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When a reservoir fills for the first time, the water is deep and clean, and this sort of environment favors trout (right). As the reservoir ages, water quality changes, favoring other species such as northern pike (left).

Life and Death of a Fishery

By Scott Gangl

A former boss paraphrasing Will Rogers used to say: "Fishing ain't as good as it used to be, and it never was."

He was referring to the angler's natural tendency to recall the best fishing trips, when a lot of fish or big fish were caught. It's human nature to forget the outings when we caught zip.

When people complain that fishing isn't as good as it used to be at their favorite lake, recollections are often based on those memorable experiences years ago, and expectations are for fishing to be that good all the time. Fisheries biologists often have to respond to these complaints, explaining that fish populations are cyclic and that fishing often follows some trend in fish population dynamics. However, for many North Dakota lakes, fishing *really isn't* what it used to be. Sometimes it's better, other times it's not. In

most cases, changes in a fishery are related to changes in habitat due to the natural aging cycle, or life and death, of lakes and reservoirs.

All lakes are destined to die from the time they are formed. Because a lake traps and holds water, it will eventually fill with silt and organic sediment. Over time – hundreds, thousands, or millions of years – the lake will completely fill to form a bog or meadow. In North Dakota, many of our lakes are surrounded by prairie or agricultural lands. Due to the erosive nature of surrounding lands, these lakes have a much shorter lifespan than lakes encircled by rock or forests. When mapping some of our fishing waters in recent years, State Game and Fish Department biologists found that many lakes had lost 20 percent or more of their capacity in the last 40 years.

The New Reservoir

A healthy fish community depends on good water quality, hospitable temperatures, balanced nutrients and favorable dissolved oxygen levels. When a reservoir fills for the first time, the water is deep and clean. There is little organic material in a new impoundment, so the reservoir isn't very productive at first. This, however, quickly changes. As water floods the landscape, nutrients are released from the soil. Grazing and shredding aquatic insects soon colonize the flooded vegetation and break it down, releasing more nutrients, promoting algae growth that zooplankton and free-swimming insects eat.

As insects colonize a new lake, their populations quickly inflate. Scientists call this explosion of productivity a trophic upsurge, or new reservoir effect. In years after filling, a new reservoir provides a prime

environment for game and forage fish to survive, grow and reproduce. Fish populations may thrive for years due to this new reservoir effect, until the aquatic community reaches equilibrium.

Like a living object, a reservoir ages and grows old over time. Inflow brings sediments and organic material from the watershed. As sediment deposits become enriched with organic material, rooted aquatic plants begin to grow. At the end of the growing season or lifecycle, plants and algae die, settling to the bottom where they decompose and further enrich sediment. More enriched sediment allows for more plant growth. So begins a cycle of life and death within the reservoir known as eutrophication. A eutrophic lake, with dense aquatic plants and thick, accumulated sediment is considered middle or old aged.

Abundant nutrients and productivity may seem like a good thing for growing fish in a lake. Unfortunately, like overfertilizing a field or garden, too many nutrients can create an imbalance that can have a negative influence on fish. Overabundant nutrients can cause thick algae blooms and excessive plant growth. After plants and algae complete their growing cycles, they break down and decompose. The bacteria doing the decomposing consume oxygen in the process. At times, competition for oxygen can surpass the level of oxygen in a lake, causing fish to die. This happens most often when ice cover prevents atmospheric oxygen from entering the water, or during summer when warm water temperatures allow less oxygen to dissolve in the water.

In a new reservoir, there is little competition for dissolved oxygen, and game fish are able to survive winter and summer. Therefore, they're able to maintain populations and continue to grow. As a reservoir ages, annual survival becomes less likely, and only the hardiest can survive harsh conditions. Unfortunately, the hardiest fish are typically carp, suckers and bullheads, which are undesirable to most anglers. This competitive advantage allows rough fish to expand in the reservoir community, taking up space, nutrients and oxygen previously available to game fish.

Because aquatic environments transform over time, fisheries management must adapt to changing conditions. For example, in a new reservoir with clean, cold, well-oxygenated water, trout can survive and grow to whopper sizes. Anglers from central North Dakota remember the fantastic trout fishing at Froelich Dam in Sioux County 30-40 years ago. Construction on Froelich Dam was completed in 1962, and rainbow trout were stocked in 1963. From 1968 through the 1970s, anglers registered 141 trout between 5-9 pounds with the Department's Whopper Club. However, during the 1980s, only 22 whopper trout were registered.

In time, conditions changed. Water temperatures warmed and oxygen levels became less dependable. Eventually, Froelich Dam simply couldn't raise large trout anymore. So in 1989 Department biologists changed their

management plan for Froelich, switching from trout to fish that could thrive in warmer water, such as walleye, bass and panfish. Because the middle 20th Century saw a proliferation of dams built, this scenario played out with many waters around the state that transitioned from the new reservoir effect with good trout survival, to more warm-water fish communities.

Natural Lakes

Although reservoirs and natural lakes differ in many ways, the processes that determine aging are much the same for both. Unfortunately, since natural lakes are natural depressions in the landscape that existed prior to modern settlement, many of our natural lakes were old before any modern fish management occurred. As a result, most fisheries management in natural lakes has focused on hardy fish species (such as pike and perch) from the beginning.

Over the last decade, biologists and anglers witnessed a fantastic transformation of many natural lakes. On the tail of severe drought in the late 1980s and early 1990s, much of the state saw above-average precipitation in the mid-1990s. Natural depressions in central North Dakota, not much more than sloughs, swelled and grew into world-class perch fisheries. These old natural lakes experienced a new lake effect when water levels rose, releasing nutrients from flooded lands and vegetation.



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Above: Cattle can trample lake shorelines, increase erosion and increase nutrient buildup by depositing waste into the water.

Right: Eroding farmland can contribute to sediment buildup in North Dakota's fishing waters.



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The boom was short-lived, as wet cycles were replaced by another drought. Water levels in most of these lakes have receded. Just like an older generation of anglers recall the fantastic trout fishing at Froelich Dam, our generation is beginning to look back on the turn of the 21st Century, just a few years ago, as some of the finest perch fishing the state has ever seen.

Role of Drought

Drought cycles play an important role in producing quality fisheries. That's a hard statement to grasp, especially in the midst of a drought. How can drought possibly be good for fish in an aging reservoir or lake? In the short term it's not, and fisheries suffer when water is lost. When water levels recede, though, sediments are exposed. This drying rejuvenates and oxygenates sediment. Often, terrestrial vegetation becomes established around the shoreline. Eventually, droughts end and lakes become flooded once again. This drying and reflooding mimics the trophic upsurge of a new reservoir.

Northern pike populations in Lake Sakakawea provide a textbook example of a fishery benefited by drought and flood cycles. After the closure of Garrison Dam in 1953, terrestrial vegetation was inundated annually as Lake Sakakawea water levels climbed. Northern pike thrive in such an environment, and became the early star of the fishery. When Sakakawea stabilized in the 1970s, waves washed away dirt and exposed cobble and gravel shorelines, providing excellent walleye spawning substrate. In the 1980s, northern pike took the backseat to walleye as Lake Sakakawea's most sought fish.

The drought of the late 1980s and early 1990s reduced Lake Sakakawea to what were then record low levels. During the drought, cottonwood trees, sweet clover and other plants grew around the shoreline. When the reservoir refilled in the 1990s, pike rebounded to levels reminiscent of the 1960s. Currently, North Dakota is in the clutches of another more severe drought, and clumps of cottonwood trees around the lake are beginning to look like full-fledged forests. No doubt, pike enthusiasts will reap the benefits of this drought when Sakakawea fills again.

Human Influence

Human activities in the watershed can greatly accelerate the aging process for a lake or reservoir. Eroding farmland, cattle trampling shorelines and stream banks,

development and construction sites all increase the amount of sediment entering streams or lakes. Allowing cattle to concentrate within a stream or lakeshore results in trampled shorelines, increased erosion and nutrients (in the form of waste) entering the lake. In cities, pet waste is often left to wash into local storm sewers, which eventually leads to a lake. Excessive garden, yard and crop fertilizers flow off the landscape and pollute waters. In some instances, failing septic systems from lakeside cabins result in nutrients from human waste entering the lake. All of these can be prevented with careful consideration and planning.



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People with an interest in preserving water quality need only to remember one simple fact: everyone lives in a watershed. Regardless if it's a river, stream, lake or reservoir, gravity rules as water always flows downstream. What you do in your own backyard can have a great influence on your favorite fishing spot.

The Game and Fish Department's Save Our Lakes Program is designed to assist people who are interested in slowing the effects of human activities on lake aging. SOL assists with projects such as dams designed to trap sediments and nutrients before they enter the lake, fencing and alternate water sources (wells) to remove cattle from the lake or stream shoreline, and planting strips of buffer vegetation to curtail erosion and keep sediments and nutrients from entering the lake.

For better or worse, North Dakota fisheries are constantly changing – adapting to whatever Mother Nature throws our way. So maybe the fishing isn't as good as it used to be at your favorite lake. Or maybe it never was. Perhaps you're an optimist and you think the fishing is better because you have a new fish species to fish for. Either way, it's bound to be different.

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