Fish Fry Lake Case Study: 2014 Update

Project Location: Shepherd, Montana

Fishing can be the primary method for removing excess nonpoint source nutrients from water, according to data collected by Floating Island International (FII). This case study updates results of FII's patented floating treatment wetland (FTW) technology and associated lake stewardship to remove nutrients from Fish Fry Lake, a 6.5-acre lake at FII's research center, along with producing outstanding fishing opportunities. Nearly all of the phosphorus and nitrogen entering the lake from agricultural runoff is now mitigated through a moderately aggressive fish-harvesting program.

The primary factors transforming Fish Fry Lake from a eutrophic pond to a productive fishery have been:

- Higher dissolved oxygen (DO) concentrations due to aeration and mixing;
- Lower overall water temperatures and a greatly expanded livable zone for fish due to aeration and mixing;
- Introduction of surface area to support periphyton, which provides a food source for fish; and
- Better penetration of sunlight into the water column from reduced turbidity, which enhances growth of diatom-based periphyton.

The last two factors are directly due to introduction of standard FTWs, while the first two are derived from the floating streambed, the latest embodiment of FTWs.

Background

As recently as July 2008, Fish Fry Lake was a small pond with low DO concentrations, high summer water temperatures, colorful algae blooms and a small population of wild northern yellow perch. Today it supports burgeoning populations of crappie, bluegill and perch. This dramatic change was made possible by:

- Deepening the pond to 28 feet and extending its reach to 6.5 acres;
- Strategically locating several aerators throughout the lake; and
- Adding 5,200 square feet of FTWs.

The FTWs are a mix of BioHavens® (passive islands) and one floating streambed (Figure 1). The floating streambed is a new embodiment of FTW with aeration and forced circulation via an airlift directional diffuser. All islands in Fish Fry Lake, which are constructed of recycled post-consumer plastic matrix, have been planted with native vegetation.

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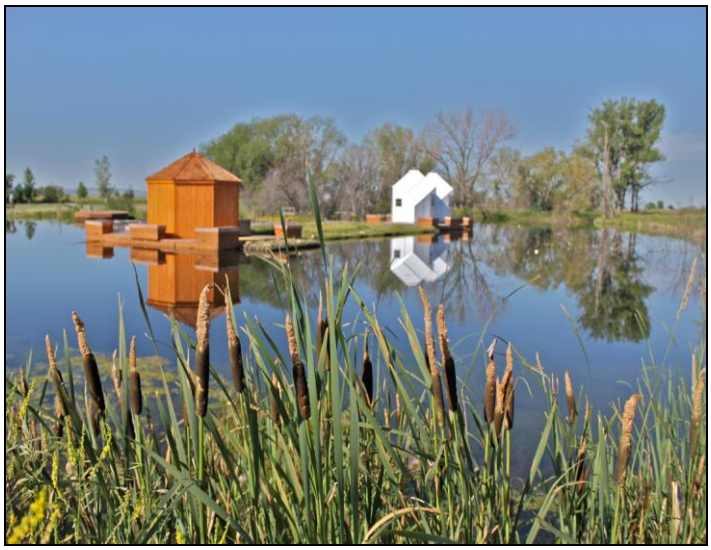

Figure 1. Floating streambed island in Fish Fry Lake

By biomimicking nature, floating islands provide the "concentrated wetland effect" that transitions nutrients up the food web. Instead of nutrients short-circuiting into algae monocultures, floating islands provide substratum--the enhanced surface area that transitions nutrients from periphyton (the microbial and algae community attached to underwater surfaces) to fish (Figure 2).

Figure 2. Extensive root system for fish food and nutrient uptake

Results

Fish Fry Lake continues to support a very productive fishery. From June through October 2011, 1,928 perch (weighing approximately 482 pounds) were harvested from the lake. Experienced fishermen averaged one perch every two minutes (Figure 3), with a typical harvest of 26 lbs/wk during the fishing season.

Figure 3. Typical perch harvest at Fish Fry Lake

In the 2011 study, perch were measured and classified by age, through otolith and scale aging. Perch in Fish Fry Lake were significantly larger than perch in the 95th percentile measured in a study by Jackson and Quist:

Table 1. Comparison of Perch Sizes

	Fish Fry Lake (FFL)		Jackson Study *		FFL/Jackson Ratio
	Inches	mm	Inches	Mm	
Age 1	6.7	170	5.0	126	135%
Age 2	8.7	221	7.3	186	119%
Age 3	10.8	274	9.3	236	116%
Age 4	12.5	318	10.4	264	120%

* 95th percentile data for North American yellow perch from Jackson & Quist (1991)

In 2012, the fish harvest from Fish Fry Lake was increased substantially to 5,168 fish weighing 1,362 pounds. The harvest was further increased to 7,109 fish in 2013, although the total weight was down slightly to about 1,336 pounds. The 2013 harvest was 206 lbs/acre or 231 kg/ha.

In 2013, the harvest had shifted from perch (now only 19% of the total) to crappie (40%) and bluegill (41%). Average sizes were 3.8 oz. for perch, 2.6 oz. for bluegill and 2.3 oz. for crappie.

Phosphorus inflow to Fish Fry Lake is estimated at 0.28 lbs/wk, based on an average concentration of 0.041 mg/L at an estimated flow of 80 gallons per minute. The average phosphorus concentration in perch is 1.0%, based on measurements by FII and

other researchers, and is assumed to be the same for other fish in Fish Fry Lake. This means that 28 lbs/wk of fish must be harvested or a total of 1,456 pounds for the year. **In 2012 and 2013, fishing removed 94% and 92% of the incoming phosphorus, respectively.**

An experienced fisherman at Fish Fry Lake can catch fish at a rate of one every two minutes. For the average fish weighing 3.0 oz., 5.0 hrs/wk of fishing time is required to keep up with the incoming phosphorus and maintain a healthy waterway (Figure 4).

Figure 4. Sunset at Fish Fry Lake