouth bass. The June and July creel survey is not predictive of full season catch rates, but the summer creel does provide an index of trends in the quality of black bass fishing. Targeted catch rate of smallmouth bass in June was 0.47/hr and 0.37/hr in July, and 0.12/hr and 0.08/hr for largemouth bass. The smallmouth bass catch rate was slightly below the 2011-19 average.
- Angler catch rates of adult black bass in Oneida Lake fall in the middle of the range for black bass populations elsewhere in the State.

### 2021 Species Reports

#### Walleye

- Based on the 2019 mark-recapture study, predicted recruitment, and mortality estimated from 2016-2019, the 2021 estimate of the adult walleye population was one million fish. The population remains at a level not observed since the mid-1980s and the late 1950s before that.
- Concurrent with increases in the walleye population are declines in growth and condition. Mean length of adult walleye has decreased every year since 2018. Relative weight of walleye in the fall has decreased from 98 in 2016 to 87 in 2020 and 85 in 2021 (100 is a fish that weighs the "average" for its length through its range). Both indices suggest that recent forage abundances cannot support past growth rates under current walleye population levels.
- Following establishment of invasive mussels, survival of pelagic (larval and early juvenile stage) walleye decreased possibly from increased vulnerability to predation associated with clearer water. In recent years, survival of young walleye was higher when white perch numbers were low, allowing recruitment of young fish to the adult walleye population.

#### Yellow Perch

- The adult yellow perch population has also increased in the last three years. The adult population rose from 1.9 million fish in 2019 to almost 3.0 million in 2020 and 2021. Similar to the walleye, these population levels have not been observed since the early 1980s.



- These increases coincide with decreases in the white perch population that is known to feed on young perch. Double-crested cormorant control has also contributed to the increase in the adult yellow perch population.
- The return of the burrowing mayfly and establishment of the round goby have also contributed to the increase in adult yellow perch abundance. Both are common in predator diets early in the summer when predators would otherwise be feeding on young yellow perch.
- The presence of these two prey species has also resulted in observed increases in adult yellow perch growth.
- Young of year yellow perch are the primary component of the adult walleye diet in spring and early summer before young gizzard shad become available as forage. All evidence suggests that the adult walleye population is too large relative to its forage base to sustain previous growth rates. Under these conditions, recruitment of yellow perch is likely to suffer in the near term.

### Largemouth Bass & Smallmouth Bass

- Establishment of first zebra mussels and then quagga mussels resulted in increases in water clarity and increases in nearshore vegetation over the period 1990 to 2021. Increased vegetation is favorable for both black bass species, especially largemouth bass. Oneida Lake is also exhibiting warming, with mean summer water temperature increasing 0.1 °F per year since the 1975. Warmer summers have been shown to enhance black bass year class size at northern latitudes like Oneida Lake.
- The smallmouth and largemouth bass populations increased during the 1990s indicating that current lake conditions have become more favorable for black bass. Black bass numbers are as much as three times higher than before the lake cleared and nearshore productivity increased.
- Black bass have been sampled with spring electrofishing two of every three years since 2011. Catch rates in 2021 were at the lower end of the range observed over that period but still suggest a larger population than prior to mussel introductions.
- During the falls of 2017 and 2018 a portion of the smallmouth bass population was observed with visible lesions which were associated with largemouth bass virus. However, we did not observe large-scale mortality, and no diseased adult smallmouth bass were observed since. It remains to be seen if the virus will affect the Oneida Lake black bass populations.

### Prey Fish

- Young of year and yearling yellow perch are a major prey for Oneida Lake's predators. Other important forage species include emerald shiner, round goby, young of year sunfish (in nearshore habitats), gizzard shad (seasonal, late summer into winter prior to an annual winter kill in most winters) and burrowing mayfly.



- In most years, gizzard shad dominate the late season diet of walleye comprising on average, nearly half of walleye diets. Gizzard shad abundance has been very low the past 3 falls, as has their contribution to fall walleye diets.
- Low survival of young of year gizzard shad in 2019-21 further indicates that the adult walleye population is high.

### Round Goby

- The round goby was first confirmed in Oneida Lake from stomachs of winter-caught yellow perch in 2013. Numbers in most sampling gears increased through 2016 when an apparent winterkill reduced numbers.
- A video survey representing all lake bottom habitats was instituted in 2018. Densities of round goby were estimated at 4,000/acre in 2018 and increased to 10,400/acre in 2020 and 16,100/acre in 2021.
- Round goby has potential to exert a large influence on the Oneida Lake ecosystem. There is already evidence that it will displace species with similar habitat preferences such as darters, reduce abundance of benthic invertebrates, reduce mussel density and biomass, and contribute to the prey base of the lake's predator population.
- All predators use round goby as forage to some extent. They appear to be most important to species that feed on small gobies (yellow perch and white perch) or that co-occur with them in nearshore areas (smallmouth bass and chain pickerel).
- Round gobies are common in double-crested cormorant diets throughout the summer.

### Lake Sturgeon

- Since 1995, just under 13,000 juvenile lake sturgeon have been stocked into Oneida Lake as part of an effort to establish a self-sustaining population, many in a single large stocking of 5,000 fish in 1995. Just over 8,100 fish were stocked between 1995 and 2004. No additional stocking took place until 2014 after which 500 fish have been stocked annually (1,000 in one year) to improve genetic diversity of the population.
- Growth rates of lake sturgeon exceed or rival those from any other system with available data (the largest fish caught by Cornell so far weighed just under 160 pounds), and natural reproduction has been documented in eight of nine years since 2011.
- Lake sturgeon consume primarily benthic invertebrates until they reach about 30 inches and mussels then become the dominant diet item. While unverified here, it is reasonable to speculate that Oneida Lake sturgeon receive an important annual diet supplement when gizzard shad winterkill, as they do in Lake Winnebago where shad dynamics are similar and growth rates are high. We have also observed small round goby in diets of some lake sturgeon.



### Other Fish Species

- Oneida Lake hosts one of, if not the most diverse fish communities of any water in New York State. Of the 167 species documented in the state (as of 2015), 85 have been reported in Oneida Lake. Of these, 73 are considered native and 12 non-native. The community includes 22 different families of fish and 52 genera.
- Species arguably underutilized as sport fish resources include white perch and chain pickerel, both common to abundant but rarely targeted as sport fish.

### Invasive Species

- Oneida Lake hosts many non-native species, some introduced intentionally as part of early management efforts (brown trout, rainbow trout, and common carp) and others arriving through the canal system or other means.
- At least 12 non-native species of fish, six molluscs, five invertebrates, and seven plants have been documented in Oneida Lake. Most recent (2019), and potentially problematic is a predatory zooplankton - the spiny water flea.
- Most non-native species do not have measurable impacts on their new ecosystems, but some do and are therefore considered invasive species.
- Zebra mussels were established in Oneida Lake in the early 1990s and quagga mussels in the mid-2000s. These mussels efficiently filter phytoplankton leading to clearer water, macrophyte growth to greater depths and a shift of energy flow from pelagic to benthic pathways.
- Gizzard shad likely invaded Oneida Lake from the Great Lakes via the canal in mid-century. A population of adults annually produces an abundant crop of young of year shad. This abundant forage helps support a larger sport fish population than could not be supported by yellow perch alone, as well as provide a buffer from predation by double-crested cormorants on more desirable species such as walleye and yellow perch. In most years uneaten shad winterkill preventing overpopulation, something that could change with continued lake warming.
- White perch likely invaded from the Atlantic coast up the canal system in mid-century. They may be as abundant as yellow perch in some years. Their young of year provide additional forage for sport fish, but adults are competitors for benthic invertebrates with more popular species such as yellow perch. White perch are also effective predators on larval walleye and yellow perch.
- Round goby established in 2014. Their impacts have yet to be fully understood but likely include roles as additional prey for predators, competitor with species with similar lifestyles, competitor for invertebrate food resources, and consumer of mussels which could reverse processes associated with the establishment of mussels and associated water clearing.
- The spiny water flea was discovered in Oneida Lake in fall 2019. Mean annual biomass had almost tripled by 2020 and remained high in 2021. Elsewhere, this species has negatively affected daphnia, another zooplankton species that is an efficient grazer of phytoplankton and preferred prey for many small fishes, and



caused declines in growth rates of young yellow perch and young walleye. Their ultimate role in Oneida Lake is yet to be determined.

### Lower Trophic Assessment

- The lake is warming significantly, with summer (June-August) water temperatures increasing 0.1 °F per year, and the period of ice cover decreasing six days per decade.
- Oneida Lake was naturally eutrophic (highly productive) even before the area was settled, surrounded by abundant, fertile swampy areas, and prone to floods that transported decaying plant matter into the lake. Oneida was also well known for its bluegreen algae blooms before modern run-off issues arose. The establishment of zebra and quagga mussels, as well as nutrient loading reductions have resulted in the lake reaching a more mesotrophic state (moderate nutrient levels). Water clarity (Secchi disc) increased further after quagga mussels became dominant, and chlorophyll *a* and phosphorus have declined. Similarly, daphnia biomass (but not other zooplankton like copepods) has decreased over the same period.
- It appears round gobies can suppress the mussel density in Oneida Lake. If this continues, limnological conditions could exhibit major changes in the near future.
- The burrowing mayfly reappeared around 2012 after a 50-year absence. Their numbers have increased to a point that they are now one of the most common diet items in walleye, yellow perch and white perch during the early summer months. They likely enhance the survival of young fishes but may make catching walleye more difficult for anglers during the peak of their emergence.