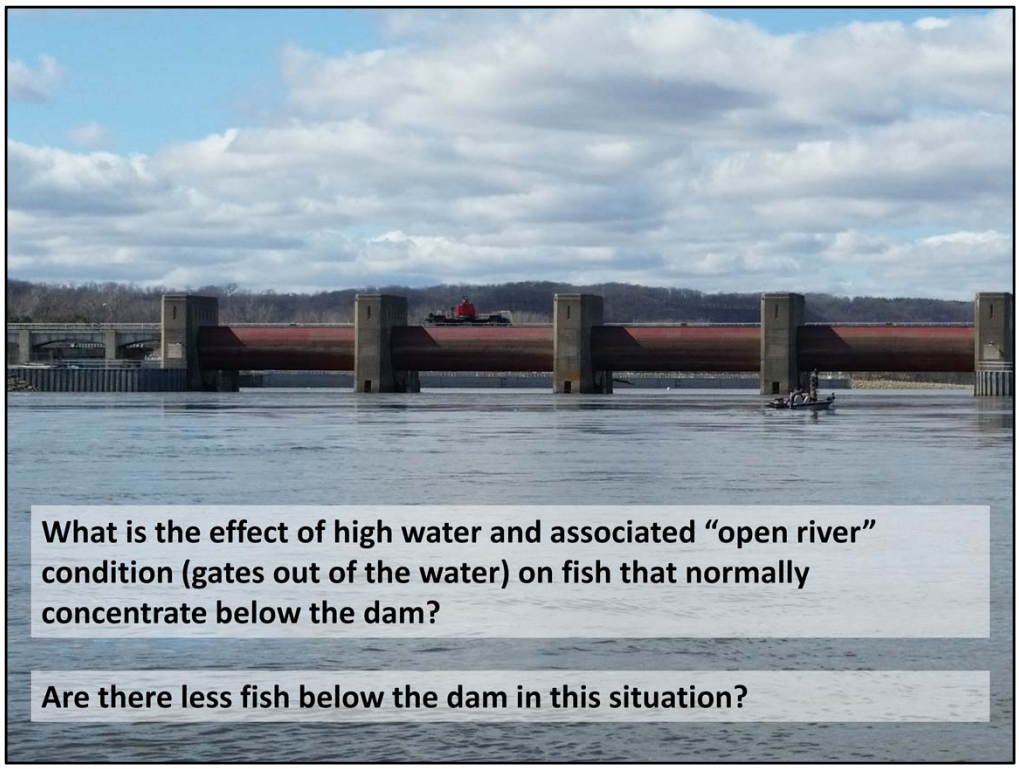
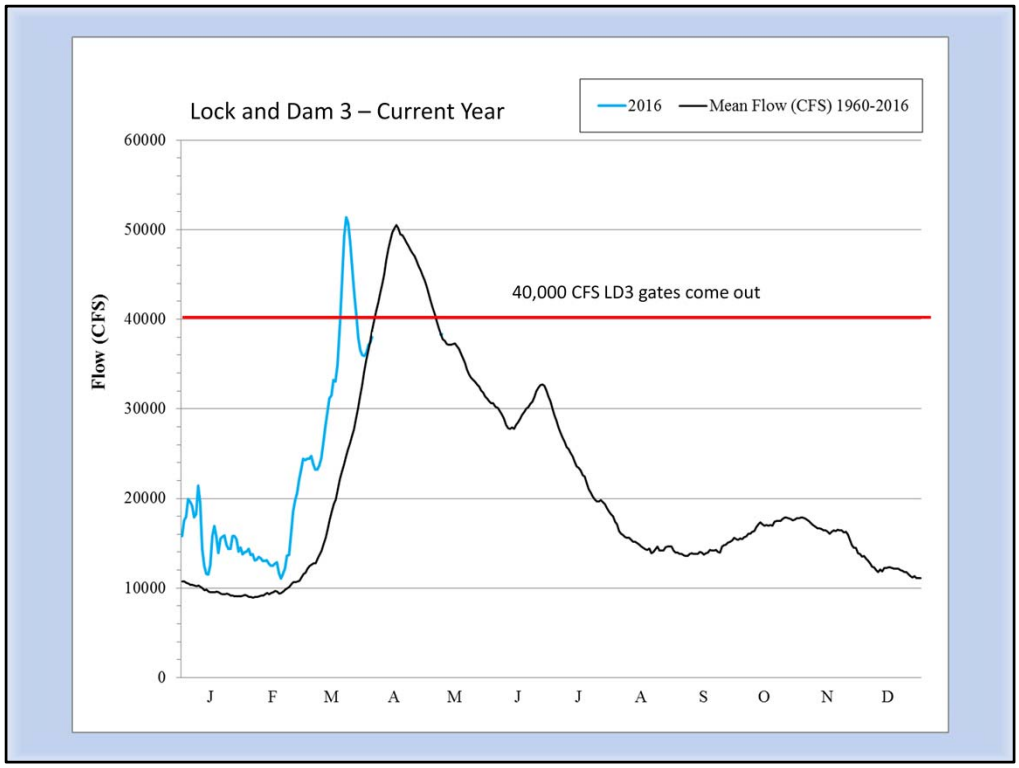


Gbfan10 originally posted on the IDO forum a question about the effects of an “open river” condition where the gates of the Mississippi River dams (in this case LD 3 near Red Wing, MN) on fish populations and fish movements (particularly walleye).

The following slides will attempt to address these questions, with figures and data to help visualize the situation.

If you have any questions feel free to contact me using the contact info on my post to IDO where this document was attached.



First lets look at the conditions this spring (2016).

The figure above is one that I generate annually for my Large Lake Report using the flow data available from the Corps of Engineers LD3 website: http://www.mvp-wc.usace.army.mil/projects/Lock3.shtml

In this case the "selected year" data that represents 2016 data up to April 6th is the blue line, and a long term daily average is represented by the black line. Lock and Dam 3 near Red Wing, MN is one of the first dams in the upper Mississippi River system to go "out of control" and assume an "open river" condition when the gates are lifted out of the water at around 40,000 cubic feet per second (CFS) of flow. Each dam in the system has a trigger point at which the gates are raised.

As you can see on the graph the black line representing a long term average of daily flows shows that Lock and Dam 3 typically is above the gate threshold for much of the month of April each year.

So why might species like Walleye and Sauger collect below a dam.

- Food sources collect there (Gizzard Shad and shiners)
- Clean rocky spawning substrate (preferred by Sauger and a secondary choice for Walleye in Pool 4) are found there
- In the case of Lock and Dam 3 the warmer water from the Prairie Island nuclear generating plant may provide a more hospitable environment in late winter

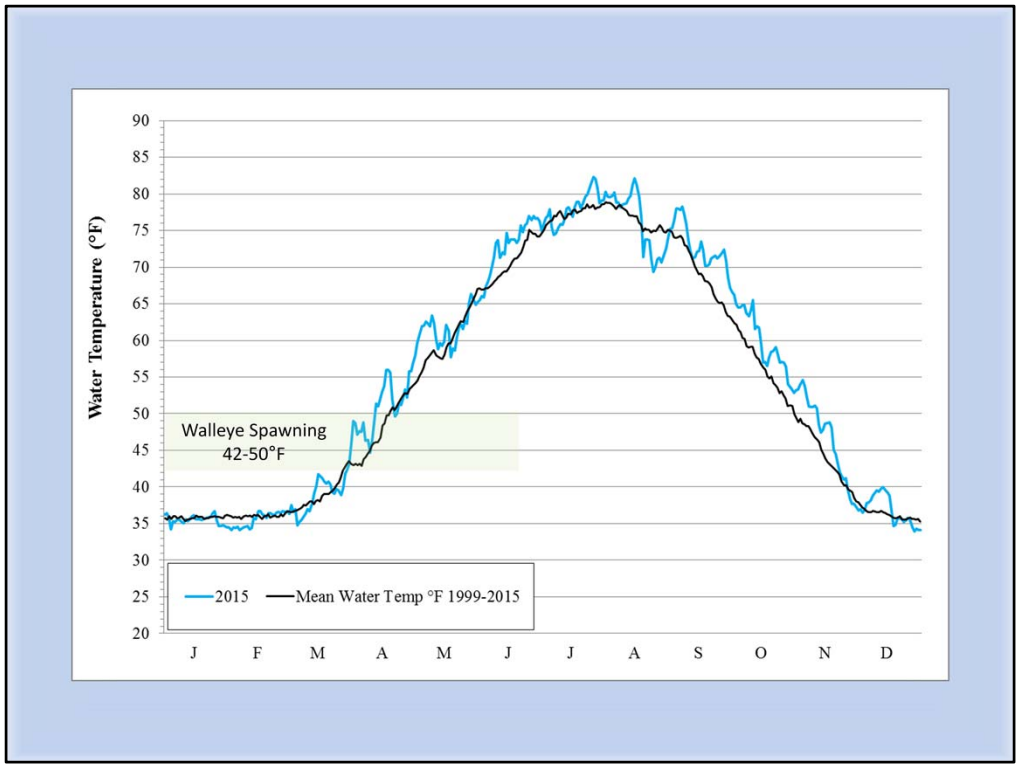
This relates to the posters question about Walleye, because he expressed concern that because species like Walleye and Sauger often swim upstream to spawn if they encountered “open” conditions while making this movement they might just pass through to the upper pool (Pool 3) and be lost to the lower pool (Pool 4).

What are the ideal spawning conditions for Sauger and Walleye and how do they differ?

- Also addressed in Investigational Report 481 – MN DNR
- Walleye – 42°-50°F seem to prefer off channel flooded timber, bulrush, and reed-canary grass for spawning on Pool 4 when available
  - During low water years channel margins and cobble are also used
  - Benefit from continued high water to keep nursery habitat wet
- Sauger – 40°-50°F seem to prefer deeper channel margins and breaks often near wing dams
  - Benefit from high water with relatively rapid drop shortly after the spawn

http://files.dnr.state.mn.us/publications/fisheries/investigational_reports/481.pdf

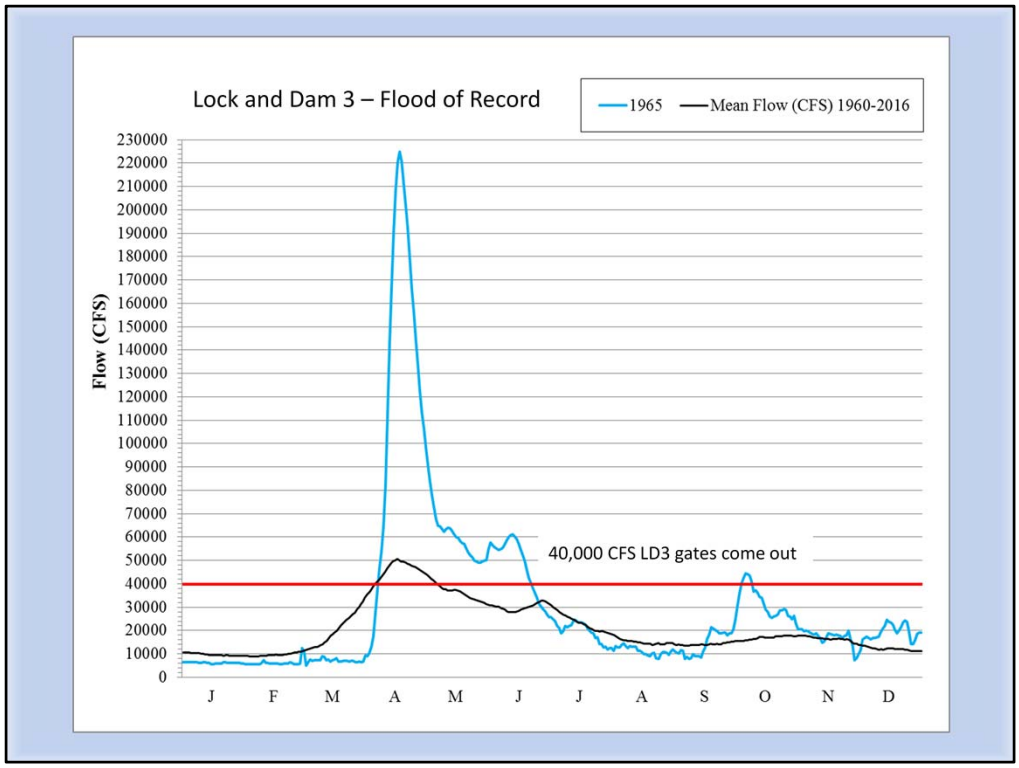
The slide above is taken from a presentation I gave to a Walleye Searchers meeting in Rochester, MN several years ago addressing questions about the Walleye and Sauger spawn on Pool 4.



This slide represents the daily temperature data collected at Lock and Dam 3 during 2015 (blue line) compared to a long term daily average (black line).
Note: The time frame for the long term average differs from the flow figures presented in this document, because temperature data was not collected as far back in time as the flow data.

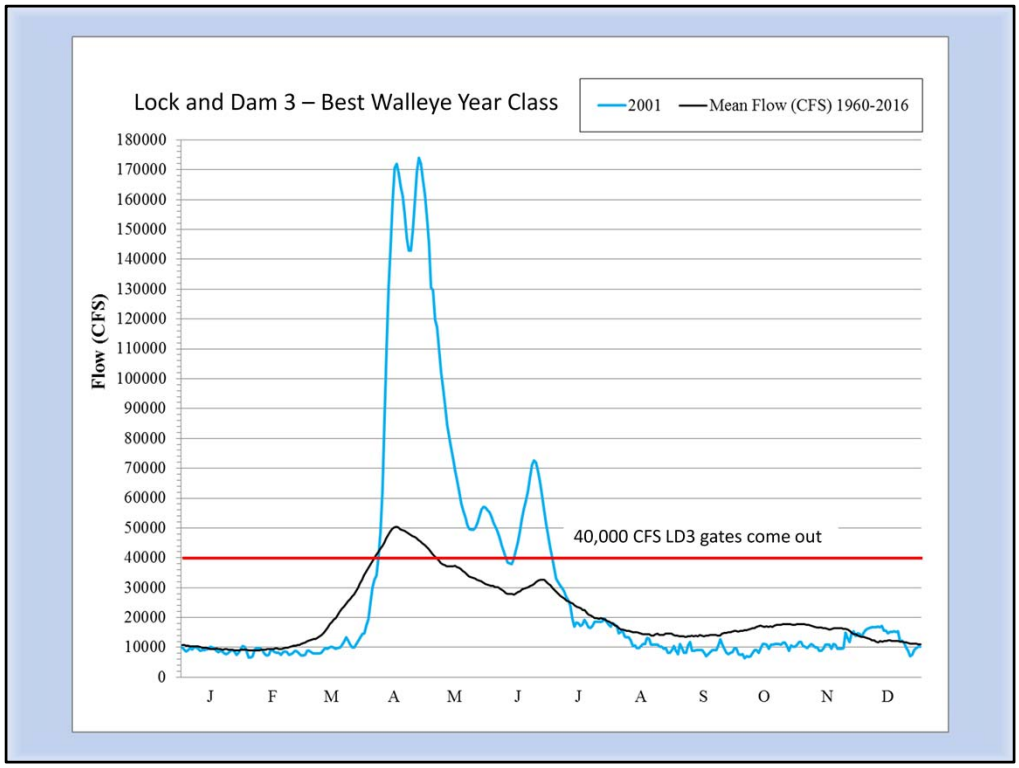
The shaded light green area represents the preferred temperature range for Walleye spawning. As you can see the period where the long term average crosses through the shaded area is in early to mid April. This corresponds closely to the time period when the previous flow figure showed that Lock and Dam 3 typically has its gates open.

One important thing to note is that because Walleye in Pool 4 seem to prefer spawning in flooded terrestrial vegetation in backwater areas they are likely to be spawning when water is high, but they also likely spawn slightly earlier than the long term temperature figure above would indicate, because the shallow darker bottomed areas with the flooded vegetation tend to warm earlier than the main channel water as measured at the dam in the figure.



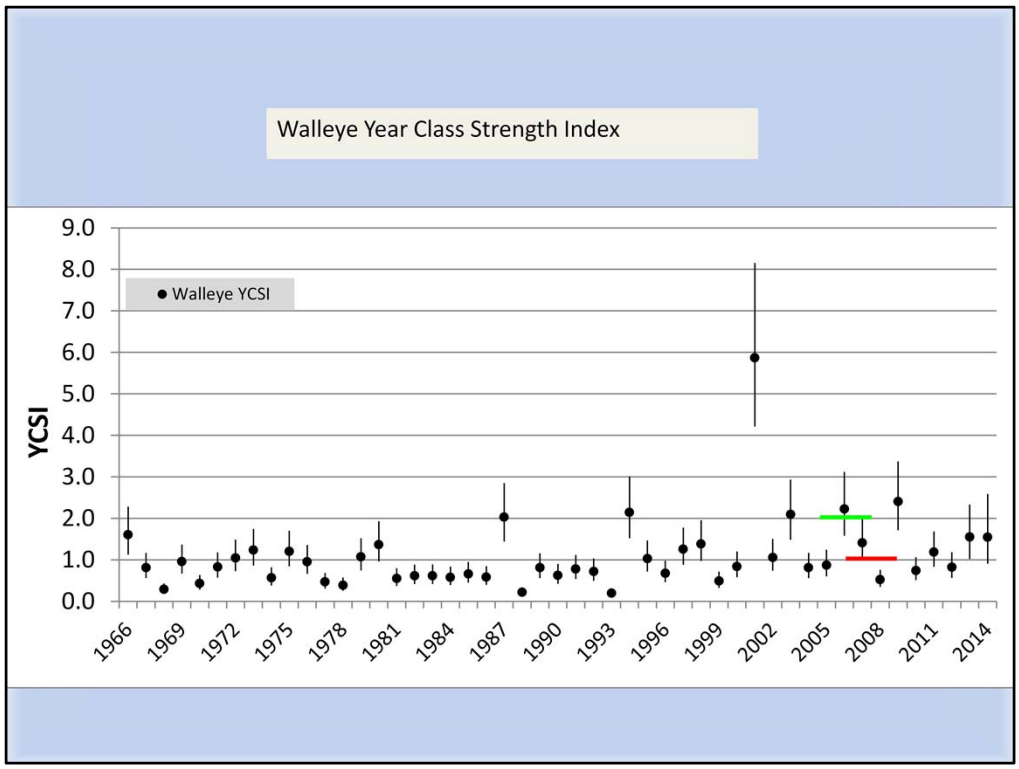
Just as a comparison the above figure represents the flood of record for Lock and Dam 3 and Pool 4 (1965).

Another thing to consider is that when the water is very high even though the gates are open there is often considerably more flow going through the gates which may be too much for Walleyes to successfully pass the structure.



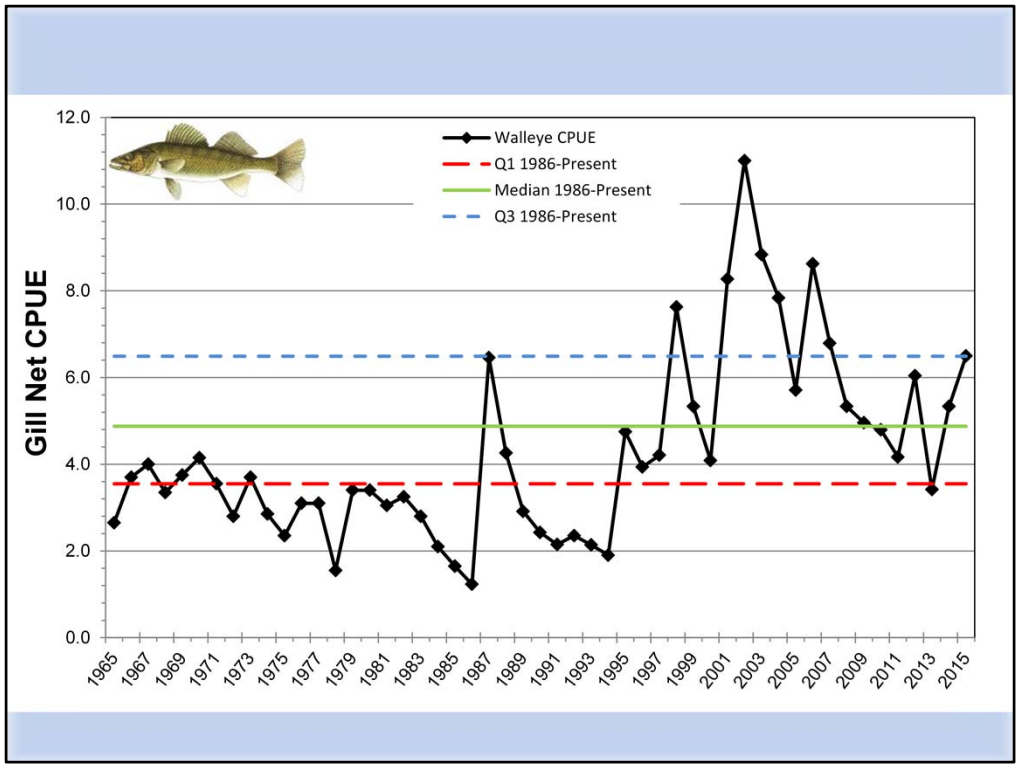
This figure shows the flow data from 2001 which produced the best year class of Walleye we have documented for Pool 4.

The next slide shows the year class strength measurements for the Pool 4 Walleye population as presented to the Walleye Searchers with description of how to interpret the figure.



The large lake program in MN is attempting to standardize estimates of year class strength across lakes which has led to a new (for those of you who have become used to my YCSI figures in the last several years) way of displaying the year class strength estimate data. The Dots represent the estimate of year class strength and the ends of the line represent statistical boundaries for that estimate. If you draw two horizontal lines from the tips (upper and lower) of a points lines and they cross another points as the green line from 2007 crosses the 2006 line then we cannot say that they are statistically different. If however the line does not cross another points lines like the red line above from 2007 which does not cross the lines from 2008 point we can then say that those two year class strengths were statistically different. Based on the methods used here an average year class should be approximately 1.0 on the y-axis.

Note: The estimate of year class strength relies on 3 years of catch data, so the last two estimates will typically have longer lines above and below them because they are estimates with only partial data. In this case I would expect the lines to tighten up around the 2013 and 2014 year class estimates as we gather more data in the coming years.



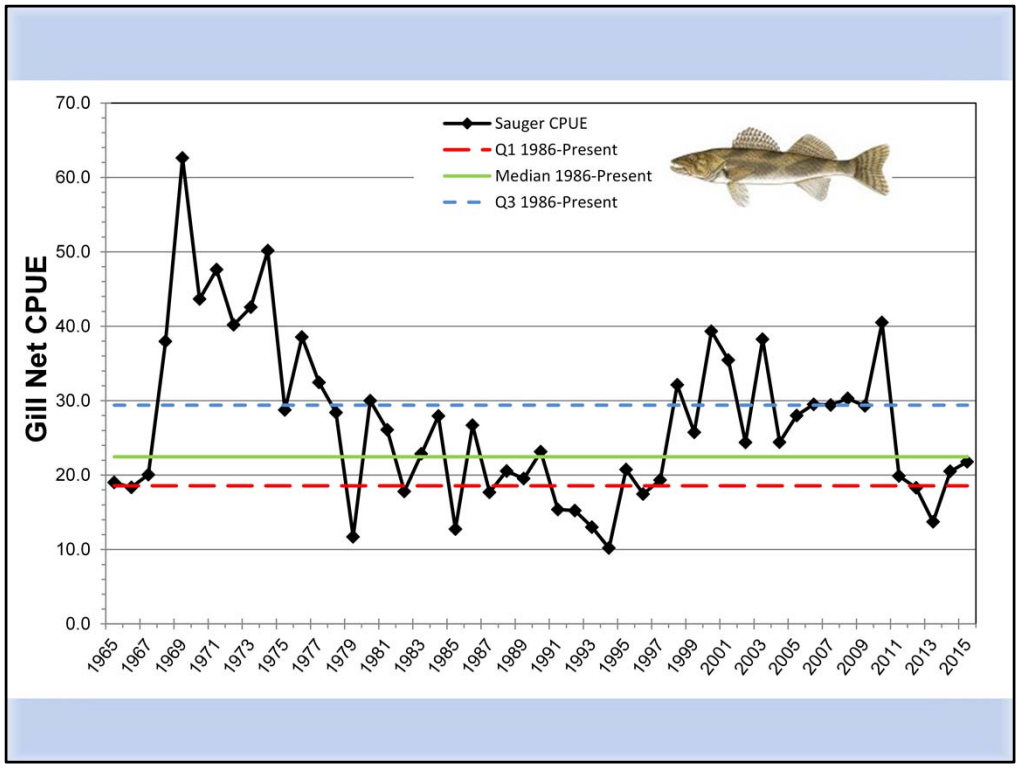
Catch per Unit Effort (CPUE) represents the average number of fish captured per net. Annually as part of the large lake survey 24 gill nets are set for ~24 hour periods in the first week of October. These gillnets provide a cross section look at the adult populations of some of the most popular gamefish in our lakes (Walleye, Sauger, Yellow Perch, etc). It should be noted that some gamefish like Largemouth and Smallmouth Bass are poorly sampled using this type of gear.

This figure shows that while Lake Pepin's walleye population is down from historic highs driven by the incredibly strong 2001 year class it is still above the long term (1986-Present) median.

So in summary:

- So we have seen that “open” river is a normal condition for Lock and Dam 3 in the spring around the time of the Walleye spawn
- High water can produce strong year classes of Walleye in Pool 4
- High water may also produce high flow velocities that can act as a barrier to upstream travel for species like Walleye that are not particularly strong endurance swimmers
- We also see that despite a typically annual period with open gates the Walleye population has remained strong in Pool 4

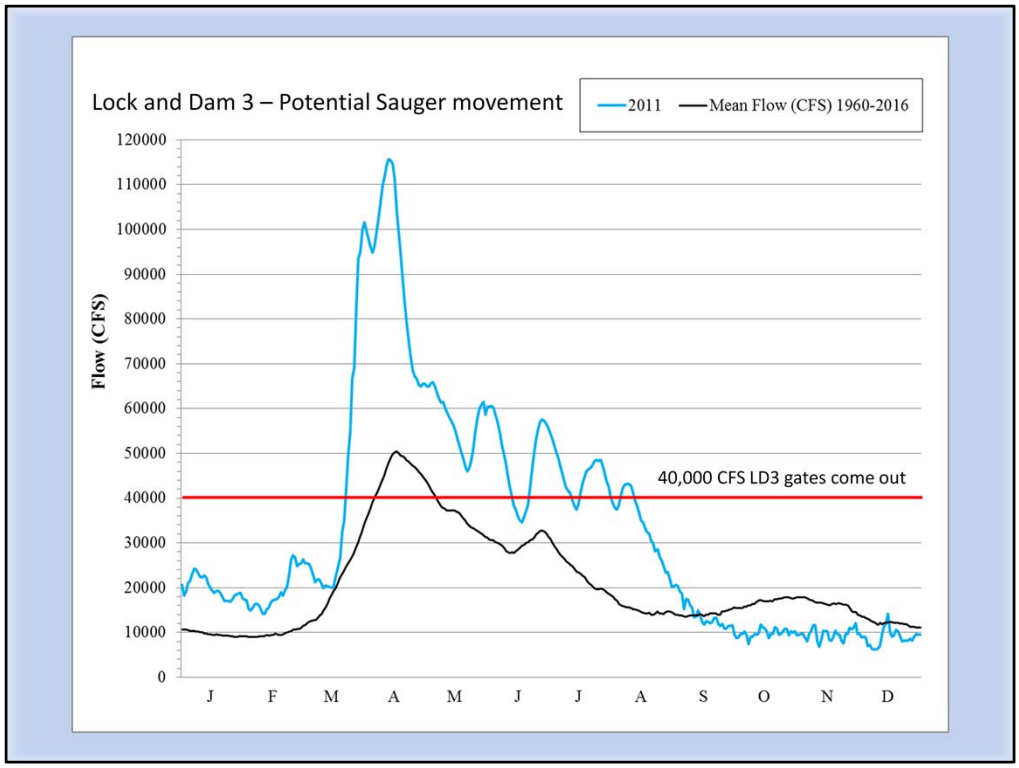
So do we have evidence of extensive movement upstream through open gates?



See Slide 8 for more complete description of this type of figure.

This figure shows that Lake Pepin's Sauger population is down from recent high levels driven by the incredibly strong 2001 year class and a series of strong year classes in the late 2000s.
While the catch number has fallen to below the median for the 1986-Present dataset it remains high compared to most other lakes in MN. The dramatic drop between 2010 and 2011 remains a bit of a mystery, but may be partially due to high water and open dams allowing fish populations to freely move around the river system (This assertion was supported by Xcel Energy sampling which showed dramatic increases in catch rate for Sauger and Walleye in lower Pool 3 in 2011 indicating likely upstream migration). Regardless, the relatively low YCSI for Sauger in 2010, 2011, and 2012 have not produced an abundance of surplus fish to rapidly increase net catch, but the apparently strong year-class of Sauger in 2013 bumped the 2014 net catches up by more than 25% from 2013.

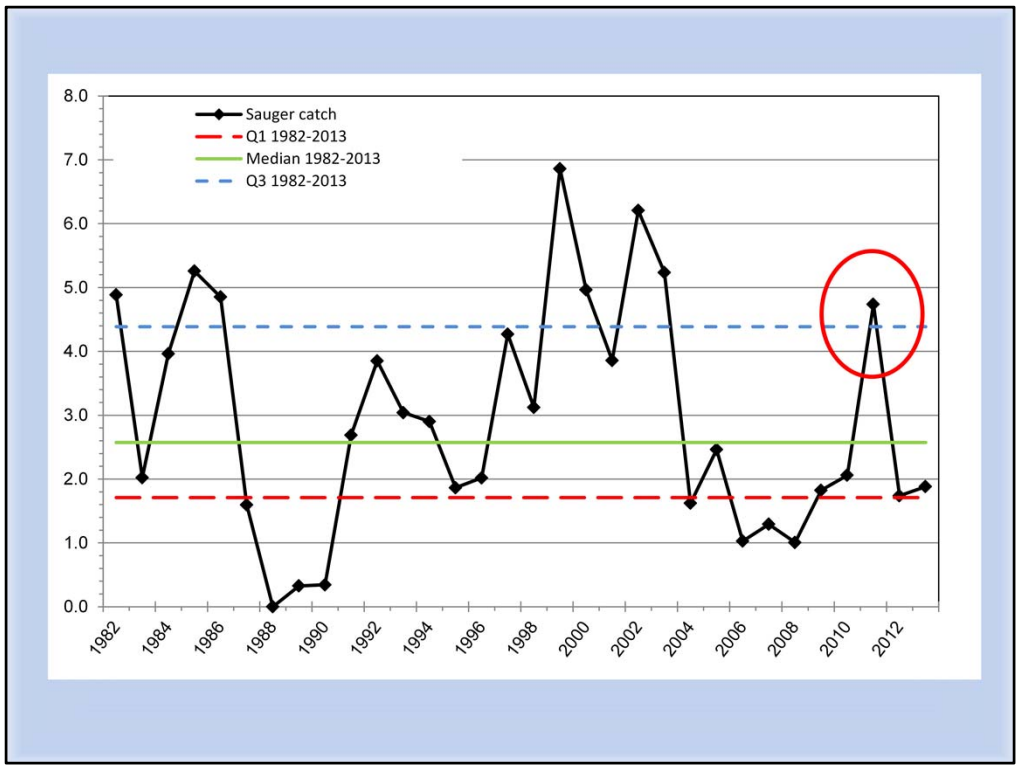
The 2015 net catches confirm that 2013 produced a strong Sauger year class. Though catch rates did not increase as much as with Walleye I anticipate it will likely increase again in 2016 as the 2014 year class recruits more fully to the gill nets.



As mentioned on the previous slide the sharp decline in Sauger gill net catch rate between 2010 and 2011 is the most likely candidate for “loss” of Walleye or Sauger from Pool 4 to Pool 3 through an “open” dam. The figure on this slide shows the flow at Lock and Dam 3 for 2011.

Note that the blue line remains above the red line for much of the summer. In actuality the gates were out of the water for all but approximately 8 days during the summer period in 2011, and notably for an extensive period of this “open” condition the flow rates were high enough to keep the gates up, but not part of a dramatic spring flood that would create the high velocities that prevent movement.

As noted movement of Sauger is not likely the driving factor that caused the reduction between 2010 and 2011. Natural and angler mortality of a major year class that was reaching the end of its lifespan combined with several poor year classes of Sauger in a row were also likely major contributors.



The figure above show the catch rates for Sauger in the station directly above Lock and Dam 3 in Pool 3.

These fish were collected as part of the Prairie Island Nuclear Plant monitoring program that samples upper Pool 4 and Lower Pool 3 with electrofishing gear from May to October annually.

Note that the spike in catch rates in 2011 doesn't last. This may indicate that though there was movement upstream during the high water in 2011 these fish may have fallen back to Pool 4 when water levels dropped, continued upstream out of the power plant sampling area, or succumbed to a combination of the other factors I mentioned as drivers of the decline in Pool 4.

Final summary:

- Some movement likely does occur in certain circumstances
- Movement of Walleye and Sauger through open gates is unlikely to strongly effect Walleye and Sauger populations in Pool 4

Other Species:

- Some species that are stronger swimmers clearly do move through the dam during open, and maybe even closed periods.
  - White Bass tagged in 2011 below Lock and Dam 3 were captured in the Apple River in WI ~2 weeks later
  - Lake Sturgeon have been extensively documented passing through Miss R. dams
  - Fish carrying acoustic tags applied upstream of Pool 4 by East Metro fisheries staff have been documented in Pool 4 and then returned to those upstream areas
    - Lake Sturgeon
    - Flathead Catfish
    - Muskellunge
    - Paddlefish

As always feel free to contact me if you have any questions:

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