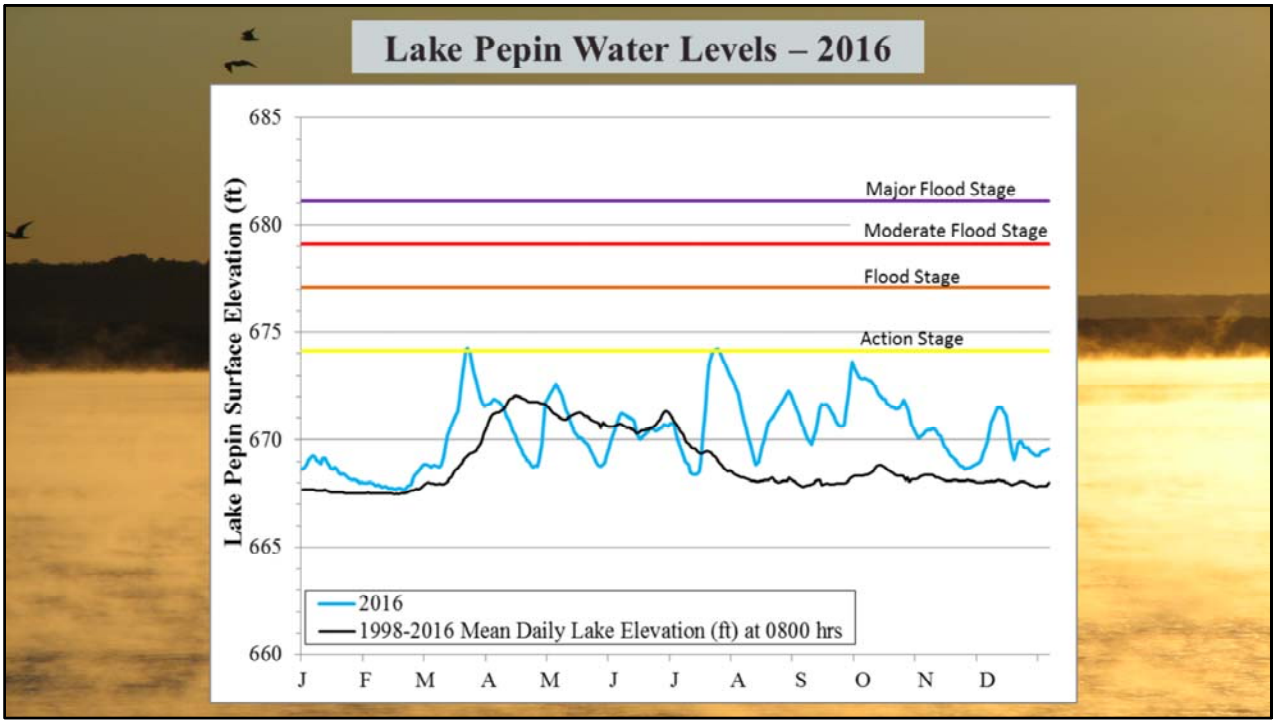
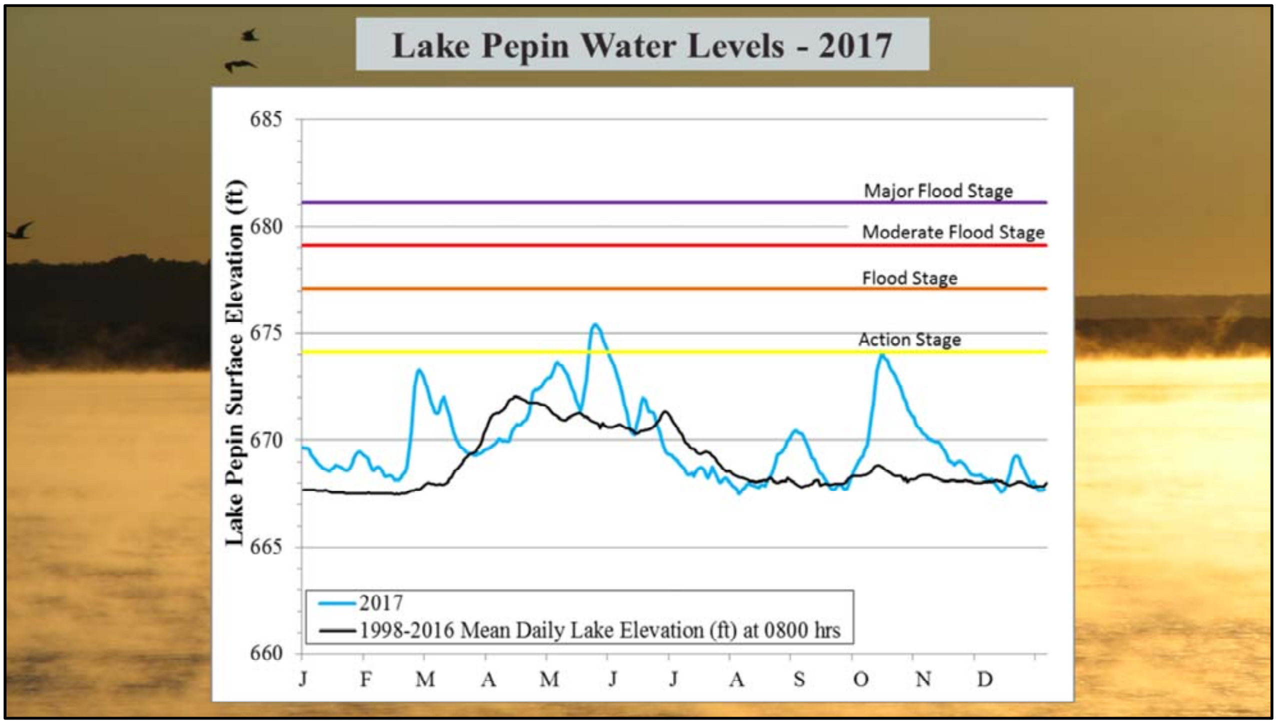
Pepin Sunrise



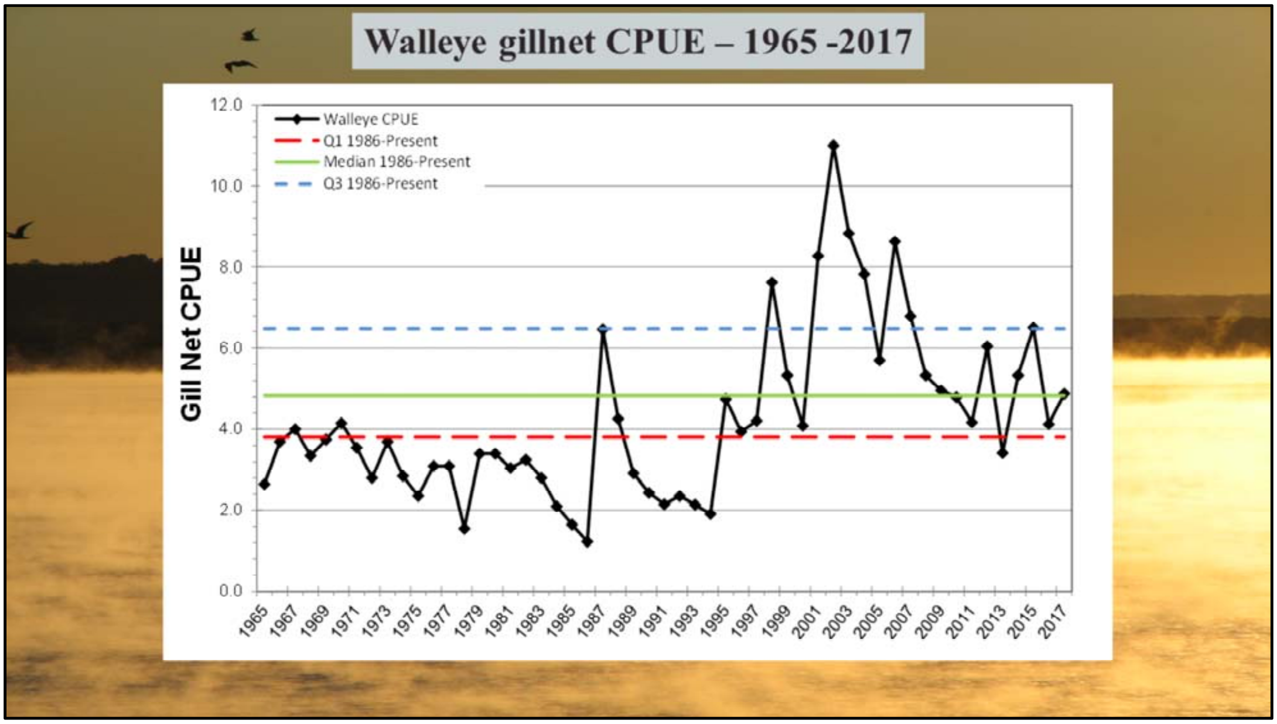
Hydrograph showing the 1998-2016 Mean Daily Water Elevation at 8:00 AM as measured at the Lake City gauge in black and the 2016 hydrograph in blue.

Various flood stages are also labeled.



Hydrograph showing the 1998-2016 Mean Daily Water Elevation at 8:00 AM as measured at the Lake City gauge in black and the 2016 hydrograph in blue.

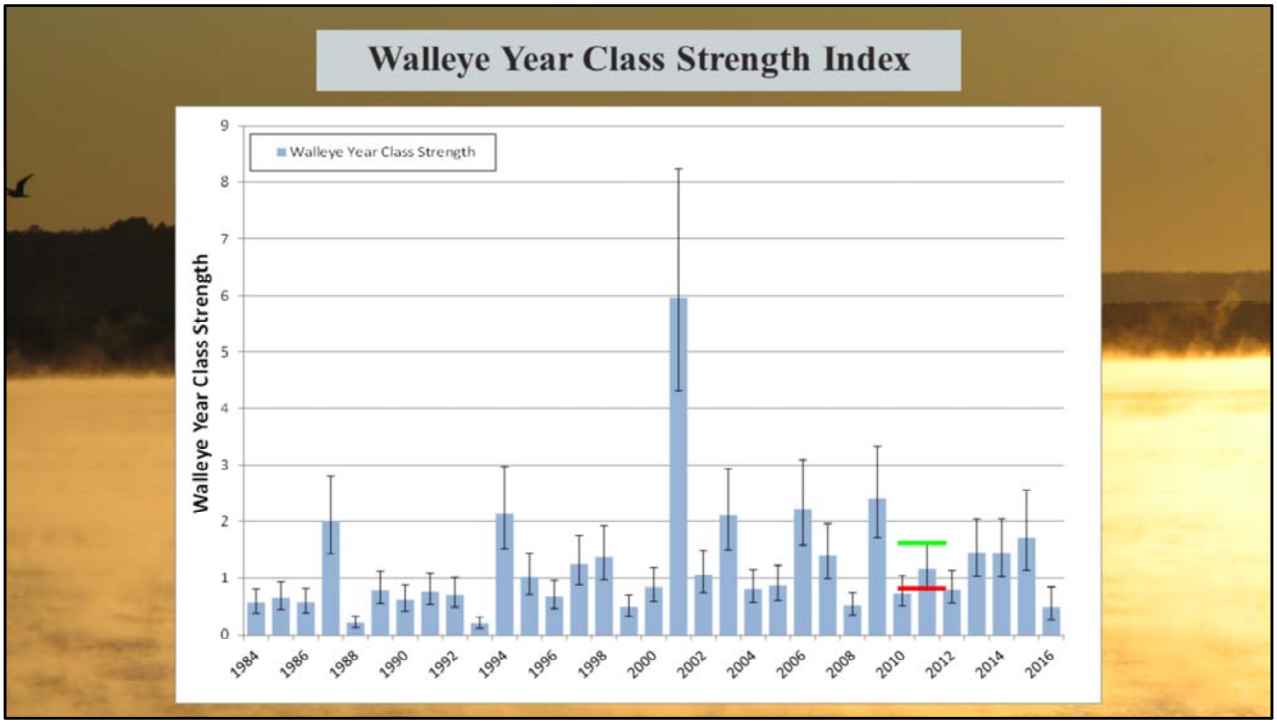
Various flood stages are also labeled.



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.

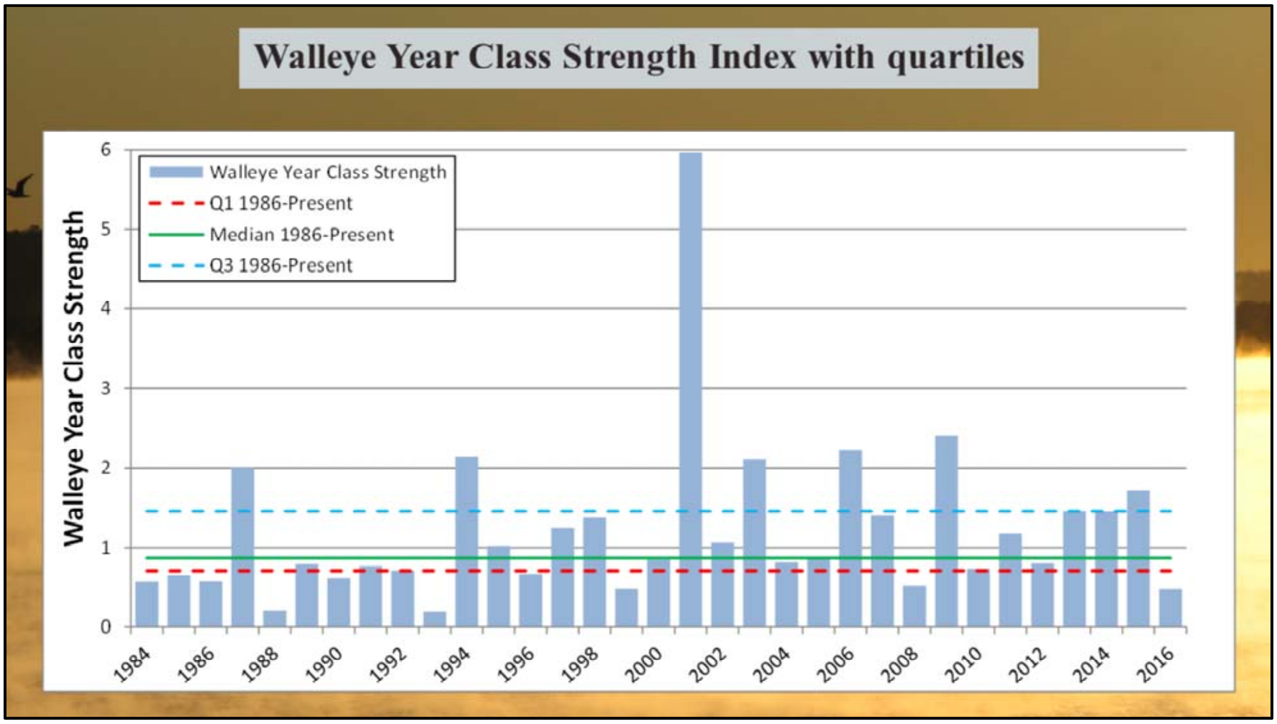
This figure shows that while Lake Pepin's walleye population is down from historic highs driven by the incredibly strong 2001 year class it is near the (1986-Present) median.

Note: As I have mentioned in these presentations many times before when interpreting these figures the most important thing to consider is trends. Individual values are meaningful, but can be influenced by conditions like water temperature or in the case of Lake Pepin flow/water level.

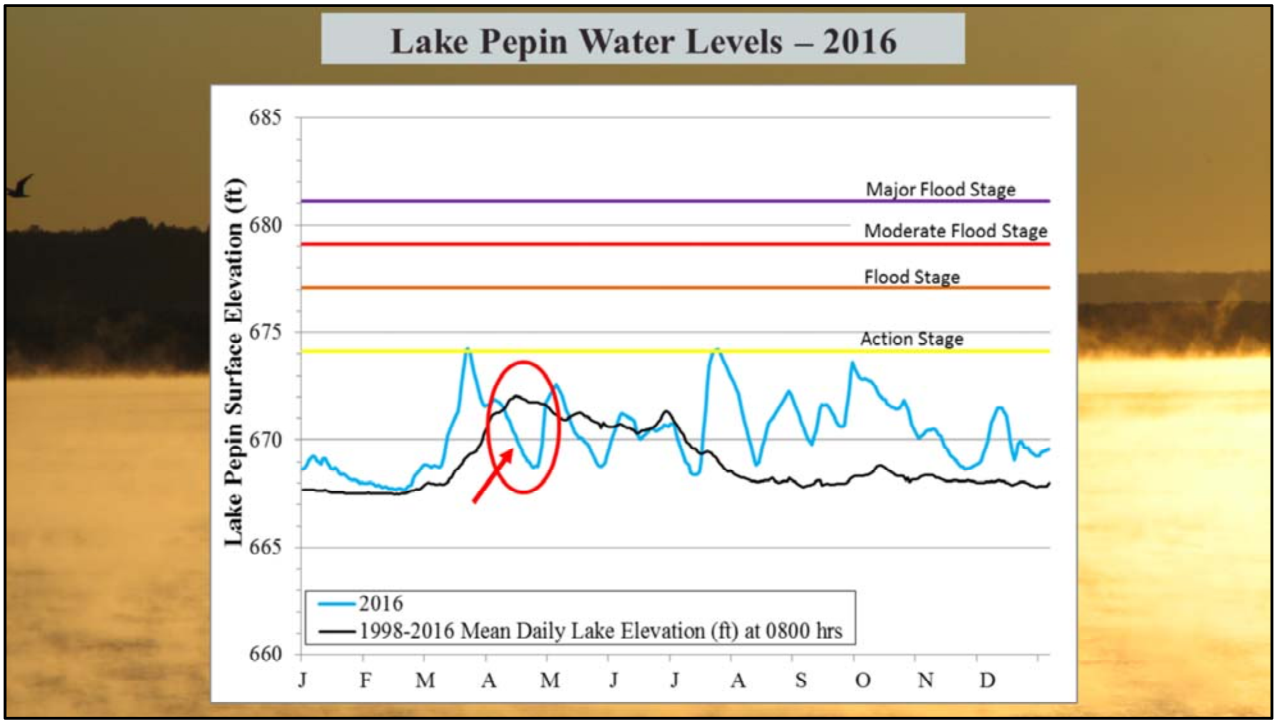


The large lake program in MN is attempting to standardize estimates of year class strength across lakes which has led to a new (for those of you who have become used to my YCSI figures in the last several years) way of displaying the year class strength estimate data. The Dots represent the estimate 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. By the nature of the calculations the larger the estimate of year class the larger the statistical boundary for that estimate, thus the longest line is associated with the 2001 year class.

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 2015 and 2016 year class estimates as we gather more data in the coming years.

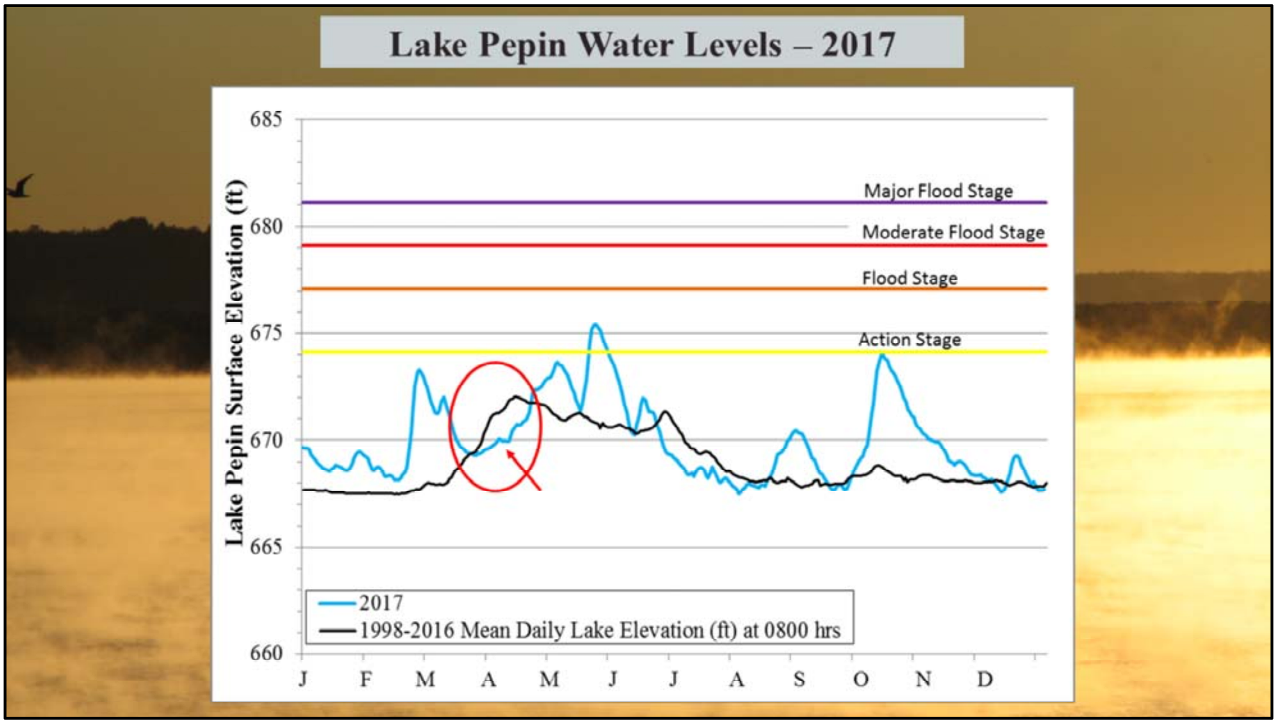


Shows the same information as the previous slide with the familiar quartiles that have been used to describe year classes as strong (above the dashed blue line), average (between the dashed blue and dashed red lines), or weak (below the dashed red lines) in recent years.



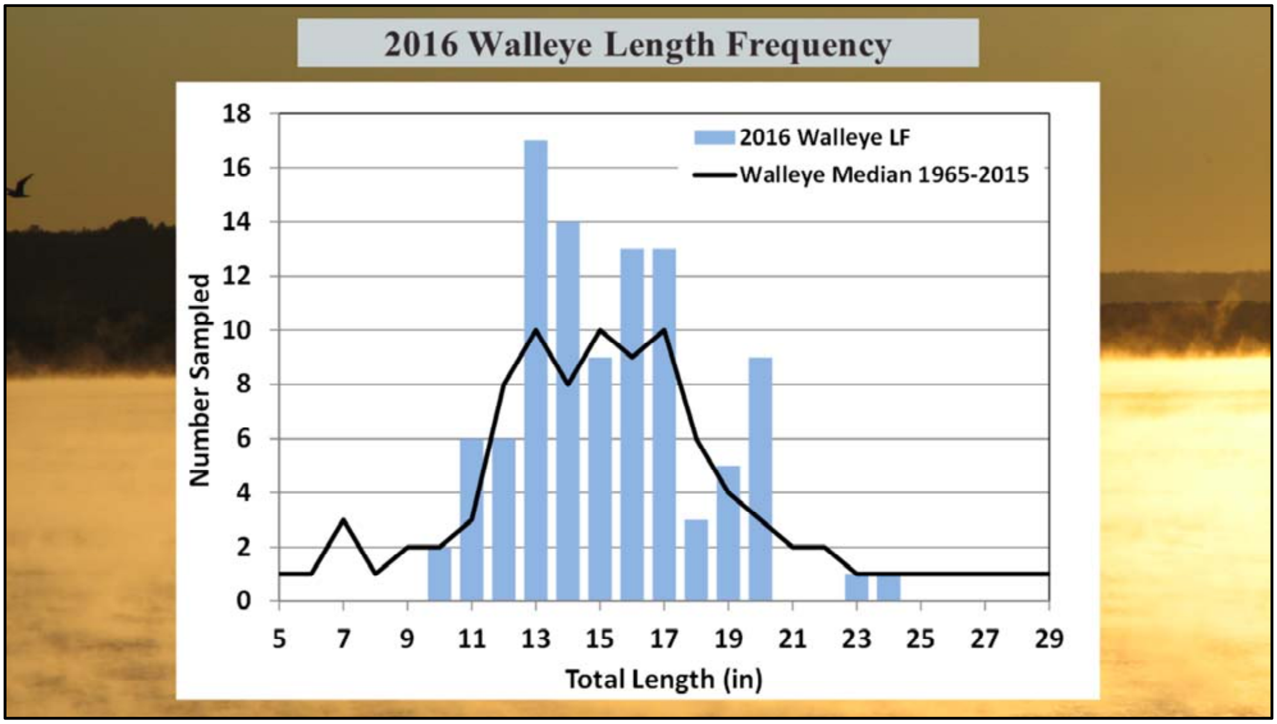
Low water during primary walleye spawn period, in this case during a descending leg of the hydrograph

The overlap of the Walleye spawning period with the descending leg of the 2016 hydrograph is potentially important because of the preferred Walleye spawning substrate in Pool 4. Previous studies have documented that Walleye in Pool 4 seem to prefer spawning on flooded terrestrial vegetation in off channel areas. The descending section of the hydrograph is problematic for these spawners, because if they spawn in flooded areas those areas may soon be dry causing a loss of the deposited eggs, and if they wait their preferred habitat will no longer be available.



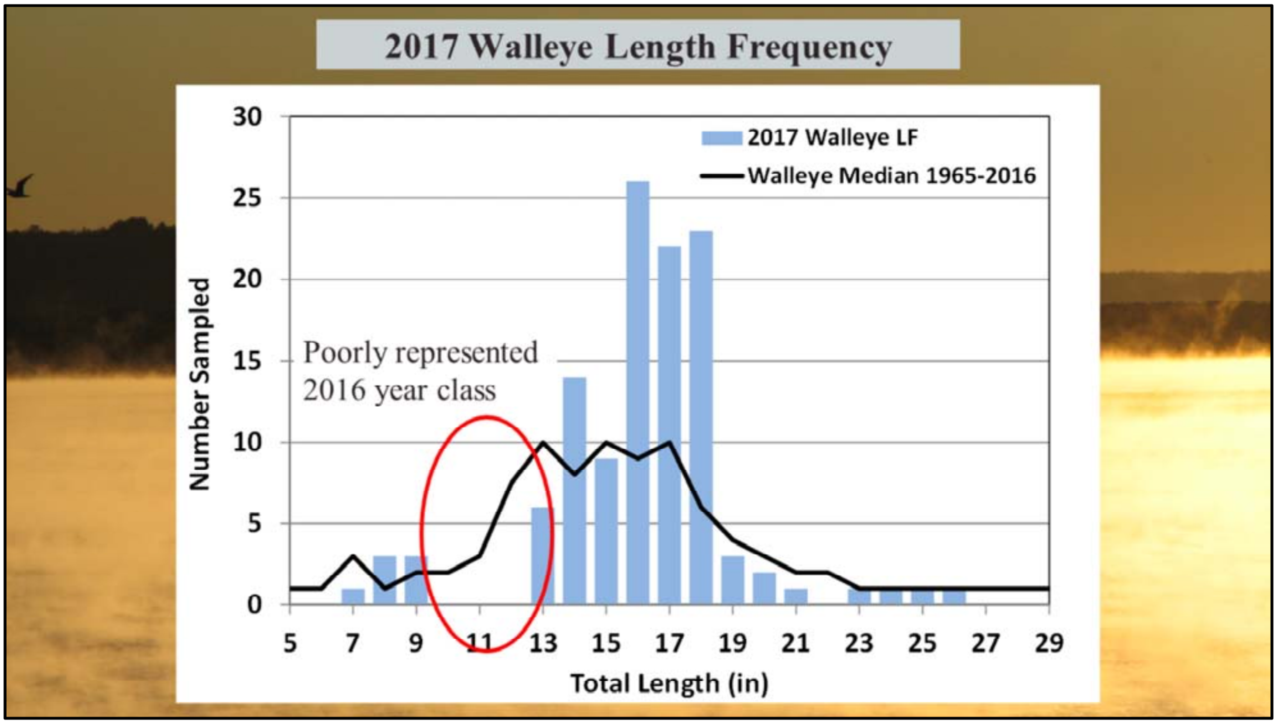
Low water during primary walleye spawn period, but in this case leading to an ascending leg of the 2017 hydrograph.

The overlap of the Walleye spawning period with the ascending leg of the 2017 hydrograph is potentially important because of the preferred Walleye spawning substrate in Pool 4. Previous studies have documented that Walleye in Pool 4 seem to prefer spawning on flooded terrestrial vegetation in off channel areas. The ascending section of the hydrograph is less problematic (than the one in the previous slide) for these spawners, because if they don't have their preferred spawning habitat and wait more areas will become available with rising waters, and if/when they spawn it is more likely that the areas where their eggs are deposited will remain inundated providing a chance for those eggs to hatch and disperse before water levels drop.



This slide represents the number of Walleyes from each 1 inch size group that was captured in the 2016 gillnets (blue bars) and the long term median for the same information from 1965-2015 represented by the black line.
As you can see the 2013 year class is represented here primarily by the 17-20 inch range (mean length for females ~ 20" mean length for males ~ 17") and seems to be over performing the long term median as indicated in the YCSI slide.

The high peak at 13" are age-1 Walleyes from 2015.



Note: Change in Y axis from the previous slide.

This slide represents the number of Walleyes from each 1 inch size group that was captured in the 2017 gillnets (blue bars) and the long term median for the same information from 1965-2016 represented by the black line.
As you can see the 2015 year class is represented here primarily by the 14-18 inch range and seems to be over performing the long term median as indicated in the YCSI slide.

The red circle indicates the hole in the size structure left by the poor 2016 year class. This year class likely suffered from poor reproduction due to an early meltwater hydrograph peak that was subsiding to lower than normal water levels by the time of peak Walleye spawn in mid-April. (For a more complete explanation see “Lake Pepin Water Levels – 2016 slide on pg 7)

Length Group	Sample size	Subsample size	Age 0	1	2	3	4	5	6	7	8	9	10
5.0 - 5.9	0	0											
6.0 - 6.9	0	0											
7.0 - 7.9	1	1	1										
8.0 - 8.9	3	3	3										
9.0 - 9.9	3	3	3										
10.0 - 10.9	0	0											
11.0 - 11.9	0	0											
12.0 - 12.9	0	0											
13.0 - 13.9	6	6		5	1								
14.0 - 14.9	14	14		7	7								
15.0 - 15.9	9	9			9								
16.0 - 16.9	26	26			20	6							
17.0 - 17.9	22	22			19	3							
18.0 - 18.9	23	22			12	8	2	1					
19.0 - 19.9	3	3				2			1				
20.0 - 20.9	2	2				1							1
21.0 - 21.9	1	1				1							
22.0 - 22.9	0	0											
23.0 - 23.9	1	1						1					
24.0 - 24.9	1	1									1		
25.0 - 25.9	1	1									1		
26.0 - 26.9	1	1									1		
27.0 - 27.9	0	0											
Totals	117	116	7	12	68	21	2	2	1	0	3	0	1
Percent			6.0	10.3	57.7	18.3	1.8	1.7	0.9	0.0	2.6	0.0	0.9
	Mean Length (in)		8.9	14.1	16.8	18.2	18.5	20.6	19.2		25.5		20.1
	Standard Deviation		0.61	0.44	1.22	1.29	0.36	3.37			1.19		
	Minimum Length (in)		7.9	13.3	13.6	16.3	18.2	18.3	19.2		24.5		20.1
	Maximum Length (in)		9.7	14.8	18.7	21.3	18.7	23.0	19.2		26.8		20.1

* Unable to age fish in this group.

This is an Age-Length Frequency table that shows how many Walleye of each age group were captured in the gillnets in 2017 by one inch increments. For example there were 12 Age-1 Walleye (hatched in 2015) that were between 13.3 and 14.8 inches in length. The sample size column represents the total number of Walleye sampled from that length group in the gill nets in 2017. The subsample size column represents the number of fish for each size group that I aged by removing a bone called an otolith (ear stone) from inside the fish's head. This bone can then be cracked in half, toasted over a candle flame, and looked at under a microscope where the heat from the candle causes distinct light and dark annual rings to emerge much like those found on a cross section of a tree. When all of the fish in a size group are not aged the unaged fish are proportionally distributed across the represented ages indicated by those fish that were aged.

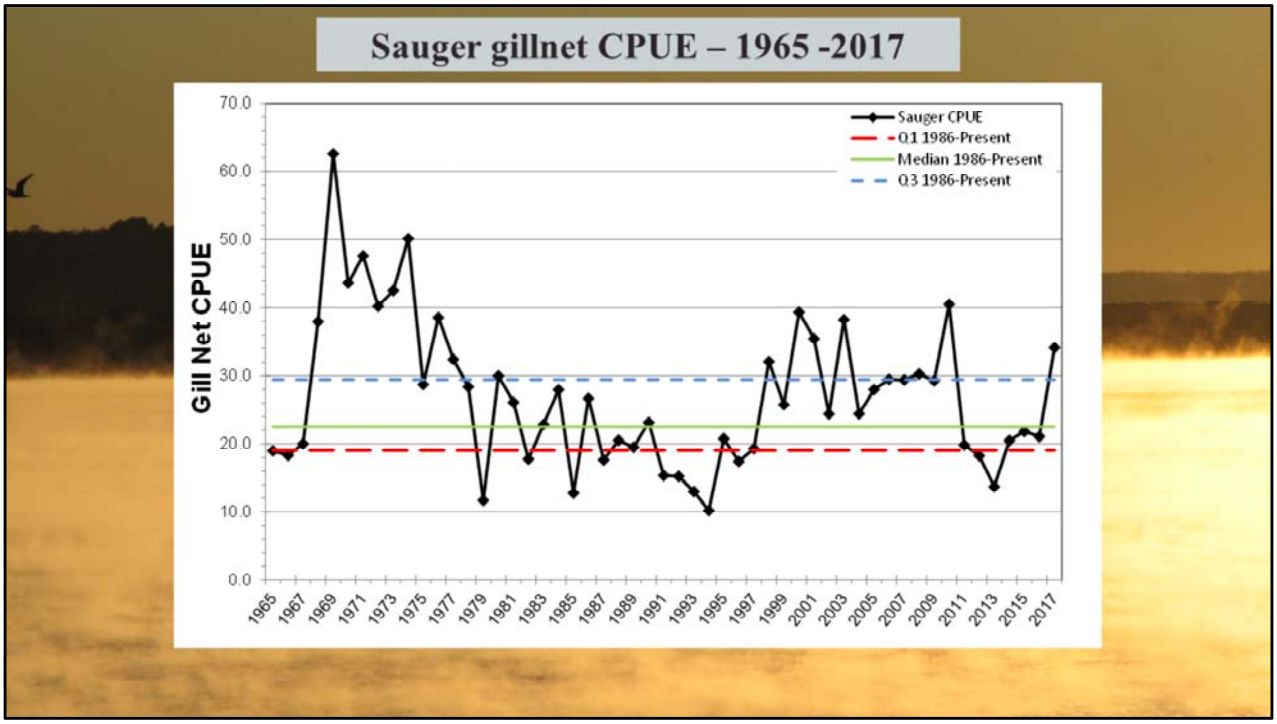
One important thing to note when looking at Age-Length Frequencies, particularly for Lake Pepin, is the speed at which the fish, Walleyes in this case, are growing. This growth is much faster than most other bodies of water in Minnesota when combined with what is also a relatively short lifespan (typically <10 years in Lake Pepin and potentially >20 in the northern lakes in MN) and represents some interesting management and regulation challenges.

Walleye Young-of-the-Year

Gear	Time of Year	Catch	Status
Trawl	August	13.2/hr	4th highest
GN	October	0.29/net	0.35/net is a 5 year mean
Fall YOY EF	November	1.3/hr	2nd Lowest

Our efforts to identify strong year classes of Walleye and Sauger in particular start in their first year of life when we monitor their numbers and growth from July (seining), through August (trawling), October (gill netting), and into November (nighttime electrofishing). Our most accurate estimates of the years reproduction typically come during November when many hours of electrofishing are done on cold nights to capture and count young of year (YOY) Walleye and Sauger.

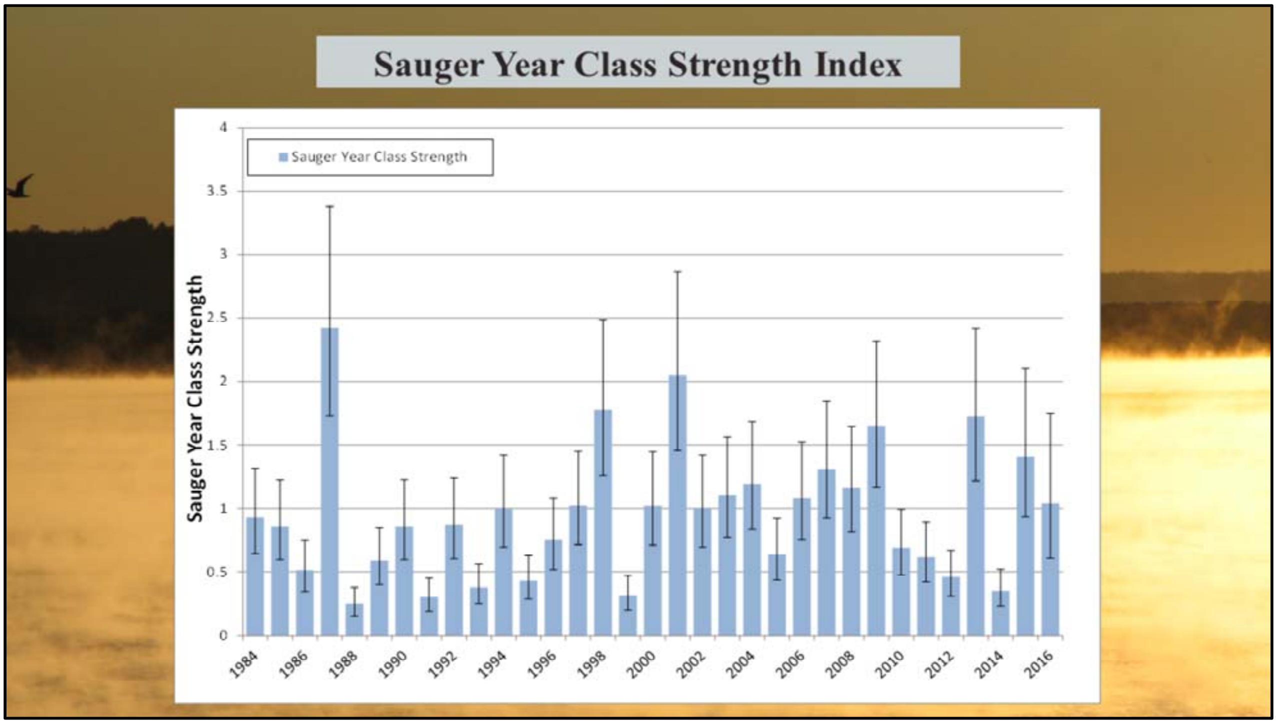
The 2017 data is presented above. High water conditions for the second year in a row forced a delay in sampling. As water levels fell water temperatures also dropped precipitously which may have contributed to the extremely poor catch rates noted during the fall YOY electrofishing. The mixed results between gear types above and concerns about water levels during the spawning period in April mean that a reliable early prediction of year class strength for 2017 will have to wait for the 2018 sampling season.



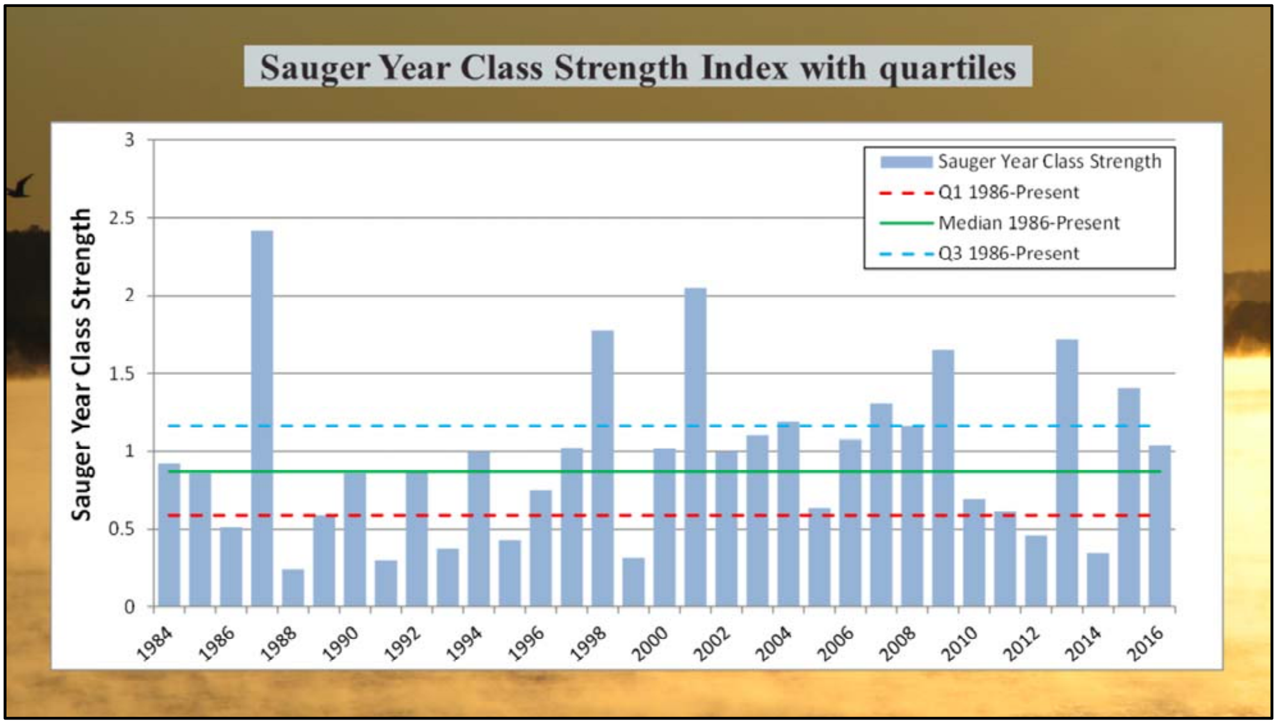
See Slide 2 for more complete description of this type of figure.

This figure shows that Lake Pepin's Sauger population rebounded strongly in 2017 from below the median to above the third quartile. Several strong year classes in the past 4 years have contributed to the higher catch rates particularly the 2015 year class that provided 56% of the Sauger in the gill net catch. This is the second highest net catch in more than a decade and should mean good numbers of Sauger available to anglers in the 2018 season.

The 2017 net catches confirm that 2015 produced a strong Sauger year class. Though numbers did not go up in 2016 like I thought they would they dropped less than those of other species during what appears to have been a poor netting year, and those fish that I anticipated have now recruited to the gill nets in 2017.

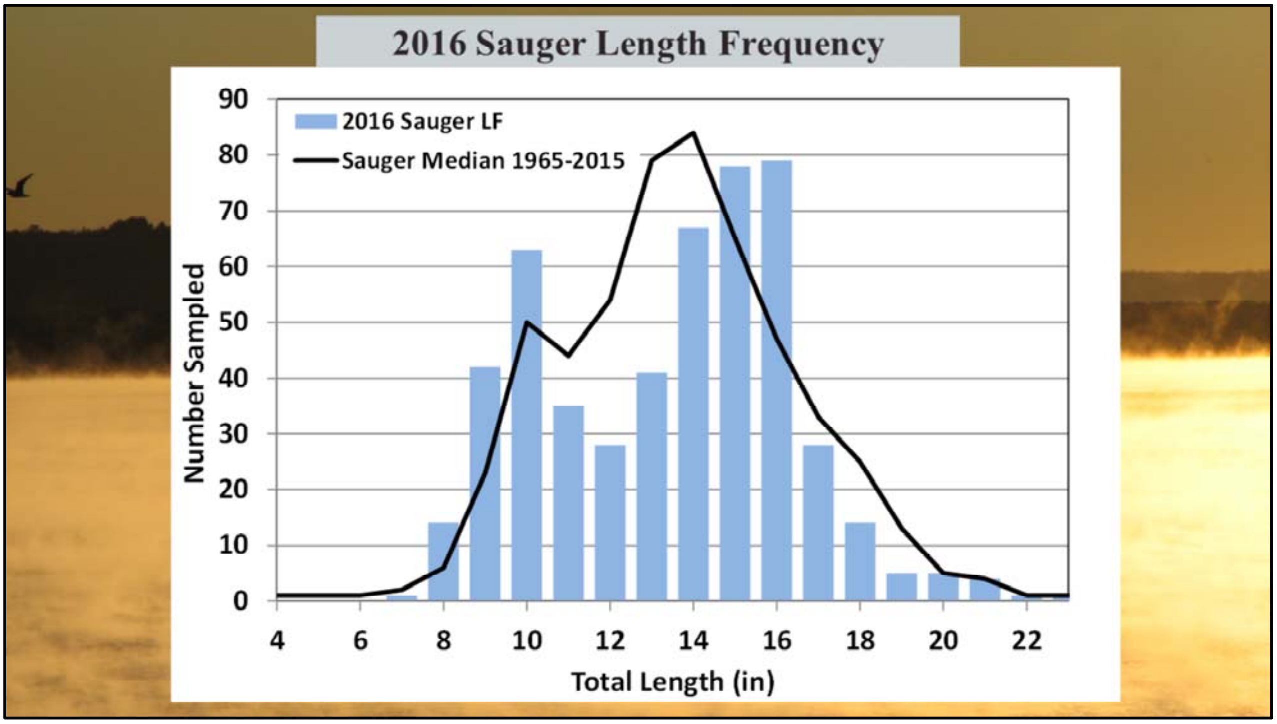


See Slide 5 for more description



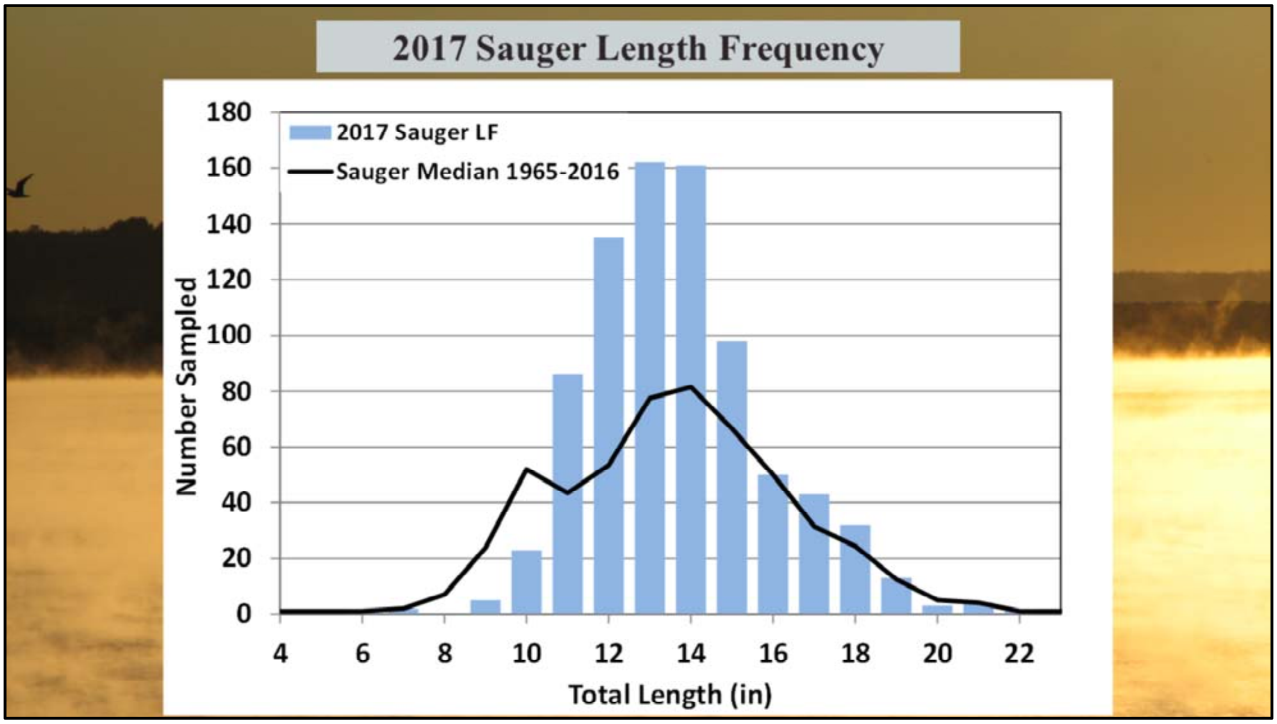
Shows the same information as the previous slide with the familiar quartiles that have been used to describe year classes as strong (above the dashed blue line), average (between the dashed blue and dashed red lines), or weak (below the dashed red lines) in recent years.

Note that after 3 relatively poor Sauger year classes (2010-2012) three of the last 4 years have produced above average year classes including 2 strong year classes (2013 and 2015). These clusters of good-strong year classes (like 2000-2009) seem to be primary drivers in higher Sauger net catches rather than occasional very large year classes that seem to be the dominant drivers in our Walleye population.



This slide represents the number of Sauger from each 1 inch size group that was captured in the 2016 gillnets (blue bars) and the long term median for the same information from 1965-2015 represented by the black line.

The 2013 year class is represented here primarily by the 12-19 inch range (mean length for females ~ 16" mean length for males ~ 14").



Note: Change in y axis from the previous slide

This slide represents the number of Sauger from each 1 inch size group that was captured in the 2017 gillnets (blue bars) and the long term median for the same information from 1965-2016 represented by the black line.

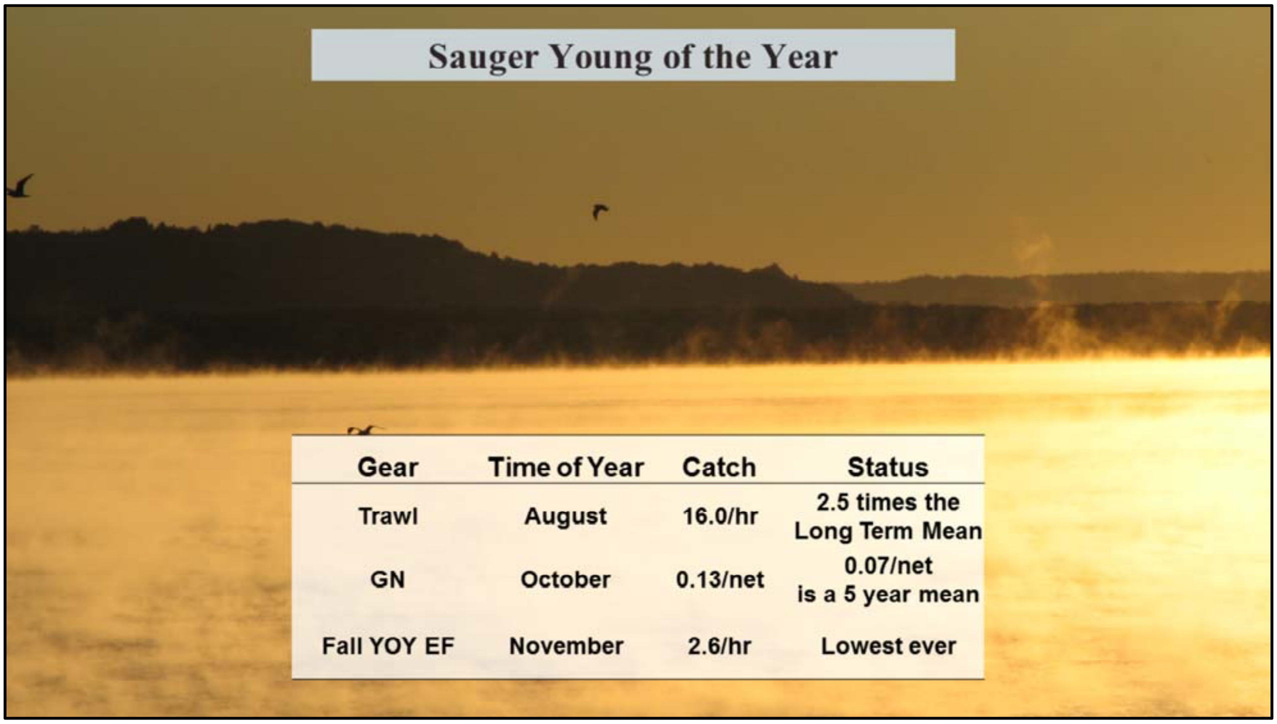
The 2015 year class is represented here primarily by the 12-16 inch range.

Comparing this slide to the previous one will clearly show the progression of the 2015 year class.

Length Group	Sample size	Subsample size	Age 0	1	2	3	4	5	6	7	8	9	10
5.0 - 5.9	0	0											
6.0 - 6.9	1	1	1										
7.0 - 7.9	2	2	2										
8.0 - 8.9	0	0											
9.0 - 9.9	5	3		3	2								
10.0 - 10.9	23	22		19	4								
11.0 - 11.9	86	38		79	7								
12.0 - 12.9	135	29		61	74								
13.0 - 13.9	162	37		4	153	4							
14.0 - 14.9	161	33			156	5							
15.0 - 15.9	98	28			56	32	7	4					
16.0 - 16.9	50	34			4	15	29	1					
17.0 - 17.9	43	28				6	28	5	2	2		2	
18.0 - 18.9	32	32				1	17	4	3	4	3		
19.0 - 19.9	13	13					4	2	1	2	4		
20.0 - 20.9	3	3						3					
21.0 - 21.9	4	4								1	3		
22.0 - 22.9	1	1										1	
23.0 - 23.9	0	0											
Totals	819	308	3	166	457	63	85	19	6	9	10	3	0
Percent			0.4	20.3	55.8	7.6	10.4	2.3	0.7	1.0	1.2	0.3	0.0
	Mean Length (in)		7.1	11.4	13.9	16.3	17.5	18.5	18.4	19.2	19.8	19.9	
	Standard Deviation		0.88	0.71	1.26	0.96	0.98	1.57	0.76	1.24	1.21	3.15	
	Minimum Length (in)		6.1	9.8	9.8	13.9	15.5	15.4	17.3	17.4	18.1	17.6	
	Maximum Length (in)		7.7	13.1	17.0	18.1	19.5	20.7	19.4	21.7	21.9	22.1	

See Slide 11 for a more complete explanation of this figure.

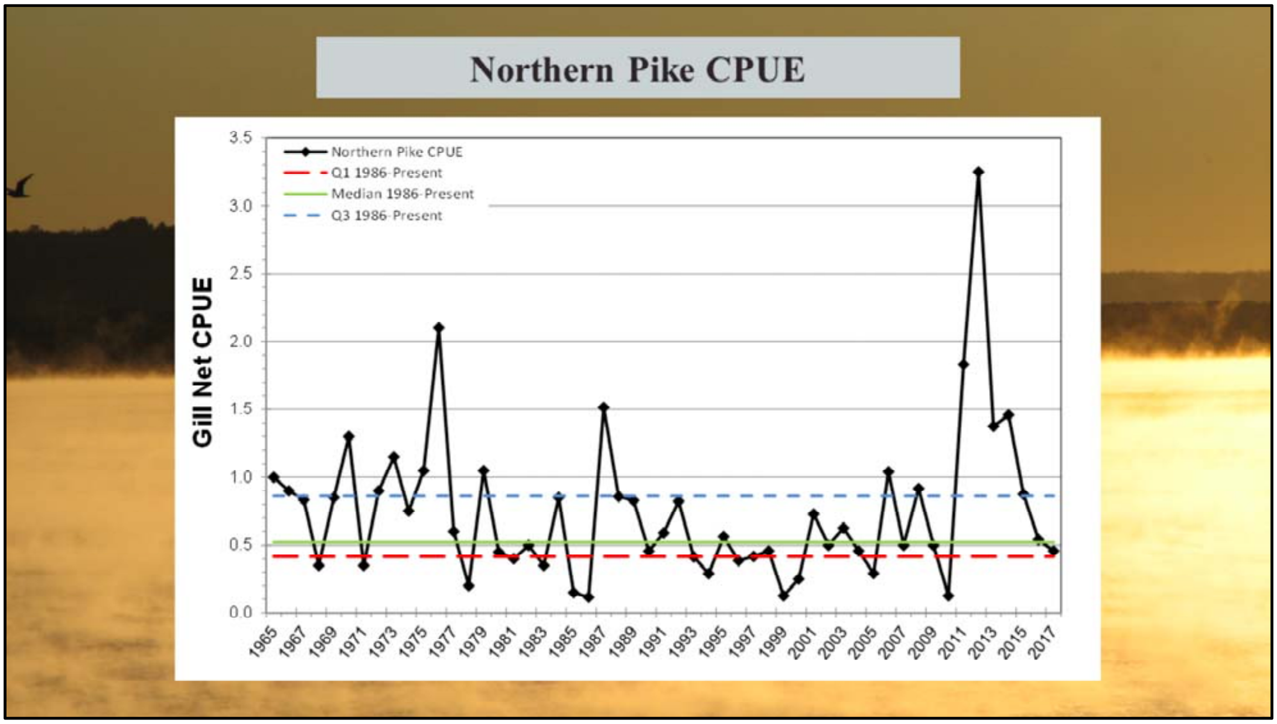
I have often told groups that Lake Pepin Sauger rarely live longer than 10 years (particularly females) and this year we only made it to Age-9.



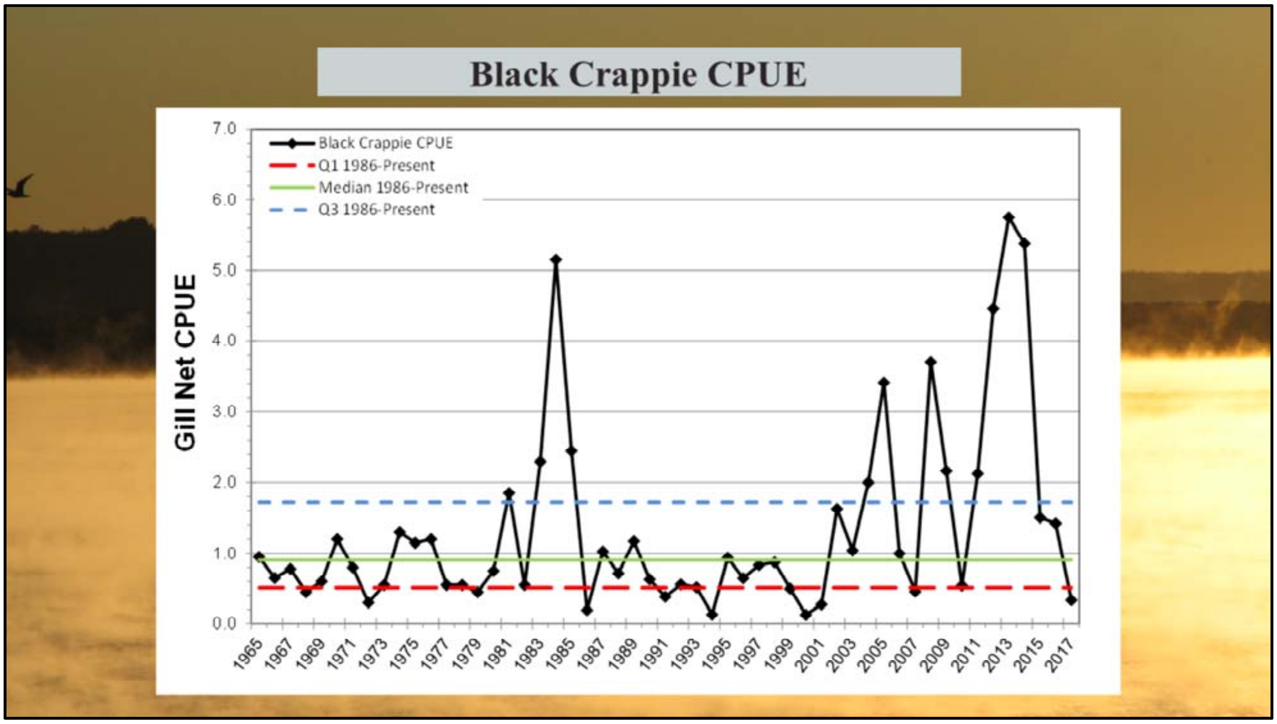
Gear	Time of Year	Catch	Status
Trawl	August	16.0/hr	2.5 times the Long Term Mean
GN	October	0.13/net	0.07/net is a 5 year mean
Fall YOY EF	November	2.6/hr	Lowest ever

Our efforts to identify strong year classes of Walleye and Sauger in particular start in their first year of life when we monitor their numbers and growth from July (seining), through August (trawling), October (gill netting), and into November (nighttime electrofishing). Our most accurate estimates of the years reproduction come during November when many hours of electrofishing are done on cold nights to capture and count young of year (YOY) Walleye and Sauger. The early freeze up of Lake Pepin in November of 2014 prevented us from getting a complete sample of young of the year Walleye or Sauger in 2014, and high water during the winter flood of 2015 prevented us from collecting data that year.

The 2017 data is presented above. High water conditions for the second year in a row forced a delay in sampling. As water levels fell water temperatures also dropped precipitously which may have contributed to the extremely poor catch rates noted during the fall YOY electrofishing. The mixed results between gear types above and concerns about water levels during the spawning period in April (despite this hampering Sauger less than Walleye) mean that a reliable early prediction of year class strength for 2017 will have to wait for the 2018 sampling season. Note that low catch of YOY Sauger (which are smaller than YOY Walleye) in the gillnets (GN) is normal. We typically only see high numbers here if a very abundant year class is produced.



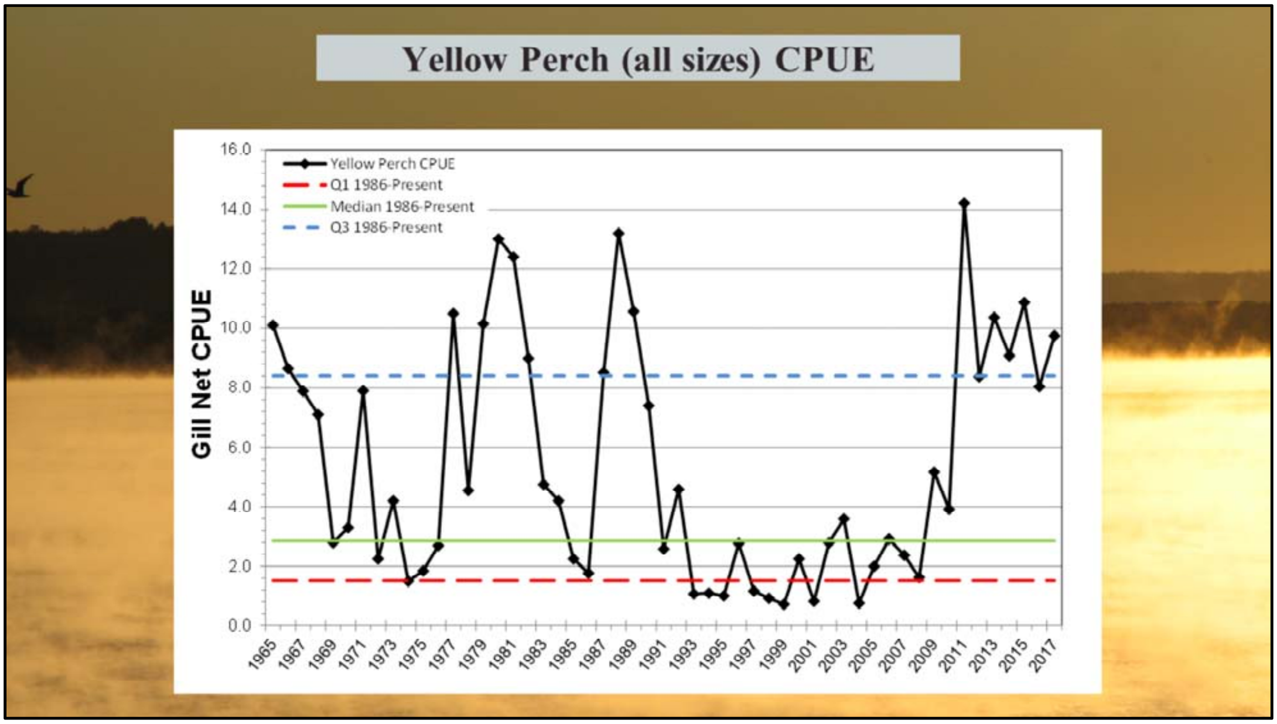
Northern Pike gill net catch history showing the recent increase in Northern Pike population likely as a result of increased water clarity and submerged aquatic vegetation. Rates returned to the long term mean in 2016, but many large fish remain in the system.



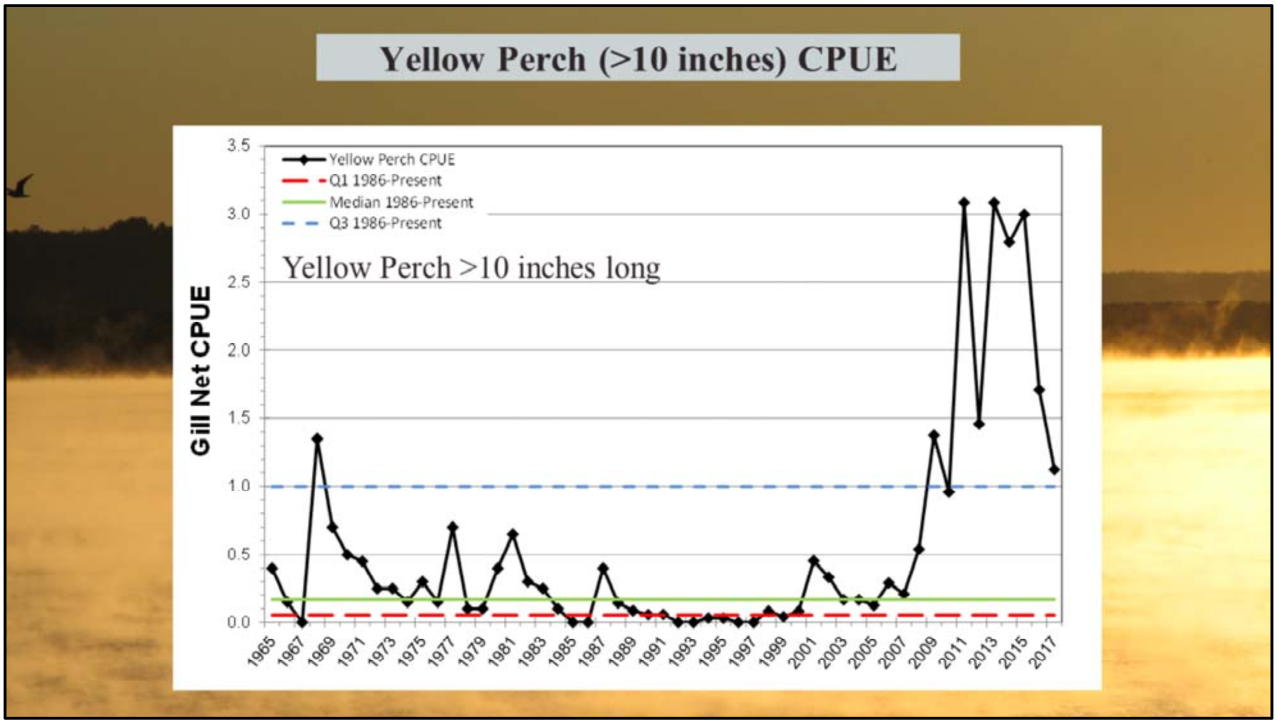
Black Crappie gill net catch history showing the recent increase in Black Crappie population likely as a result of increased water clarity and submerged aquatic vegetation combined with the last three years of record breaking or near record breaking Black Crappie year-classes in Lake Pepin.

Fewer YOY Black Crappie in the gill nets in 2016 and 2017 led to a continued lower overall catch rates, but there are still good numbers of crappies in the system. Many of the peaks in the graph above come from high numbers of YOY crappie that wedge easily in the nets unlike the deep bodied adults, so often the peak years in the figure above represent good reproduction as opposed to high numbers of catchable fish that would be represented by a similar graph of Walleye catch.

Lower numbers in the 2016 and 2017 gill net catch may also be a result of fall/winter floods that occurred during gill netting. The crappie may have been seeking to avoid higher flow conditions by moving to shore and thus may have been captured in lower numbers. This would likely be especially true of YOY crappies that as I mentioned above often contribute well to crappie catches in the gill nets.

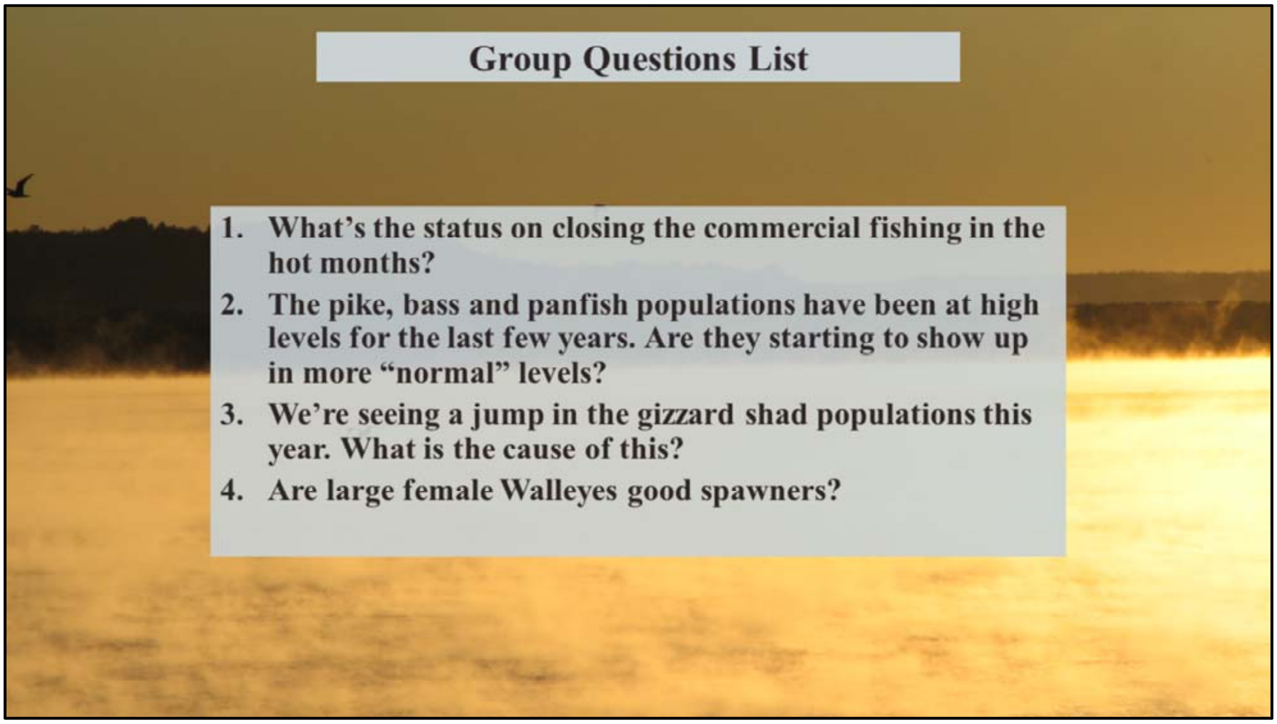


Yellow Perch gill net catch history showing the recent increase in Yellow Perch population likely as a result of increased water clarity and submerged aquatic vegetation needed for perch reproduction.



Gill net catch of Yellow Perch >10” showing the recent and unprecedented increase in the population of large Yellow Perch.

Numbers have now dropped to near the 3rd quartile, and growth seems to have slowed a bit as populations have increased. That being said there are good numbers of smaller perch in the system that will likely be recruiting to this >10” group soon, and I would expect it to maintain current levels or even increase a bit in the near future years.



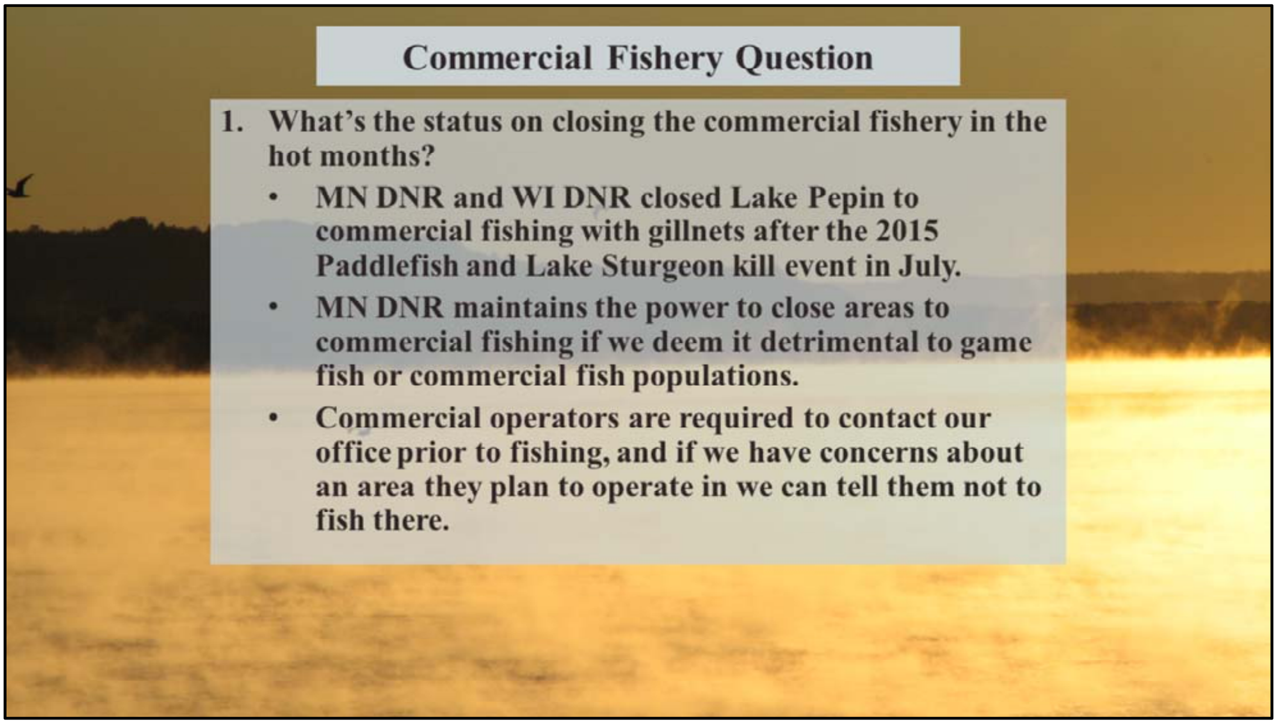
Several questions submitted to me prior to the Walleye Searchers meeting.

Not all questions submitted were included in this presentation for the purposes of time.

Individuals with questions about the Lake Pepin/Pool 4 fishery or other Mississippi River questions can contact me directly and I will do my best to answer them as soon as I can.

My contact information is:

Nick Schlesser (MN DNR Large Lake Specialist Lake Pepin/Pool 4)
1801 S Oak St
Lake City, MN 55041
651-345-3365 extension 235
nicholas.Schlesser@state.mn.us



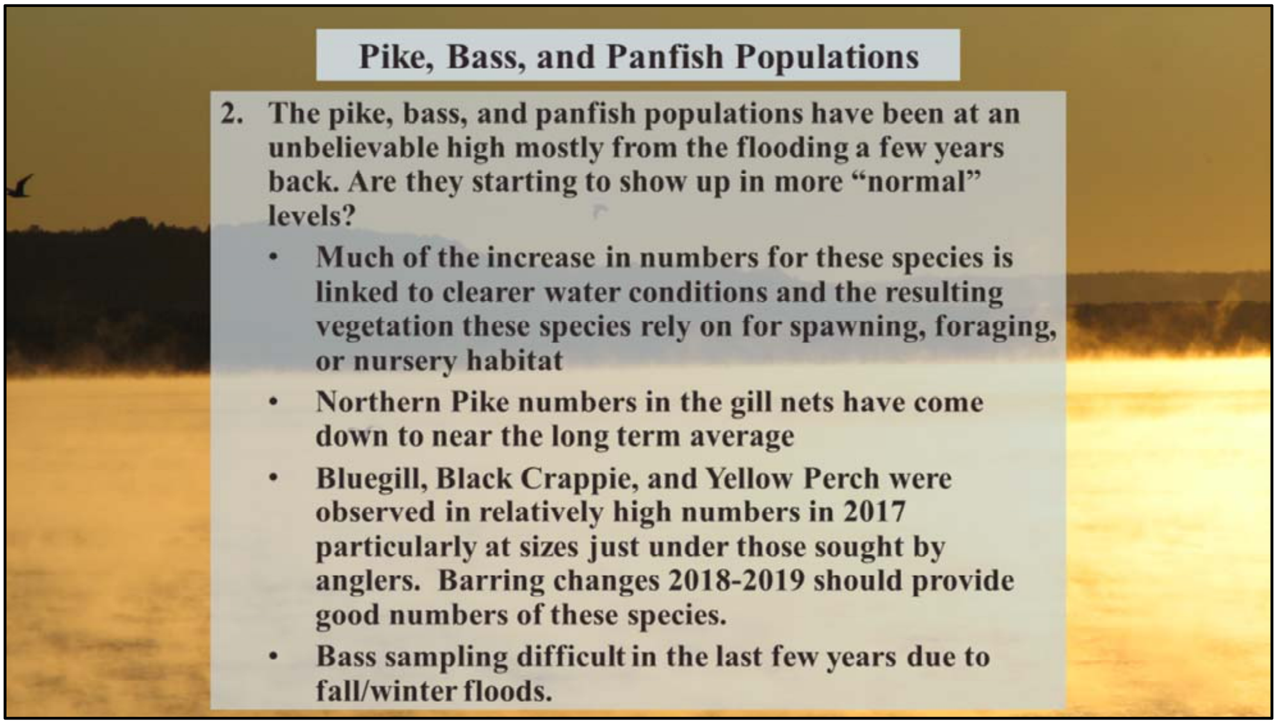
Presumably this question relates to the DNRs ability to close the commercial fishery in order to prevent excessive mortality on target or non-target species of fish.

After a commercial bycatch related fish kill involving dozens of Lake Sturgeon and Paddlefish mortalities in the summer of 2015 both MN DNR and WI DNR closed the gill net fishery on Lake Pepin to prevent further impacts on these recovering fish populations.

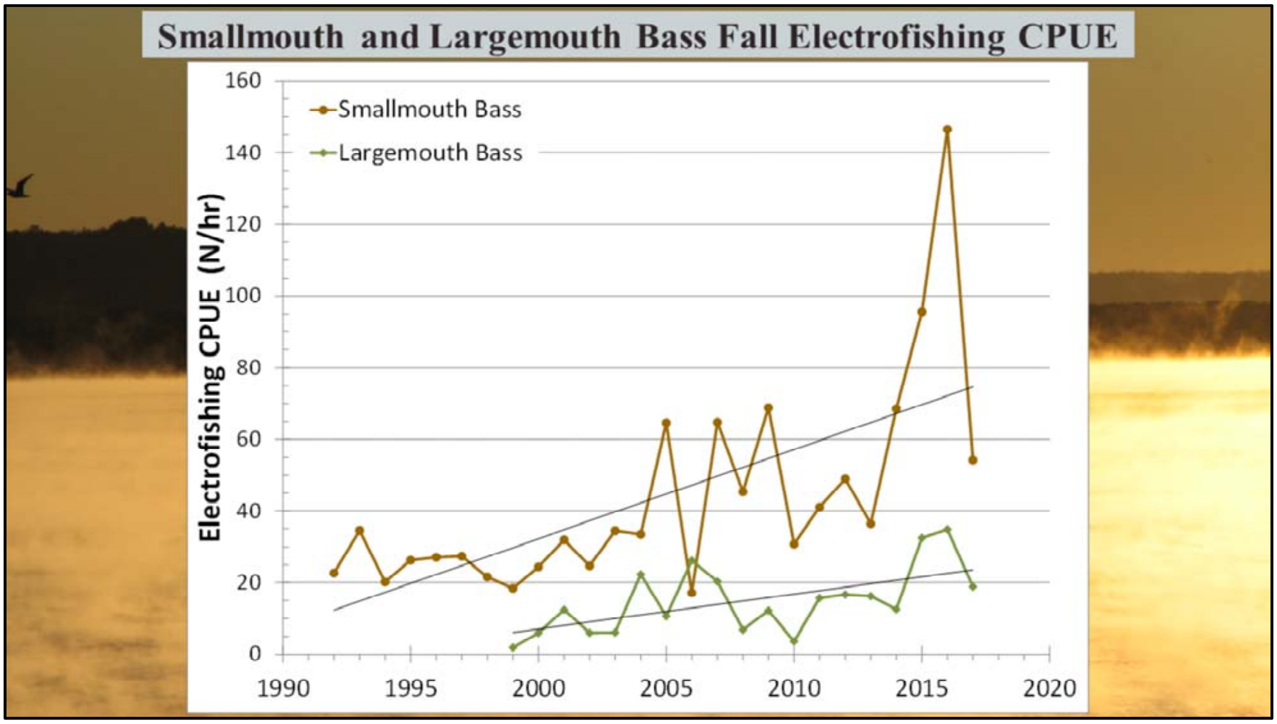
Wisconsin has since made that closure permanent through its process, and the MN DNR has maintained the closure on an interim basis. The MN DNR rule that will make the closure permanent is working its way through the rulemaking process. The commercial seine fishery on Lake Pepin remains open, because as an encirclement rather than entanglement gear it represents a much lower risk of mortality to these species.

Thant being said the MN DNR maintains the power to close areas to commercial fishing if we would deem it detrimental to fish populations (game, non-game, or commercial).

Our commercial fishermen are required to contact our office prior to setting gear in an area, and if we have concerns about an area they plan to operate in we can tell them not to fish there.

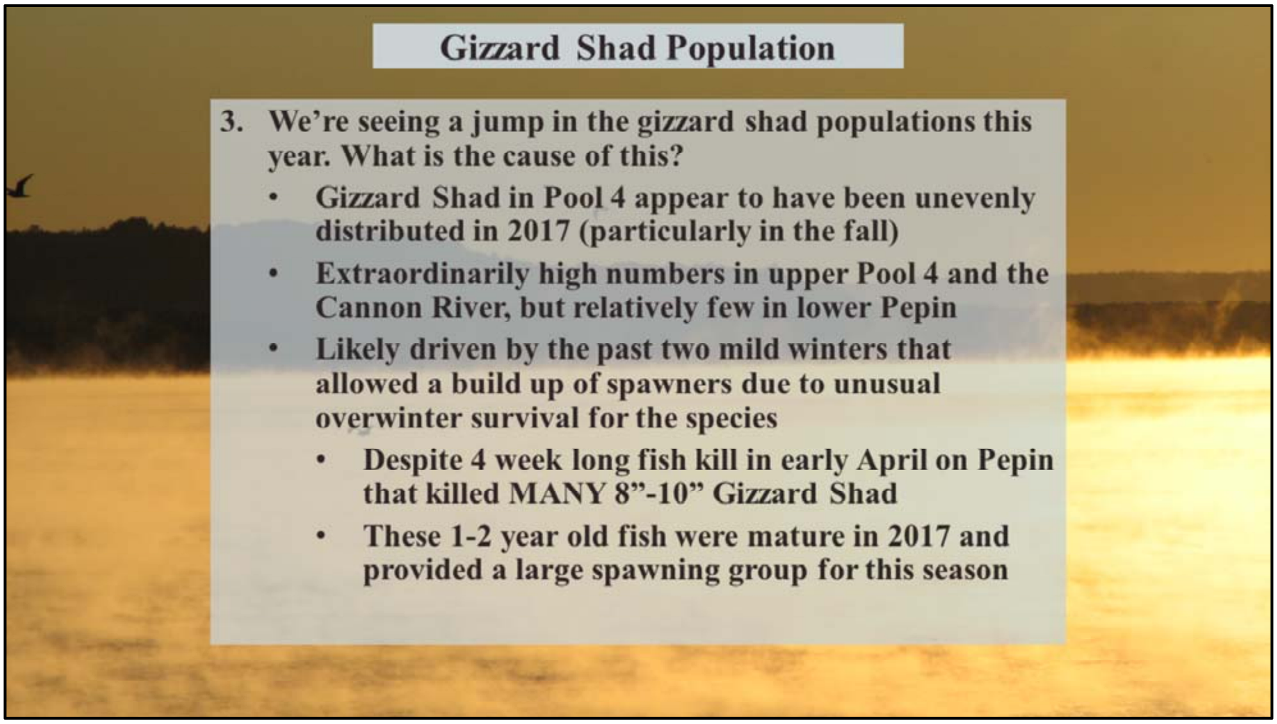


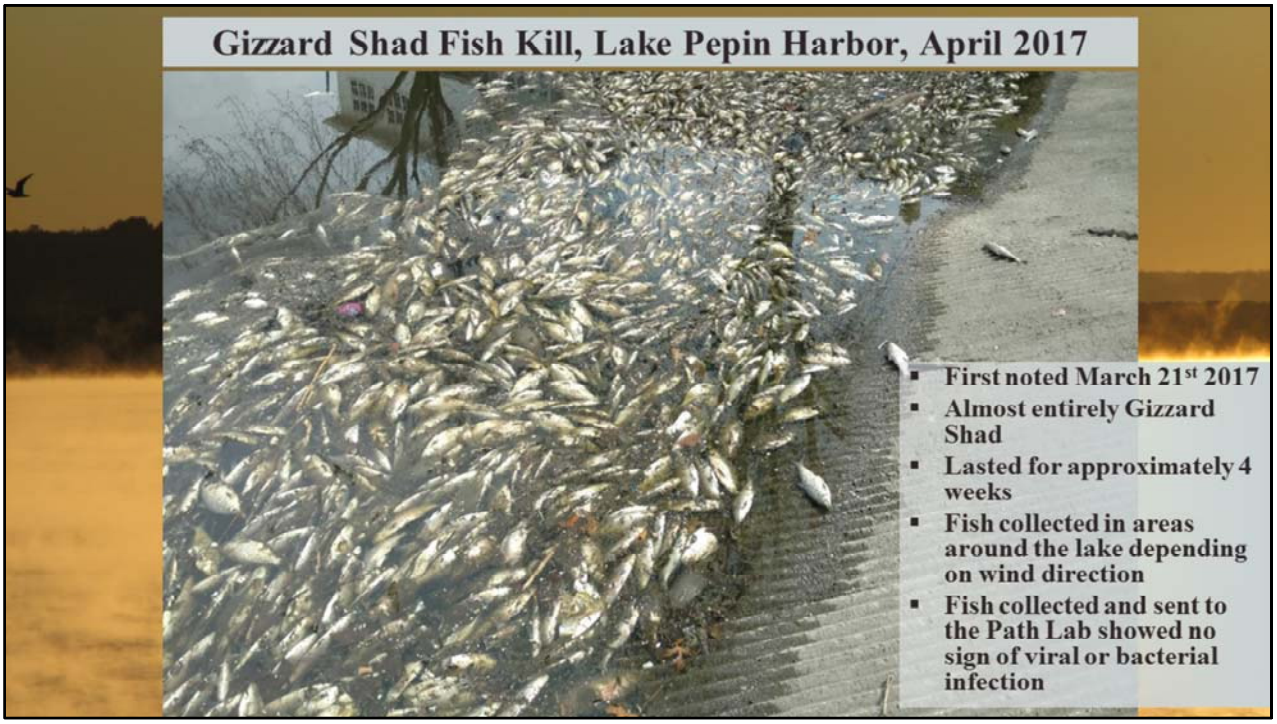
Several of these species Northern Pike, Black Crappie, and Yellow Perch are also addressed in previous slides in this presentation.



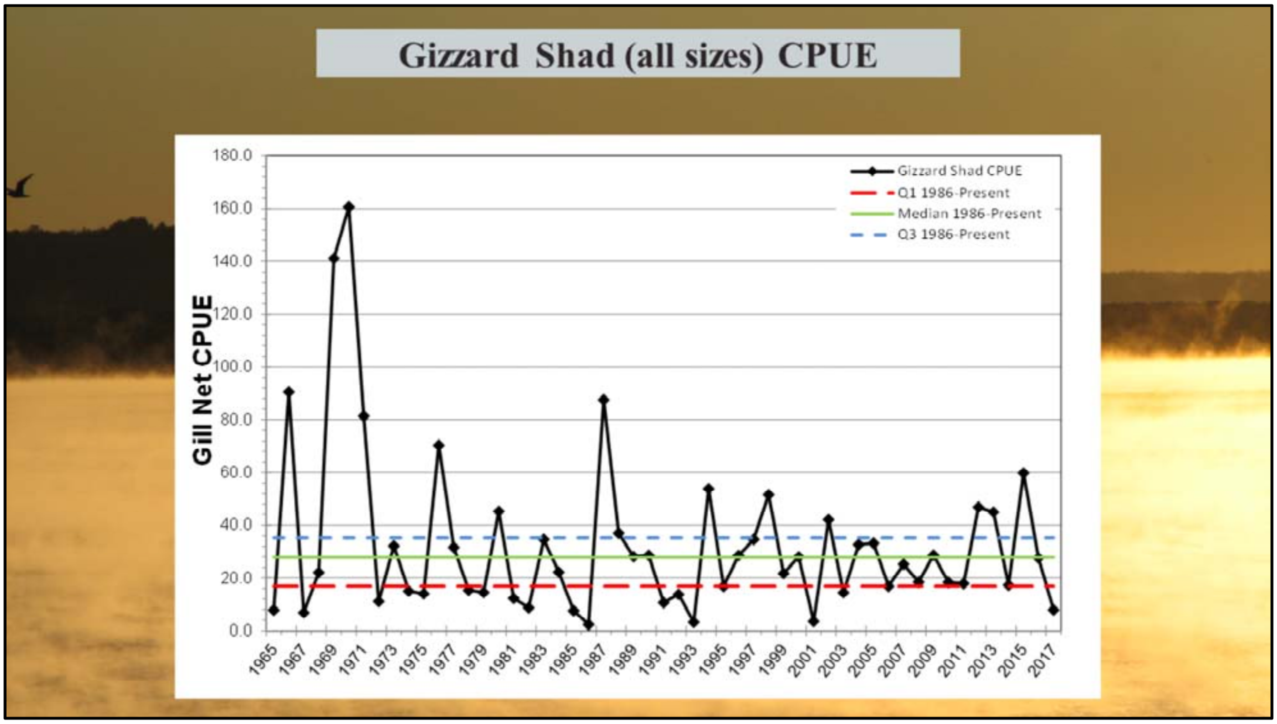
Despite difficult sampling conditions in 2016 due to fall flooding a small sampling window opened during November when we were able to conduct some electrofishing runs that produced very high catch rates of bass particularly Smallmouth Bass.

High water in the fall is an ongoing issue with this sampling due to the limited effective depth (~6') of our electrofishing boats, and the inability to access nearshore areas under overhanging trees when the water levels rise.


Gizzard Shad Population
3. We're seeing a jump in the gizzard shad populations this year. What is the cause of this?
• Gizzard Shad in Pool 4 appear to have been unevenly distributed in 2017 (particularly in the fall)
• Extraordinarily high numbers in upper Pool 4 and the Cannon River, but relatively few in lower Pepin
• Likely driven by the past two mild winters that allowed a build up of spawners due to unusual overwinter survival for the species
• Despite 4 week long fish kill in early April on Pepin that killed MANY 8"-10" Gizzard Shad
• These 1-2 year old fish were mature in 2017 and provided a large spawning group for this season



Example of an area that collected many Gizzard Shad during the extended fish kill on Lake Pepin in the spring of 2017.



Overall gill net catch rates from 1965 to 2017 of all sizes of Gizzard Shad. Note the low catch rate in 2017. Much of the total catch of Gizzard Shad in our nets is composed of YOY fish generally from 3”-6” in length. Larger fish are also captured, but mesh size limits that some. During the 2017 gill netting survey Lake Pepin was 5’-7’ above normal pool for that time of year. Despite seeing numerous schools of YOY shad when launching the boat each morning very few YOY fish (see next slide) were captured in our gillnets (N=13). I think that many of these smaller Gizzard Shad in Lake Pepin sought the flooded willows and vegetation along the shorelines of Lake Pepin to avoid the increased flow in open water.

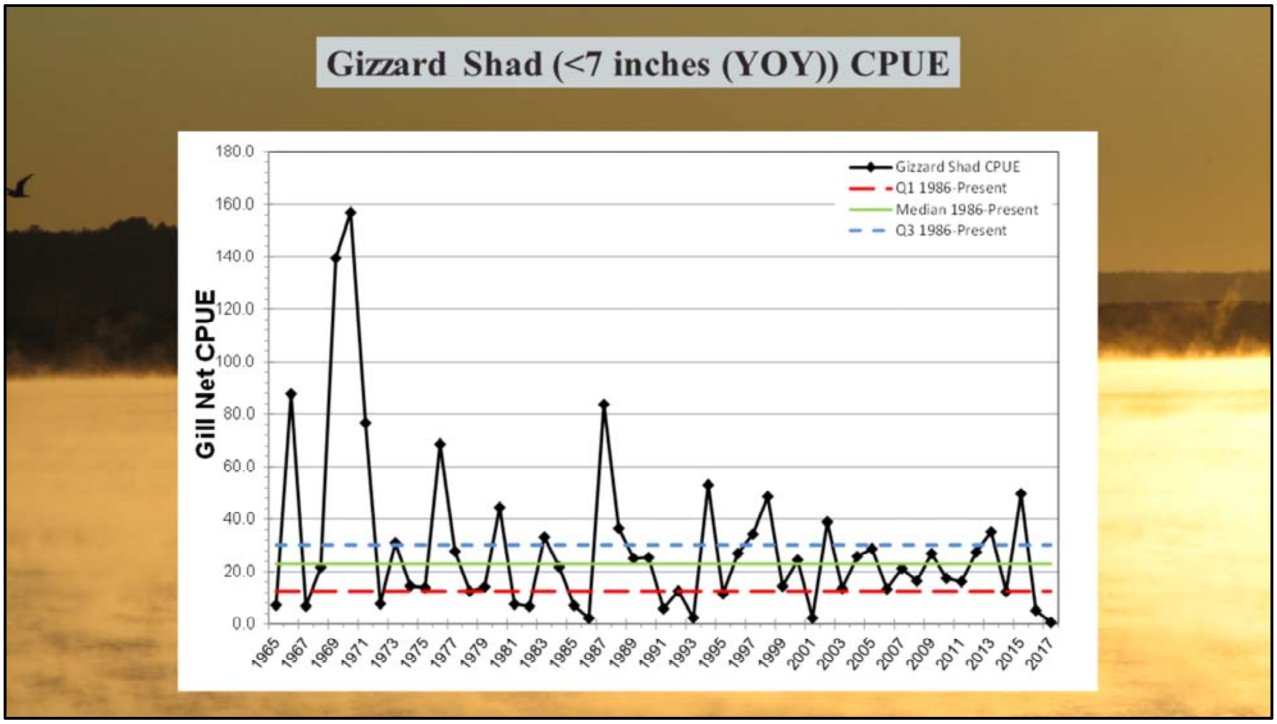
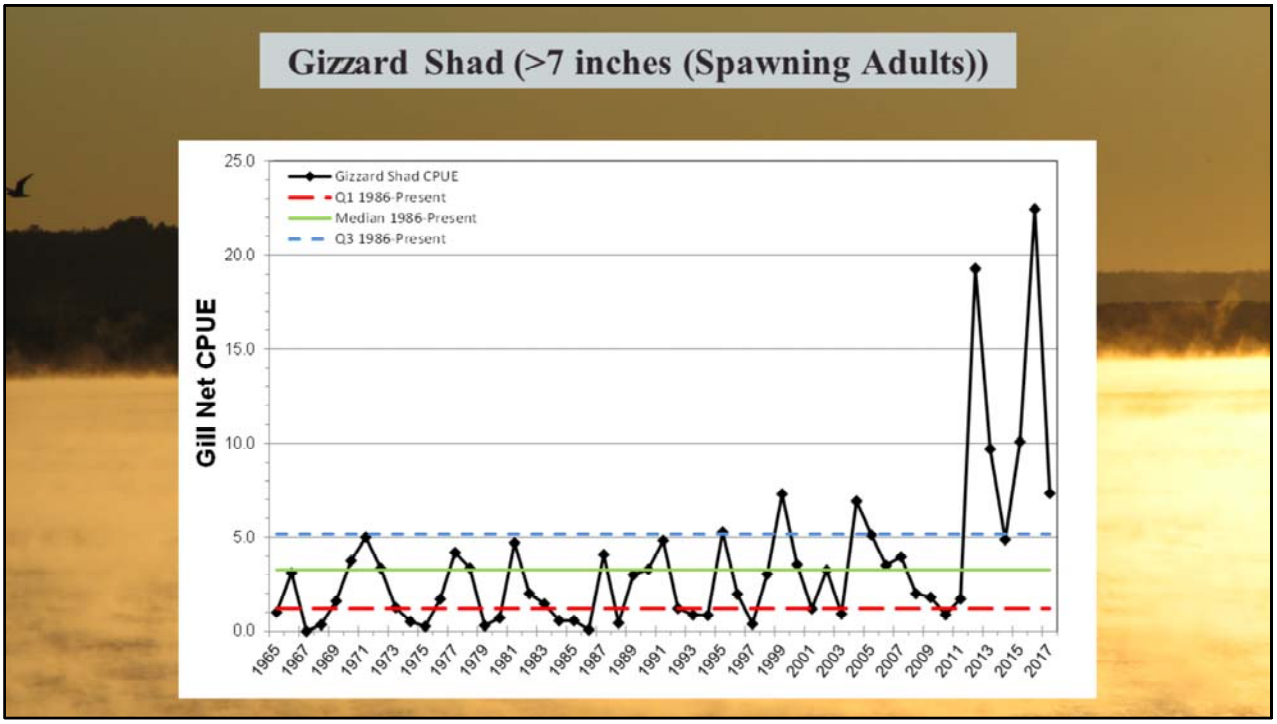


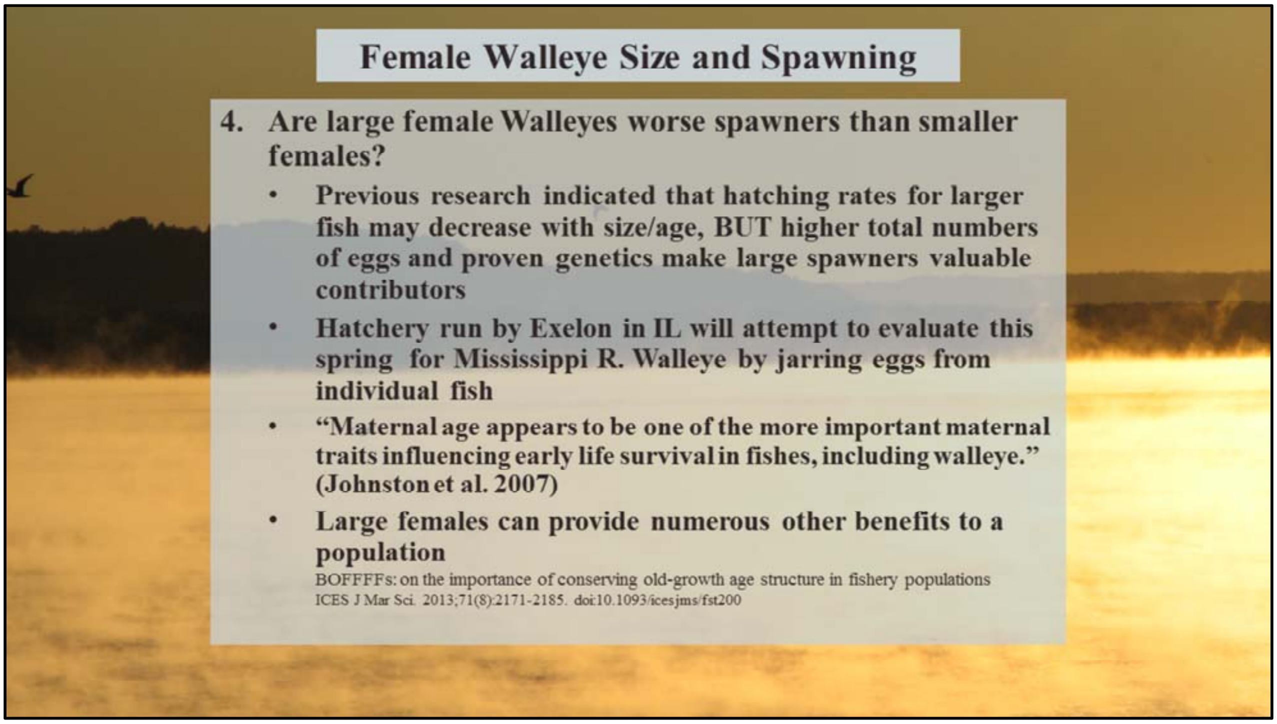
Figure showing the gill net catch of Gizzard Shad less than 7" in length (representative of the YOY Gizzard Shad catch)



Gill net catch rate for Gizzard Shad >7" in length (these Gizzard Shad are largely mature and contributing to the reproductive effort in the following spring).

The large drop from 2016-2017 likely reflects (at least in part) the large fish kill from the beginning of the 2017 open water season.

The high number of adult Gizzard Shad seen from 2012 to 2017 are largely a result of the relatively mild winters that we have experienced over the last 4-5 years. The mild winters have allowed higher than normal numbers of YOY Gizzard Shad (the vast majority of which typically die each winter) to survive and become members of the reproductive population.



I am often asked whether large female Walleye are worse spawners than smaller Walleyes.

This seems to be based on the general perception that Walleyes (especially female Walleyes) become less important contributors to the spawning population as they grow and age.

While this may be a simple academic question for some. Conclusions drawn about this topic are often used for two proposes:

1) To justify guilt free harvesting of large female Walleyes based on the perception that they are not good contributors to the overall population.

2) To justify increased protection for larger (mostly female) Walleye because of their importance to the population.

In the past when asked this question the general answer I was able to compile from quick searches was that hatch rates/fertility may decrease with size/age, BUT that higher total numbers of eggs produced and proven genetics of larger individuals make them valuable contributors to the spawning population.

While trying put together a more detailed answer to this question I spoke with several different biologists involved with egg take and spawning of Walleyes in several states, and I performed a fairly cursory look at some of the literature available on the topic.

The general impression from some of the biologists was that there can be relatively high variation in success rates between fish of any size. They did acknowledge that it is more memorable when the spawn of a large fish fails than when a smaller fish fails. In an effort to better understand how female size may affect the hatch rate of Mississippi River Walleyes the staff at the Exelon Corporation owned Quad Cities Generating Station and its associated fish hatchery are planning to attempt to look at individual fish hatch rates. I will update the group in future presentations as any results become available.

Much of the scientific literature related to large fish fecundity/reproduction is focused on large bodied and long lived marine species which are often exposed to commercial harvest.

One of the papers I read that deals directly with Walleye is by Johnston et al. (2007). This group of provincial biologists and academics in Canada looked at how variations in female Walleye and the eggs they lay affect hatching rates. They found that spawning date had a significant effect on hatching success. Additionally they found that “Maternal age appears to be one of the more important maternal traits influencing early life survival in fishes, including walleye” (Johnston et al. 2007). They also hypothesized that age /size of female Walleye may be a representative trait that combines a number of traits for egg quality related to the age of the female producing the eggs. In both of the experiments they analyzed spawning date was the most important variable in hatching success. Both studies also showed that increasing maternal age had a positive effect on hatch rates. Both studies were conducted on stocks of Walleye from more northerly sources than the Mississippi River (Lake Manitoba and Lake Ontario) with fish up to age-18 included in the analysis. These ages don’t represent the oldest fish in either system, but according to the paper represent

A concept that takes this argument for the value of large female fish a bit further can be found in an article by Hixon et al. published in the ICES Journal of Marine Science. The article though primarily discussing marine fish species references the Johnston et al. (2007) paper I discussed above. It also discusses the concept of BOFFFFs or Big Old Fat Fecund Female Fish, and how these large females can influence a fish stock in a number of ways. The next slide in this presentation contains a figure from their paper that outlines several ways in which that influence might affect the stock.

Hixon et al. BOFFFFs: on the importance of conserving old-growth age structure in fishery populations ICES J Mar Sci. 2013;71(8):2171-2185.

Johnston TA, Wiegand MD, Leggett WC, Pronyk RJ, Dyal SD, Watchorn, KE, Kollar S, Casselman JM. Hatching success of walleye embryos in relation to maternal and ova characteristics.
Ecology of Freshwater Fish 2007: 16: 295–306.

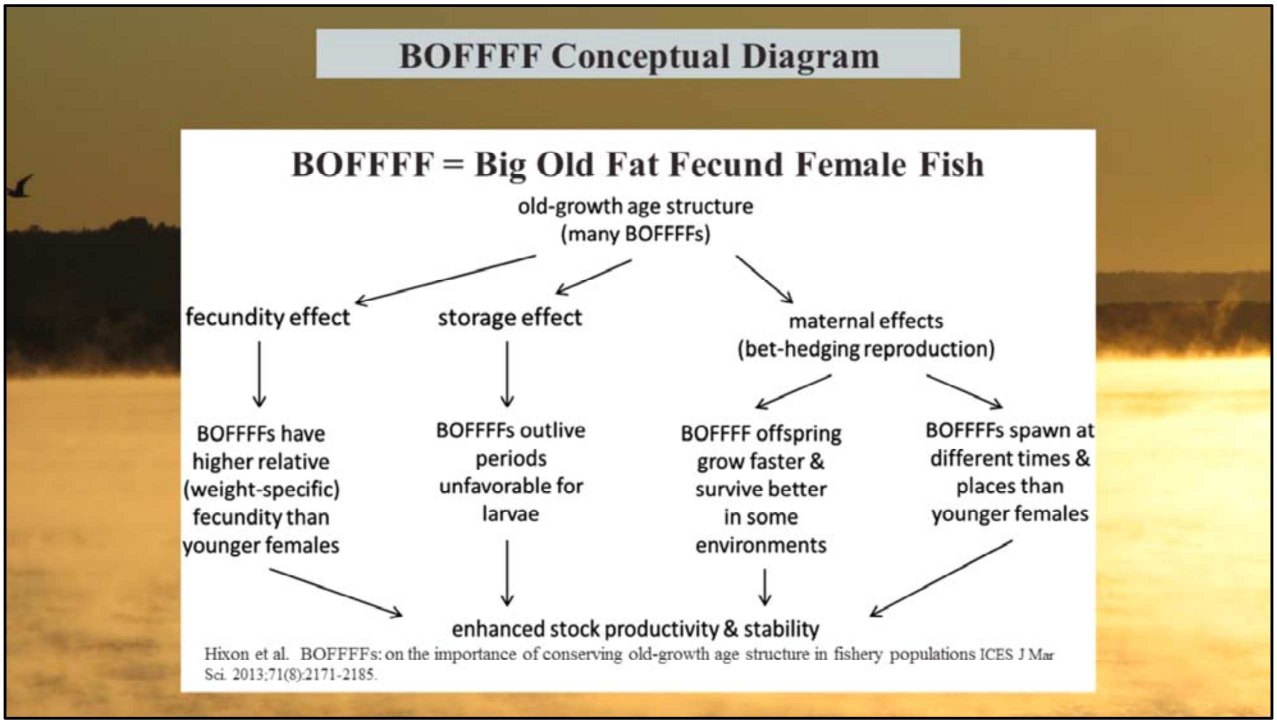


Figure 3. Summary of the benefits to stock productivity and stability provided by old-growth age structure, which includes many BOFFFFs. These benefits are negated by severe size and age truncation (removal of BOFFFFs) caused by fishing, which can further result in fisheries-induced evolution that is difficult to reverse once a stock has collapsed.

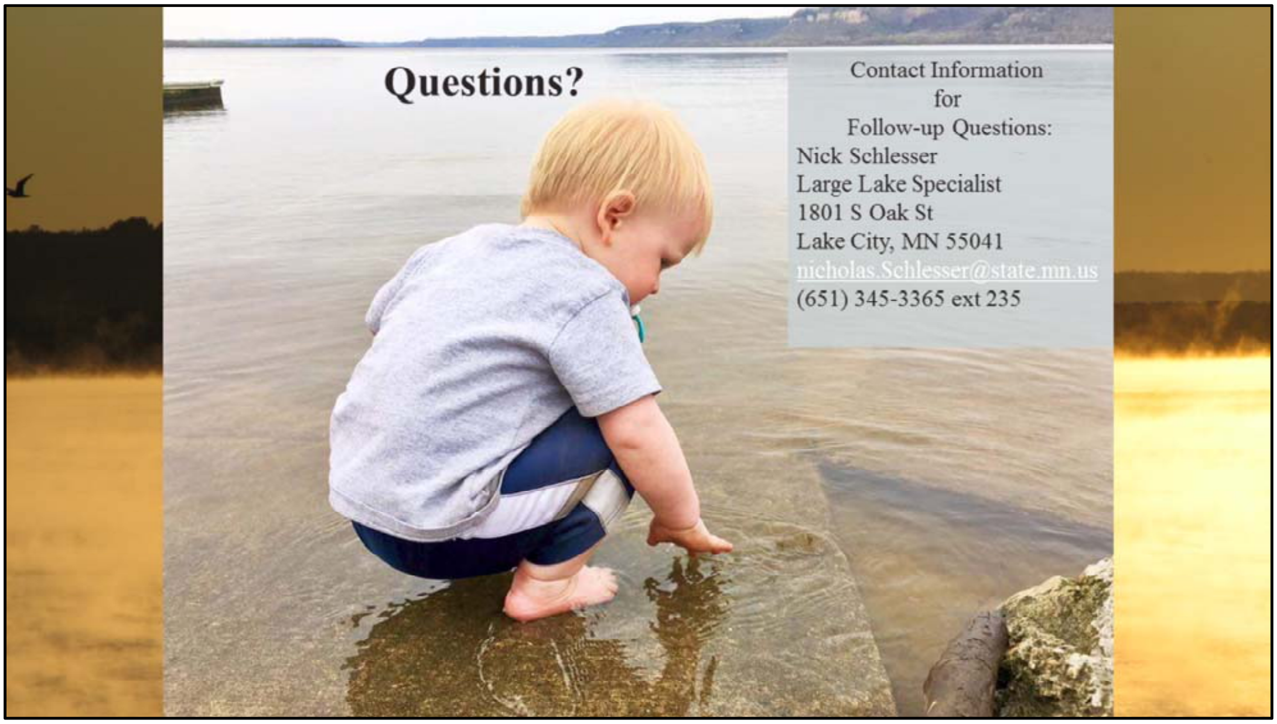
Figure from: Hixon et al. BOFFFFs: on the importance of conserving old-growth age structure in fishery populations ICES J Mar Sci. 2013;71(8):2171-2185.

The figure on this slide addresses four conceptual pathways through which large female fish can affect a population:

1) The fecundity effect refers to the findings discussed above that many large fish produce more eggs per pound of fish than smaller individuals and thus may contribute proportionately more to the population.
2) The storage effect relies on older fish with proven survival capability to be able to live through conditions that could wipe out a year class of young and then spawn again once conditions have returned to a more favorable condition.
3) The first of the maternal effects relies on proven genetics of large fish to

produce offspring that are capable of faster growth or better survival. (This could compound with the fecundity effect from point 1 to make large females even more proportionally important.)

4) The second of the maternal effects involves the potential of large females for extended spawning efforts across longer periods of time or spatial distances that increase the odds that at least a portion of the eggs deposited and the resulting young that hatch find conditions favorable to their growth and development.



Feel free to contact me using the info below if you have any questions about the information presented here or Lake Pepin/Pool 4 in general and I will do my best to get them answered for you.

Thanks again,

Nick

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