GIZZARD SHAD:

Impacts on Fishing in the Winnebago System

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Curt Schmahl displays a healthy 9 pound Winnebago System walleye that was captured as part of the annual spring spawning stock assessments conducted by the Wisconsin DNR.

Many anglers are aware that gizzard shad and other non-native forage fish species are present in larger water bodies within Wisconsin, but the impacts these fish have on fishing success may be a little more obscure. Fish species like gizzard shad are typically prolific and exhibit boom and bust recruitment dynamics. Strong "boom" year classes of gizzard shad can shut down an active bite quicker than any cold front, while fishing can be exceptional during low "bust" recruitment years.

In Wisconsin, gizzard shad (see below) occur mostly within the Mississippi River and Lake Michigan drainages. Shad are very prolific reproducers due to a variety of life history

characteristics including protracted spawning window, high fecundity (large numbers of eggs), early maturation, and short egg incubation periods. Spawning typically takes place at water temperatures of 60-70°F, coinciding with May through early August in Wisconsin. This extended spawning period allows for multiple hatches of shad throughout the summer growing season. Females mature at 23 years of age and have been observed carrying in excess of 300,000 eggs. In comparison, a small percentage of males mature at age-1, while the majority spawn for the first time at age-2. Following fertilization, eggs incubate for a relatively short period of time before hatching (36-95 hours, dependent on water temperature).

Shad primarily feed on zooplankton (animal constituent of plankton) early in their life history, while larger shad feed on both zooplankton and phytoplankton (algae). Therefore, shad are pelagic feeders that spend considerable amounts of time suspended in the water column. Shad are highly susceptible to mortality during cold water periods and thus experience large die offs during Wisconsin winters. In large part due to the advantageous life history attributes described earlier, the relatively low percentage of fish that do survive the winter months are able to effectively reproduce and sustain the population.

The abundance of gizzard shad, in combination with being soft rayed fish containing high fat content, make them a desirable prey item for larger predatory fish. This is the case on the Winnebago System, where shad are an important forage item for a multitude of fish including walleye, northern pike, muskellunge, and largemouth bass. Lake sturgeon also opportunistically feed on dead or dying gizzard shad during winter months. In fact, gut contents collected from sturgeon harvested during recent sturgeon spear fisheries have almost exclusively contained gizzard shad.

Given the importance of gizzard shad and other forage fish species to the health of the fishery, DNR fisheries staff monitor the year class strength of various game and non-game fish species through bottom trawl sampling conducted during the first week of August, September, and October. Important forage fish species monitored include gizzard shad, freshwater drum, troutperch, white bass, and emerald shiners. In general, a strong forage base should result in healthy predatory fish that are in good condition (plumpness).

To assess condition of walleye in the Winnebago System, DNR fisheries staff measure and weigh a sample of adult walleye collected during spring spawning assessments. The length and weight data allows us to track the relative condition

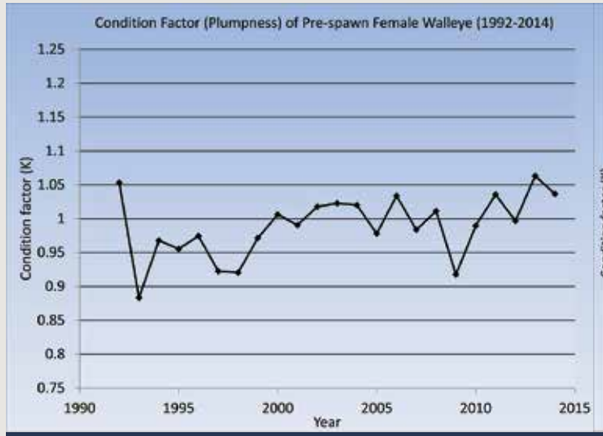

Figure 1. Displays the relative condition (plumpness) of pre-spawn adult female walleye captured during spring spawning assessments on the Winnebago System (1992-2014).

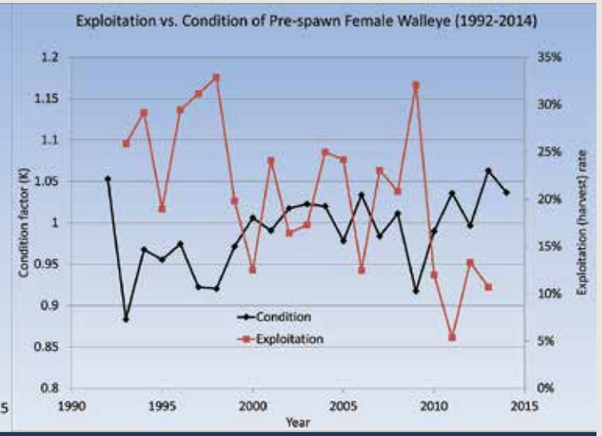

Figure 2. Displays the inverse relationship between pre-spawn female walleye condition (plumpness) and exploitation (harvest) rates of female walleye from the Winnebago System (1992-2014).

(plumpness) of fish from one year to the next. In this analysis, a condition value of 1 is average, while condition values greater than 1 represent years that fish are in above average condition. Figure 1 (see above) displays the condition values of pre-spawn female walleyes collected from the Winnebago System during spawning assessments spanning 1992-2014. As the figure indicats, the fish condition has been variable through the last 22 years, with peak condition observed in 1992, 2006, 2011, and 2013.

The above picture was taken in 2010 during a bottom trawl assessment conducted by the DNR. The 2010 hatch is one of the largest shad hatches during the time series of 1986-present.

These years of well above average walleye condition all follow strong year classes of gizzard shad. In fact, bottom trawl data indicate that the six strongest shad hatches since 1986 in order from strongest to weakest were: 1991, 2010, 2009, 2012, 2002, and 2005. The improved condition of fish in the spring following a strong hatch is expected when considering that a strong shad hatch provides abundant forage to piscivorous fish from mid-summer through the remainder of the growing season. Therefore, strong hatches would translate to favorable walleye condition coming into the following April spawning migration, which appeared to be the case in most years.

Gizzard shad may be an important forage fish, but they are not the only species that walleye predate on. Similar to gizzard shad, hatch strength of freshwater drum (sheepshead) also correlate with years of strong walleye condition. Of the four highest years of walleye condition, two were preceded by well above average drum hatches while the remaining two years were preceded by average drum hatches. White bass and trout perch year class strength data do not correlate as well with walleye condition, suggesting that abundance of age-0 shad and drum have a stronger influence on walleye condition. Age-0 fish are hatched in the spring and are collected the same year. It is uncertain which species have the strongest impact on walleye condition, but shad recruitment is far more variable than drum recruitment and all "boom" shad hatches have been followed by springs of increasing walleye condition. Forage species including freshwater drum, white bass, and trout perch are more consistently available to predatory fish such as walleye, but gizzard shad abundance may have the strongest impact on fish condition due to their boom or bust nature.

Many anglers may be wondering what impacts fish condition and year class strength of forage fish have on fishing success. Well, simply put it's harder to catch fish that are in better condition than fish in poor condition. One of the main objectives of tagging walleye during spring spawning assessments is to assess exploitation (harvest) rates via angler tag returns. We know how many fish are tagged per sex and also how many of those fish are harvested in the following year. Figure 2 (see left) demonstrates the inverse relationship that exists between walleye condition and exploitation rates spanning a 20+ year period from 1992-2014. It shows that years of high fish condition are accompanied by below average exploitation rates and vice versa.

Interestingly, fish condition is trending upwards during this time series while exploitation rates are trending downwards. This may be hard for Winnebago System anglers to wrap their mind around, given that fishing on the system has been exceptional the last few years. However, there is one variable that has not been taken into consideration to this point and that is walleye abundance. Similar to monitoring year class strength of forage fish species, we also monitor year class strength of walleye and other game fish during bottom trawl assessments. We have been fortunate with some very strong walleye year classes produced within the last 6-8 years. These strong year classes are contributing large numbers of fish to the population and harvest, while still maintaining relatively low exploitation rates of the adult population.

The information presented in this article is a great example of the application of biological fisheries data to the understanding of angling success. We are fortunate to be able to collect these types of data on an annual basis on the Winnebago System. These data are the lifeblood of our walleye management program and critical to effective, sustainable management of the fishery.

The trends that are described in this case study from the Winnebago System are applicable to other populations. It's no secret that forage abundance affects fishing success, but understanding the dynamics of the forage base can lead to putting more fish in the boat. There's a reason that shad shaped crankbaits such as Berkley flicker shads and Rapala Shadraps can yield fruitful catches of walleye from the Winnebago System and other water bodies containing gizzard shad; most of the time it's about "matching the hatch". If nothing else, understanding forage base dynamics helps explain variable fishing success from year to year. There are other factors that affect fishing success, but none are likely more critical than year class strength of target game fish and critical forage species.

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