Smallwood Lake Restoration - Fishery Scoping Report

NOTE: Following the May 2020 flood event, Smallwood Lake was partially drawn down. Due to the limited nature of the drawdown, impacts to the fish community have likely been minimal. The following discussion presumes that Smallwood Lake will be refilled. Ultimately, Fisheries Division of the Department of Natural Resources is the management agency charged with overseeing the management of the fishery resources in the Tittabawassee River and its' impoundments. We expect any management activities such as fish stocking, habitat improvement, or fish passage at the dams would be led by or endorsed by DNR Fisheries Division.

A. Fishing Economic Activity – Smallwood Lake vs. Tittabawassee River Segments

Fishing generates economic activity. Fishing activity differs between different aquatic habitats, such as lakes and rivers. The purpose of this section is to evaluate the relative economic impact of restoring the fishery in the fully restored Smallwood Lake against the fishery that could be expected in the Tittabawassee River if the impoundment were fully dewatered.

Fisheries management agencies use creel or angler surveys to measure the amount of fishing activity that takes place on a given body of water. Estimated fishing activity is generally measured in hours of fishing per angler or fishing trips to the water body. The economic impact of a fishing trip is estimated regularly by the United States Department of the Interior including estimates for freshwater and saltwater fishing activities. By applying the estimated economic impact of a fishing trip to the fishing pressure measured at a water body, it is possible to estimate the economic activity generated by the fishery.

Streamside Ecological Services (SES) staff searched for creel survey data from the impoundments on the Tittabawassee River collected during the past 20 years. We found that the fishery at Sanford Lake was creel surveyed in 2015. To provide additional data, we expanded our data search to include other similar-sized southern Michigan impoundments. This resulted in seven additional datasets for impoundment fisheries measured in the last 20 years. We found that the estimated angler fishing trips per acre for the seven impoundments ranged from 2.5 to 17.2 trips per acre (Table 1), and an average of 7.7 trips per acre.

Table 1. Angler fishing trips for four southern Michigan impoundments.

Waterbody	Area (acres)	Year	Time period	Total angler trips	Angler Trips per acre
Sanford Lake	1,250	2015	June to August	6,261	5.0
Hardy Pond	3,971	2006	April to October	23,111	5.8
Kent Lake	1,200	2007	April to September	8,532	7.1
Hamlin Lake	5,350	2008	April to September	28,968	5.4
Hamlin Lake	5,350	2019	April to September	13,135	2.5
Belleville Lake	1,270	2005	April to October	21,901	17.2
Ford Lake	975	2006	April to October	9,008	9.2
Croton Impoundment	1,380	2007	April to October	13,133	9.5
Average					7.7

We then used the average number of angler boat trips per acre to generate estimated annual fishing trips for all four of the Tittabawassee River impoundments (Table 2). Using the estimated $36 expenditure per trip for freshwater non-Great Lake fishing (USDI et al. 2016), estimated annual expenditures for the Smallwood Lake fishery was $111,434.

It's noteworthy that these estimates are conservative. Night fishing, ice fishing, early and late season open water fishing, shore fishing and fishing from private docks were not measured or included in the data used for Table 1. However, ice fishing and shore fishing at Kent Lake were also measured in 2007. When those components of the fishery are included, the estimated angler trips increased 2.4 times from 8,532 trips to 20,468 trips. Based on this dataset, we submit it would be reasonable to estimate total economic expenditures for fishing activity on Smallwood Lake would be approximately $267,442 annually ($111,434 X 2.4).

Table 2. Annual angler boat fishing trips and expenditures estimated for the four Tittabawassee River impoundments.

Lake	Surface Area	Est. Trips per acre	Trips	Est. Expenditures
Sanford	1,250	7.7	9,625	$346,500
Wixom	2,600	7.7	20,020	$720,720
Smallwood	402	7.7	3,095	$111,434
Secord	895	7.7	6,892	$248,094
Total			39,632	$1,426,748

Non-fishing or recreational boating also contributes to the local economy. We have not attempted to estimate the amount of recreational boating that takes place on the impoundments when they are at full pool. However, all four impoundments are multi-use waters with large numbers and a wide variety of power watercraft. We suspect the local economic impact of recreational (non-fishing) boating on these waters is also significant.

To facilitate comparison of the estimated economic activity generated by the restored impoundments versus economic activity that could be expected from the fishery on the Tittabawassee River segments lying above the four dams (Sanford, Edenville, Smallwood, and Secord) without the impoundments, SES staff sought creel survey data for comparable river fisheries in Southern Michigan. Specifically, we looked for warm or cool water river creel surveys from sections of rivers without dams and impoundments. We also filtered out any river segments that were open to fish movements from waters of the Great Lakes which generally result in increased angling effort during seasons when anadromous salmonids or walleye (*Sander vitreus*) are present. We found creel survey data for Michigan river fisheries are limited and data for warm water, inland (no Great Lakes fish access), un-impounded reaches are even rarer. We were able to find creel survey data including estimated trips for segments of the Huron River near Ann Arbor, the Muskegon River near Temple, and the Grand River near Grand Ledge. For the Grand River, fish passage from Lake Michigan upstream to Lansing is possible, but we only used the summer data when no Lake Michigan salmonids (and probably salmonid targeting anglers) were present, for this analysis.

The estimated angler trips were summed across the creel surveyed months (April to September) to generate a total number of trips per season for each river section. The linear distance of river included in each surveyed section was then used to divide the total number of estimated angler trips to arrive at a number of angler trips per mile of river. We then averaged the angler trips per mile across the 5 sections of river to arrive at the average of 280 angler trips per river mile (Table 3).

Table 3. Annual angler fishing trips from creel surveys on southern Michigan river segments.

River	Section	Year	Angler trips	Distance (mi)	Angler trips/mile
Muskegon	Temple Dr. to M115	2008	1,728	9.0	191
Muskegon	Reedsburg Dam to Dolph Rd	2008	4,619	21.3	217
Grand	Moores Park to Grand Ledge	2004	6,237	15.4	405
Huron	Bell to Mast Road	1993	1,770	5.7	311
Huron	Mast to Delhi	1993	1,296	4.7	276
Average					280

The number of annual angler trips for the Smallwood dam river segments were estimated by multiplying the estimated linear distance of river within the section by 280 angler trips per mile. For the Smallwood river section, we included 2.3 miles of the lower Sugar River, 1.2 miles of the lower Little Tobacco River, and 7.5 miles of Tittabawassee River mainstem for a total of 11.0 miles. Multiplying 11.0 river miles by an estimated 280 angler trips per mile, results in a total of 3,080 trips and an annual estimated expenditure of $110,880 for fishing activity on the river segment.

These estimates were based on seasonal fishing trip totals summed across the months of April thru September. Unlike the impoundments, where ice fishing contributes substantially to the fishery, we would not expect much additional fishing activity on the river segments during the late fall or winter. However, if upstream fish passage from Saginaw Bay is re-established and seasonal walleye or salmonid spawning runs occur, a considerably higher level of fishing effort and associated expenditures would be expected.

In summary, if Smallwood Lake were completely dewatered we estimate fishing activity in the resulting riverine habitat would generate $110,880 of economic activity. Fully restoring the impoundment and lake fishery would generate an estimated $267,442 of fishery based economic activity annually. Thus, restoration of the impoundment fishery results in 2.4 times more economic activity, with benefits for the local economy.

B. Fish Passage at Smallwood Dam

Dams have four basic negative effects on rivers. First, they prevent fish migration. For some species, this limits access to spawning habitat. Second, dams slow the flow of the river and can alter the timing of peak and low flows. The natural seasonal flow variations that trigger growth and reproductive cycles in many fish species can be altered. Third, dams alter habitat and change the way rivers function. They trap sediment and woody debris with negative impacts on downstream river habitat complexity. Finally, dams can result in abnormal physical and chemical changes such as water temperature fluctuations and abnormal dissolved oxygen levels in downstream waters.

Additionally, dams directly impact fish populations through mortality caused by entrainment and impingement. Entrainment is the unwanted passage of fish through a water intake, which is generally caused by an absent or inadequate screen surrounding the water intake. Impingement is the physical contact of a fish with such a barrier structure (screen) due to intake velocities which are too high to allow the fish to escape. Sources of entrainment or impingement-related injury or mortality include the following: (1) fish passage through hydroelectric facilities (i.e., turbines, spillways, sluiceways, and other passage routes) during downstream migration for migratory fish; (2) the entrainment of resident fish; and (3) the impingement of adult or large fish (migratory or resident) against screens/trash racks (Rytwinski et al. 2017).

Schrouder et al. (2009) summarized the results of fish entrainment and impingement assessment studies at the 4 FERC licensed dams on the Tittabawassee as follows: "*Environmental assessments were conducted for several years (Freshwater Physicians 1988) in conjunction with the relicensing of the hydroelectric dams on the main stem Tittabawassee River (FERC 1998). The estimated total annual mortality rate for all species of larval fish was 13.9 million at Smallwood Dam. Highest mortality occurred in spring during high flows. Total juvenile and adult mortality were also estimated for the major hydro dams. Estimated losses were 411,622 at Smallwood Dam. Annual monetary replacement costs were estimated to be $3,530 at Smallwood Dam.*"

According to Schrouder et al. (2009), there are 143 dams in the Tittabawassee River watershed and many have significant negative effects on aquatic resources. Most of the larger dams in the Tittabawassee River basin were built on the higher gradient habitats to create the highest hydraulic head possible for the lowest cost. These areas were probably fast riffles to small waterfalls. Historically, these areas provided spawning habitat for a wide variety of species including lake sturgeon (*Acipenser fulvescens*) and walleye from Lake Huron. These areas are no longer accessible and quality riverine habitat has been lost.

However, Schrouder et al. (2009) also recognize that dams do provide benefits. These can include recreational opportunities (boating, swimming, fishing, hunting) that differ from those on free-flowing reaches. Dams also create barriers blocking upstream migration of undesired species such as sea lamprey (*Petromyzon marinus*) and common carp (*Cyprinus carpio*). Finally, contaminated sediments are sometimes trapped behind dams which prevents their downstream transport.

Fish passage technology has been used to try and mitigate some of the negative impacts of dams on fish populations. Fish passage structures can help enable some fish to pass around or over a dam, but their effectiveness largely depends on the species of fish and the physical properties of the dam, such as hydraulic head and dam design. Upstream movement can be facilitated with nature-like constructed channels (pool/riffle or rock ramp), technical fishways (vertical slot, pool and weir, Denil), and special-purpose structures (eel ladders, fish locks and fish lifts). Downstream movement can be facilitated by engineering that minimizes fish entrainment and impingement. However, fish passage is far from a proven technology, and successful fish passage at a particular site can be impeded by numerous knowledge and information gaps (Silva et al. 2017) that can include both biological and physical factors. Zielinski and Freiburger (2020) reviewed the current state of fish passage technologies in the Laurentian Great Lakes basin, and highlight the challenges resource managers face when making decisions about barriers and fish passage that are critical for invasive species control and fishery restoration.

The most downstream barrier to fish passage on the Tittabawassee River is the Dow Dam in Midland. Dow dam has a normal hydraulic head of 4 feet with a height of 7 feet and a crest width of 325 feet. Schrouder et al. (2009) provided a detailed history of the efforts to create effective fish passage at Dow Dam and modifications to the dam. At present, fish passage at Dow Dam is limited to high water periods, but includes the invasive sea lamprey, necessitating sea lamprey control in the mainstem of the Tittabawassee River up to Sanford Dam, and the major tributaries including the Chippewa and Pine Rivers. Recently, a proposal to construct fish passage at Dow Dam has been connected to the Tittabawassee River Natural Resources Damage Assessment. This proposal targets walleye, suckers, white bass (*Morone chrysops*), and lake sturgeon as the primary species of interest. A nature-like design, such as a rock ramp, has been suggested for this low hydraulic head site.

There are major challenges associated with constructing effective fish passage at the 4 Tittabawassee River dams upstream from Midland. First, all four dams have hydraulic head much higher than the Dow Dam (26 foot at Sanford, 44 foot at Edenville, 28 foot at Smallwood, and 46 foot at Secord). In general, the higher the hydraulic head, the more difficult and expensive it becomes to successfully design an effective fishway. Second, the primary species of interest for upstream fish passage in the Tittabawassee River are walleye, suckers, and lake sturgeon. All of which are poor jumpers, relative to trout and salmon, and are notoriously difficult species to pass upstream through technical fishways. Third, creating passage for those desired species, while blocking upstream movement of invasive spawning sea lamprey, nuisance common carp, and potential future invasive species such as silver (*Hypophthalmichthys molitrix*) or bighead carp *(Hypophthalmichthys nobilis*), would be difficult or impossible. This is a dilemma for fisheries managers across the Great Lakes basin (Zielinski and Freiburger 2020).

McLaughlin et al. (2013) directly address this dilemma: "*Trade-offs arise when fish passage decisions intended to benefit native species interfere with management decisions intended to control the unwanted spread of non-native fishes and aquatic invertebrates, or genes, diseases and contaminants carried by hatchery and wild fishes. These consequences and trade-offs will vary in importance from system to system and can result in large economic and environmental costs.*" These difficult decisions may benefit from a formal, structured process such as decision analysis, that is transparent, objective, and can incorporate quantitative evaluation of risk (McLaughlin et al. 2013). Experts at the Quantitative Fisheries Research Center at Michigan State University have been leaders in decision analysis approaches to addressing these types of difficult resource management questions in recent years.

In summary, creation of effective upstream fish passage at the Smallwood dam on the Tittabawassee river for walleye, lake sturgeon, and suckers would be challenging at best. Major trade-offs related to unwanted spread of invasive species need to be rigorously evaluated. These decisions will require a collaborative and comprehensive process that involves stakeholders as well as resource management agencies and probably academia.

<u>Literature cited</u>

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