

Factors Influencing Smallmouth Bass Year-Class Strength and Future Smallmouth Bass Fisheries

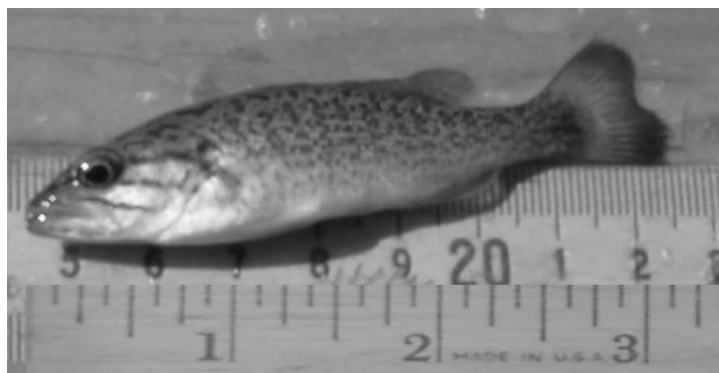
Smallmouth bass fishing is a popular sport on Pennsylvania's rivers and streams. Bass anglers spend many hours on the water pursuing this fish. Many anglers have a written record or a sense of their success on a particular waterway in a given season. Their experiences show that some years are better than others. Anglers often express their concerns over these fluctuations to the Commission, and they want to know why they occur. Some anglers may even have concerns that these fluctuations occur because of the fishing regulations in place.

Our agency must look at all factors, environmental as well as social, to make sound fish management decisions. We cannot thoroughly evaluate harvest regulations until we account for other influences. Doing so requires a detailed look at bass populations and environmental conditions over many years. It also requires keeping up to date with research conducted in other states and provinces

Commission data, and research conducted on other rivers in North America, show that environmental factors such as flow have the greatest influence on year-class strength--no matter which regulations are in place.

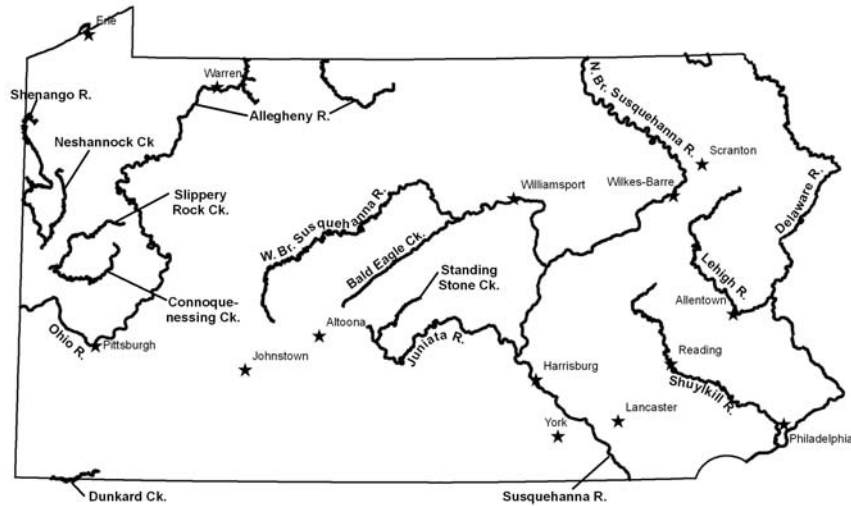
Agency fisheries biologists have been monitoring smallmouth bass populations in rivers and warmwater streams since the late 1980s. We use backpack electrofishing gear to collect young bass, July through August each year.

At each sampling station, our biologists conduct six 50-meter electrofishing runs. They sample some 70 stations each year, and they collect data in approximately 400 50-meter sections. They gather information on the number, size and condition of young-of-the-year (Y-O-Y) smallmouth bass.



Young-of year bass range in size from 34 to 75mm
(1.25 to 3 inches).

Rivers are divided into reaches for sampling purposes, since an entire length can't be sampled. A reach of river is a segment that is well defined and has habitat and conditions that are similar or representative of the rest of the river. Waters sampled as part of our Y-O-Y monitoring include the Delaware, Lehigh, Schuylkill, Susquehanna, Juniata, Ohio and Allegheny rivers and several warmwater streams. The map below shows most of the waters we sampled.



We then use the number of bass caught to estimate the average Y-O-Y density for each river or warmwater stream reach. The Y-O-Y index is the measure of bass caught per 50 meters. The number that results from this sampling is an index, not an absolute number. In other words, if the Y-O-Y index for a given reach of river is five, it doesn't mean that there are only five bass in that 50 m section of the river! This index helps us compare years, establish trends, and evaluate individual year-class strength. The relationship of the index to other variables can be measured and tested.

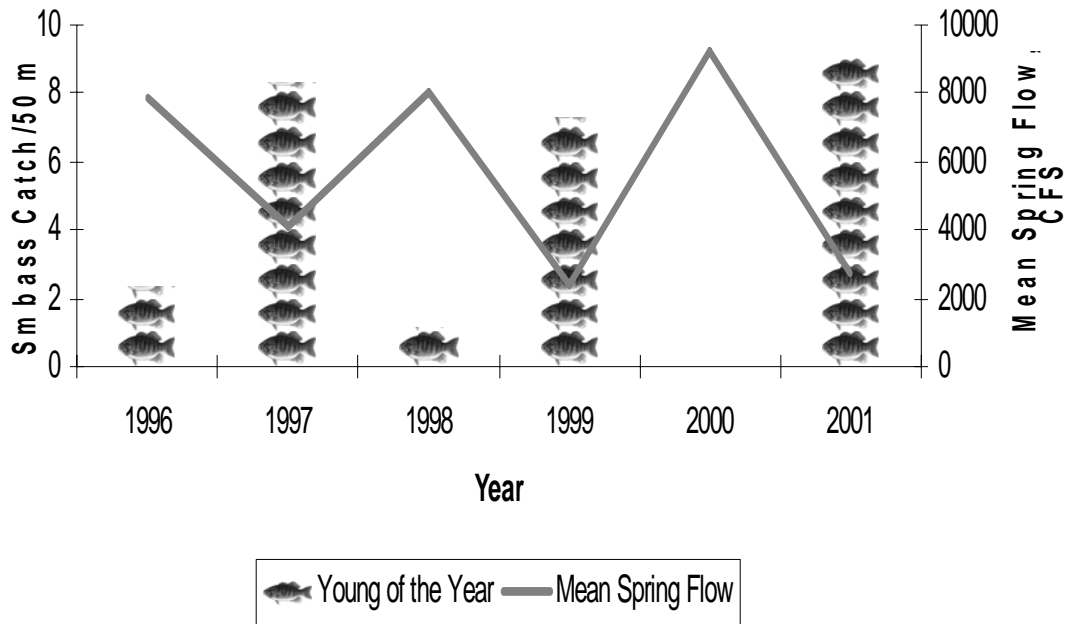
We compared the Y-O-Y index to river flow and water temperature for these waterways during the bass spawning seasons for 1987-2001. Spawning season starts when water temperature reaches 15°C (59°F) for three days in a row. In a typical year, this begins sometime in mid-April and usually runs through late June. These comparisons allowed us to determine which environmental factors were influencing production of Y-O-Y.

Our monitoring showed that Y-O-Y bass populations varied widely from 1987 to 2001. This is no surprise since fish populations naturally fluctuate over time. Our analysis also showed that temperature by itself did not seem to have a significant influence on the Y-O-Y densities, although we suspect that there would be some effect when coupled with river flow. We also learned that the greater the river flow, the lower the Y-O-Y density. It seems apparent from our research, then, that river flow does affect survival of young bass and ultimately the adult population.

Here's an example of this relationship, with data from a 6-year period on the Delaware River, reach 14. This is the section of the river between the Lackawaxen River and the Lehigh River.

The average index (for the period 1987-2005) for this reach is 4.67. As you can see, when river flows were high, as they were in 1996, 1998, and 2000, the Y-O-Y index was below average. Above average Y-O-Y catches occurred (1997, 1999 & 2001) when flows were lower.

Reach 14 Delaware River, Young of the Year and Mean Spring Flow



How do river flow and water temperature influence bass populations? Several studies suggest how, and give us some idea of what occurs. Spawning male bass need to choose good nesting habitat. Ideal smallmouth bass nest habitat includes shallows, backwaters and warm sloughs. The substrate should include clean stone, rock or gravel (about the size of marbles or golf balls—but no larger). There should be adequate cover (depth of water or vegetation) and refuge from the current.

Ideal nest locations are those with the right combinations of bottom type, cover and current. High river flow and turbid conditions limit ideal habitat or make some habitat unsuitable—because of faster currents. These difficult conditions force the bass to select poor or less-than-ideal habitat for nest construction. Less-than-ideal nesting habitat can reduce the number of eggs or fry that survive.

Strong river flow and colder-than-average water temperature have a big influence on bass eggs and bass fry. Heavy river flow can displace bass eggs or fry from the nest. Eggs or sac fry can be covered with sediment. The fry may become disoriented in the turbid conditions and abandon their nest. Research has shown that fry cannot tolerate high water turbidity when combined with increased river flows. Older fry that leave the nest will have to use a lot more energy to swim and feed in heavier currents. Heavy river flows also reduce the amount of shallow areas that

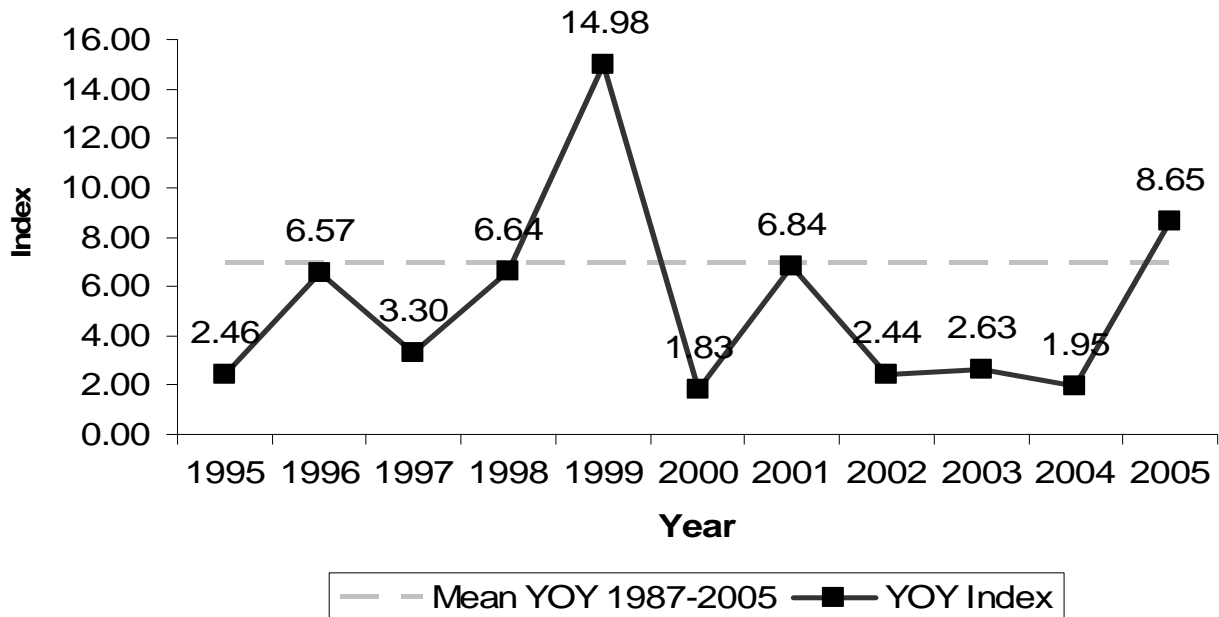
young bass need to survive. These shallow areas provide the ideal growing conditions. They are warmer and have fewer predators. In cold water, fertilized eggs take longer to develop, making them more susceptible to disease and predators. Fry activity and swimming will decrease at low water temperatures. Cold water and high river flows together make it difficult for bass fry to move about, find food and survive. While many studies show that water temperatures influence Y-O-Y strength, studies conducted in Pennsylvania don't show that. In Pennsylvania, river flow has the greatest influence on Y-O-Y strength.

We have learned that we cannot use the Y-O-Y index to predict exactly how many legal size bass will be available in the future. However, we have learned that the number of 1-year-old-fish caught in our sampling is related closely to Y-O-Y.

Smallmouth bass length	Approximate age
6"	1
12"	4
15"	6

Analysis of data collected on fish length and age in Pennsylvania tells us that one-year-old fish are approximately 6 inches in length. It will take three more years for a bass to reach 12 inches in length. To reach 15 inches it will take at least six years. Many variables come into play over that period. However, stronger year classes (based on our Y-O-Y index) can result in better fishing 3-6 years later.

Below is a plot of the Y-O-Y index for the Susquehanna and Juniata rivers. The average index for these waters is 6.9. The 1999 Y-O-Y index was 14.98 bass/50 m. If all conditions in the river were ideal each year (and we know they never are), it's reasonable to expect that 4-6 years after an above average year class, fishing for legal fish would be better.



From 2000 to 2004 the Y-O-Y index was at or below average. Bass anglers seemed to catch fewer bass in 2005. This was likely due to the very high river flows and colder water temperatures that occurred several springs ago across much of our state.

The 2005 index was calculated at 8.6 Y-O-Y smallmouth per 50 meters surveyed, above the average of 6.9. What will fishing be like then in 2009 and 2010? Unfortunately, during the time it takes to reach legal length, a 12-inch smallmouth bass has probably survived being caught and released, escaped predators, survived four winters, spring floods and summer droughts. A 12-inch bass has also likely survived the rigors of spawning at least once. Some studies have documented that half the smallmouth bass population dies of natural causes, or is caught and kept.

Anglers complaining about lousy bass fishing—or rejoicing about the great fishing, should consider spring and summer conditions 3-4 years earlier. What were the conditions at that time? Were the river flows high during the spring? Was the water colder than usual during the spring? It is very likely that a poor bass fishing season was the result of high spring river flows and cold-water temperatures that occurred in the previous two or three years.

—*prepared by PFBC Staff*

References

Lorantas, R. M. and Kristine, D.P., 2004. Annual monitoring of young of the year abundance of smallmouth bass in rivers in Pennsylvania: Relationships between abundance, river characteristics, and spring fishing. Pennsylvania Fish & Boat Commission, Bellefonte. USA.

A copy of this report is available from the PFBC website, www.fish.state.pa.us. Many references to the scientific literature on smallmouth bass are included in this report.