INTEROFFICE MEMORANDUM

TO: DR. IAN MUNN
FROM: MICHAEL E. COLVIN
SUBJECT: URSP COMPLETION REPORT
DATE: SEPTEMBER 14, 2016
CC:

Christian Shirley was the undergraduate associated with my URSP project. He performed exceptionally. The results of this study were used to support a decision by the MDWFP Commission to change the current minimum length limit for Crappie harvested in Lake Washington from 10 to 11 inches. Originally determined to pursue a career path in wildlife, through this project he modified his path to one of fisheries and most recently accepted a graduate position working with Crappie culture with Dr. Peter Allen in WFA. It is without a doubt the URSP experience altered his career path and provided him the skills to be successful in landing a graduate position.

Christian did not complete an associated DIS with this project.

Attached to this document are documents requested for items 1-4 in your email.

1) An abstract describing Christian's study on Crappie in Lake Washington

2) Three photos with captions. JPEG format of these photos are also included in the *.zip file.

3) A completion report. It is anticipated that this report will be modified into a management article to be submitted to the North American Journal of Fisheries Management

4) Copies of research products

- Abstract of an oral presentation deliver by Christian to the Mississippi Chapter of the American Fisheries Society
- Slides corresponding to the abstract above
- Poster delivered at the Undergraduate Research Symposium on 15 April 2016

URSP Project abstract: Effects of Proposed Length Limit Changes and “5 under rule” on Lake

Washington Crappie Populations and Harvest

Mentor: Michael E. Colvin
Undergraduate mentee: Christian Shirley

Lake Washington is a popular Black and White Crappie fishery. Because of a perceived decrease in harvest rates and average weight, 595 anglers signed a petition stating that they wanted an increase in the minimum length limit from 10 inches to 12 inches last year. An additional component of this fishery is a “5 under rule” that allows anglers to harvest up to 5 fish under the minimum length limit. Harvest occurring below a minimum length limit (MLL) precludes the use of a traditional Beverton Holt yield per recruit (YPR) analysis; therefore we developed a modification to the YPR model that accounts for harvest below the MLL to evaluate minimum length limit changes. The model requires the same information as a traditional YPR analysis: length-age relationship, weight-length relationship, and natural mortality rates. We estimated parameters for the length-weight relationship (a=5.80436E-07, b=3.6) and we used otoliths to estimate age and fit a von Bertalanffy growth function (L_∞= 344, k= 0.4, t_0 =-1.03) to size and age structure data from crappie captured in Lake Washington. Then we evaluated yield per recruit for varying conditional fishing mortality levels (0, 0.01, 0.05, 0.1, 0.2) occurring under an MLL of 10, 11, and 12 inches. Analyses indicated that that growth overfishing was not occurring in this crappie population even with high levels of harvest occurring under MLL. These results support creel survey estimates of catch rate and mean length that indicates the population has remained stable over the past 20 years, and the potential for growth overfishing is low.

Photo 1. Christian gaining additional field experience by assisting with Paddlefish sampling at Noxubee National Wildlife Refuge, Mississippi. Source: M.E. Colvin

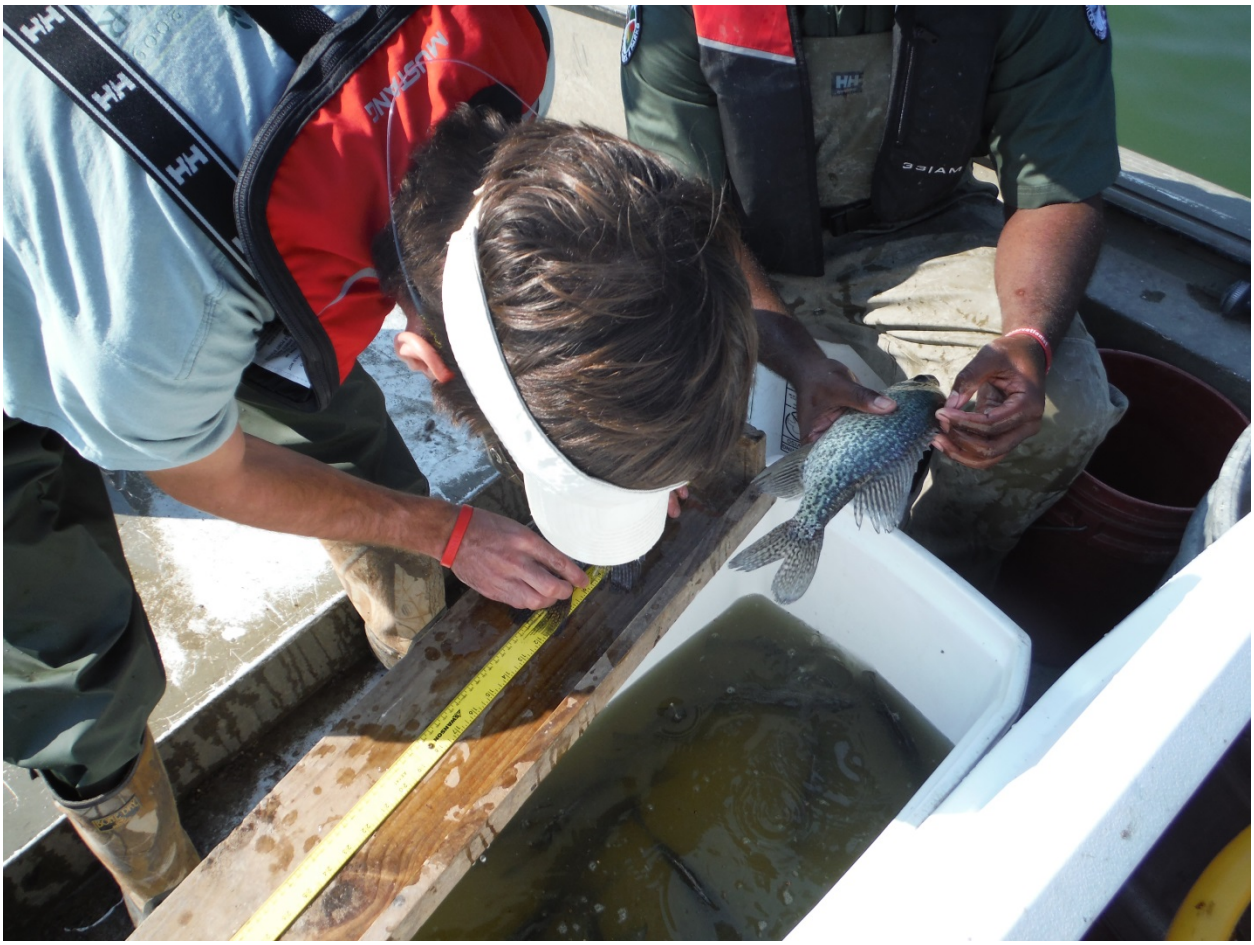

Photo 2. Christian measuring the length of a Crappie at Lake Washington, Mississippi. Source: M.E. Colvin

Photo 3. Christian answering questions after his presentation to the Mississippi Chapter of the American Fisheries Society at their annual meeting at Tara Lodge, Vicksburg, Mississippi. Source: M.E. Colvin

Manuscript draft-target journal North American Journal of Fisheries Management

Effects of Proposed Length Limit Changes and "5 under rule" on Lake Washington Crappie Populations and Harvest

Christian Shirley[1], Michael E. Colvin[1], and Nathan Aycock[2]

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[2] Mississippi Department of Wildlife, Fisheries, and Parks. Delta Region. Rosedale, Mississippi 38769.

Abstract

Lake Washington is a popular Black and White Crappie fishery. Because of a perceived decrease in harvest rates and average weight, 595 anglers signed a petition stating that they wanted an increase in the minimum length limit from 10 inches to 12 inches last year. An additional component of this fishery is a "5 under rule" that allows anglers to harvest up to 5 fish under the minimum length limit. Harvest occurring below a minimum length limit (MLL) precludes the use of a traditional Beverton Holt yield per recruit (YPR) analysis; therefore we developed a modification to the YPR model that accounts for harvest below the MLL to evaluate minimum length limit changes. The model requires the same information as a traditional YPR analysis: length-age relationship, weight-length relationship, and natural mortality rates. We estimated parameters for the length-weight relationship (a=5.80436E-07, b=3.6) and we used otoliths to estimate age and fit a von Bertalanffy growth function (L_∞= 344, k= 0.4, t_0 =-1.03) to size and age structure data from crappie captured in Lake Washington. Then we evaluated yield per recruit for varying conditional fishing mortality levels (0, 0.01, 0.05, 0.1, 0.2) occurring under an MLL of 10, 11, and 12 inches. Analyses indicated that that growth overfishing was not occurring in this crappie population even with high levels of harvest occurring under MLL. These results support creel survey estimates of catch rate and mean length that indicates the population has remained stable over the past 20 years, and the potential for growth overfishing is low.

Introduction

Black crappie *Pomoxis nigromaculatus* and white crappie *Pomoxis annularis* are popular and important sport fish (Sammons et al. 2002). Many anglers often cite crappie as first or second in angler preference (McDonough and Buchanan 1991; Mitzner 1991).Due to increased fishing pressure and angler success minimum length limits (MLL) have become a necessary management tool to prevent overharvest or to meet angler demands for larger fish in the system (Boxrucker 2002; Hale et al. 1999). The use of harvest restrictions can help improve harvest only if growth is fast and natural mortality is low. Conversely, crappie population yield will potentially decrease when growth is slower and natural mortality increases (Miranda and Allen 1995).

Lake Washington is well known for the number of crappie caught, as well as, producing trophy sized fish. It is a very popular crappie fishery for recreational, tournament, as well as subsistence anglers. Since many local anglers are fishing for subsistence, a unique rule for the system, the "5 under rule", was put in place. This rule allows anglers to keep up to 5 fish under

the current MLL of 254 mm a day. When surveyed, most anglers said that they would be a fish that was 8 inches or greater (N.Aycock, unpublished data). We were unable to find any scientific data that suggest what effect this type of rule may have on yields.

In 2015, a petition was signed by 595 anglers that called for an increase in the Minimum Length Limit (MLL) and to drop the "5 under rule". Anglers who signed this petition gave the primary reason for wanting a new regulation was that harvest rates and average weights had decreased in recent years with increased fishing pressure. Mississippi Department of Wildlife, Fisheries and Park wanted to evaluate the effects on yield of MLL of 254, 279.4, or 304.8-millimeter MLL. By evaluating different MLL and varying harvest below the MLL, the department would have the necessary data to propose a new regulation if needed. To establish a yield per recruit model, needed to evaluate the population, we would need to collect or estimate length-weight relationship, a growth curve, and mortality. Traditionally a Beverton-Holt yield per recruit models (YPR) only take into account harvest above the MLL, but for this study, we modified this traditional YPR model to be able to evaluate harvest below the MLL. This let us evaluate yield per recruit for multiple mortality levels below the MLL occurring under the proposed MLLs of 254, 279.4, or 304.8 millimeters.

Methods

Study Area

The research took place on Lake Washington, in Washington County, Mississippi. The lake is located 25 miles south of Greenville, along the Mississippi River. An oxbow lake of the Mississippi River, Lake Washington is now one of the largest natural lakes in the state at 5,000 acres of surface area. The lake varies in depth ranging from 1.8 feet to 6.7 meters, with an average around 1.8 meters. The lake consists of natural cover and structure, as well as, man-made cover. The natural cover found in the lake includes cypress trees and aquatic vegetation. The old river channels and ledges found throughout the lake make up the natural structure. The man-made cover includes all of the piers, docks, rip-rap, and any sunken attractants found in the lake. Lake Washington is well known for its crappie fishing and is a popular fishing destination for Sportfish found in the lake include largemouth bass (*Micropterus salmoides)*, bluegill (*Lepomis macrochirus)*, channel catfish (*Ictalurus punctatus)*, Black Crappie (*Pomoxis nigromaculatus*), and White Crappie (*Pomoxis annularis*). Black and White Crappie are often fished for as one species in this system, and in turn, are managed for as one species. Currently, crappie harvest is regulated with a 254 mm MLL and a daily bag limit of 30 fish. This system is unique because regulations allow anglers to keep 5 fish under the 254 mm MLL, known as the "5 under rule".

Data Collection

Fish sampling was conducted on October 4, 2015 – October 6, 2015. Trap and lead nets were set on October 4 in twelve different locations in Lake Washington. The traps were then checked and reset on October 5, and checked again on October 6. At each net location, water temperature and depth was recorded, as well as any additional comments. Every fish that was caught in a net was identified and total length was recorded to the nearest millimeter (mm). The first 5 crappie caught from each centimeter bin were kept to be weighed and aged at a later date.

The trap nets are constructed of two 3 foot x 6 foot x 1-inch fiberglass frames, with four 2.5 foot diameter hoops in the fiberglass. Hoops are 2 feet apart. The netting is square knotless treated nylon with 0.5-inch openings. The trap nets are 40 feet in length, 3 feet in depth, and attached to the first frame. The lead nets that we used were constructed with two hoops facing

each other, and are connected with a lead that attaches to each hoop net. The net and lead are constructed from 1 inch treated bar mesh. The hoops are constructed of 7 fiberglass hoops, with a diameter of 3.5 feet, which are separated by 2 feet with throats located at the 2nd and 4th hoop. The lead between the two hoops nets is 30 feet in length.

Mortality and Exploitation

Mortality rates were provided by Mississippi Department of Wildlife, Fisheries, and Parks, N. Aycock, unpublished data. In 2012 MDWFP caught and aged crappie from Lake Washington to establish an annual mortality rate. An annual mortality rate of 66% was calculated using a weighted catch curve. A tag-return study was done in 2014-2015 to establish an annual exploitation rate. The study was done by tagging 400 fish greater than the MLL (>254 mm), and a reward was given out for each returned tags. After taking into account tagging mortality, non-reporting, and tag loss, the annual exploitation rate was found to be 41%. We would use this exploitation rate for our yield per recruit models.

Length-weight and Age-length Relationships

The first 5 crappie caught from each centimeter bin, were measured for total length and kept to be weighed. This fish were then measured again and weighed before being aged. The data was entered into Excel and the parameters for the length-weight relationship were established. A scatterplot was then created to show the relationship.

$$Weight = a * Length^b$$

Weights were recorded, and otoliths were pulled and taken to Mississippi State University to be aged. Aging was done by counting growth rings on the otolith under a Leica DFC 290 HD microscope. Each otolith was aged by Maddy Ruble and myself. The otoliths were ages independently and then compared. If a disagreement occurred, the otolith was reviewed together until a consensus was reached. To establish a growth curve, needed to run Yield per Recruit models, we fit a von Bertalanffy growth function to the size and age of the crappie aged from Lake Washington.

$$L(t) = L_\infty(1 - e^{k*Age-t_0})$$

Yield Per-recruit Models

Traditionally YPR models only account for yield occurring above the MLL. Since Lake Washington has the unique regulation allowing for harvest of 5 crappie under the MLL, we had to develop a modified model. The new, modified model needs the same information as a traditional Beverton-Holt model: weight-length relationship, length-age relationship, and a mortality rate. By using this new model we were able to evaluate the 3 proposed MLL, 254 mm (current), 279.4 mm, and 304.80; while accounting for various fishing mortalities below the MLL (0, 0.01, 0.05, 0.1, 0.2). By evaluating various fishing mortality below the MLL we were able to evaluate the potential effect of fishing mortality below the MLL, while still evaluating that effect that different length limits would have on yield in the system. This would also allow us to see when, if at all, growth overfishing could occur in the system.

Results

Data Collection

During our sampling period we collected a total of 589 individual fish from 16 different species. Fish other than Black or White Crappie were measured for length and returned to the lake. A total of 478 crappie were captured, 360 Black Crappie and 118 White Crappie. We kept 5 crappie from a 5-centimeter bin for aging. A total of 154 Black Crappie and 62 White Crappie were kept for a total of 216. Table 1 shows the minimum, maximum, and mean for lengths, weights, and ages for the 216 crappie that were kept. The minimum length of a crappie that we recorded was 100 mm and the maximum length recorded was 364 mm. The range of lengths recorded for Black Crappie was 105 mm – 359 mm with an average of 242.55 mm. White Crappie ranged in length from 100 mm – 364 mm and averaged 227.19 mm. The majority of small fish (around 100 mm) were White Crappie.

Length-weight and age-length Relationship

The lengths and weights that were recorded from the kept crappie was entered into Excel and the used to form a length-weight relationship. Once the date was entered the log10 and regression function of Excel was used to find the intercept (a), 5.8E-07, and slope (b), 3.615 (Figure 1). Once the fish were aged and the data was entered into Excel a von Bertalanffy growth function was fit to the data. The solver function of Microsoft Excel was to fit the growth function to the data. Length at infinity is 343.97 mm, k is 0.395, and t_0 is -1.026 (Figure 2). By understanding at what age most fish reach 254 mm we can assess growth overfishing. Most of the Black Crappie reached 254 mm by age 2, while most of the White Crappie seemed to reach the current MLL at ages 1-4.

Yield per Recruit

Once the required information: length-weight relationship, the VBGF, and annual exploitation were calculated we were able to simulate 5 different Yield per Recruit models, each assessing a different conditional fishing mortality below the MLL and the three options for the proposed length limit; 254, 279.4, 304.8 mm. We also assessed the fishery for the potential for growth overfishing, by looking for decline in yield with increased effort. For each scenario, the current MLL of 254 mm had the greatest yield at the 41% exploitation rate. Yield decrease in every scenario with an increased MLL. As the conditional fishing mortality below the MLL increases we see a shift to the right on the exploitation axis was the 254 mm length limit yield exceeds the 279.4 and 3014.8 mm length limit yield. However, for each scenario this point occurs under the 41% exploitation line that this fishery experiences.

Discussion

Black and White Crappie are an important sport fish in the United States (Maceina and Stimpert 1998). They are often managed for as the same species because anglers rarely differentiate between the two species (Mitzner 1991). For this study, we evaluated the two species together because under the current regulations there is no difference in length limits or bag limits for Black and White Crappie. However, one species is often more abundant than the other in one system (Sammons et al. 2002). Assuming that Catch per Unit Effort in Lake Washington is linearly related to abundance, it can be suggested that there is more Black Crappie than White Crappie in the system. There is data that suggest that there may be a bias for Black Crappie when using trap nets, resulting in more Black Crappie being sampled that white crappie when relying solely on trap style nets for catch data (Sammons et al. 2002). It is also is shown that electrofishing may be more effective in capturing larger fish needed to obtain age and growth data, and that trap nets may be biased to smaller, younger fish (Sammons et al. 2002). Electrofishing in the spring could be done to add data, and improve the yield per recruit models.

In our study, the mean length and weight was greater for Black Crappie than White Crappie. The mean age of White Crappie captured was also lower than the mean age of Black Crappie captured. This could suggest that trap nets are biased to capturing more Black Crappie, and that some electrofishing may also be needed to sample the larger fish in the system.

Length limits have become increasingly popular ways on managing to meet angler demands of larger fish in the system. In many systems, harvest numbers, not larger sized fish, is of more importance to crappie anglers (Hale et all 1999). Lake Washington may be unique in that some anglers are specially seeking the larger trophy sized fish, yet others are seeking large numbers of fish harvested (N. Aycock, unpublished data). In a study by Hale et al. (1999), a 254 mm length limit was imposed on the Delaware Reservoir to increase size of crappie caught without greatly reducing harvest numbers. The length limit was successful in increasing the mean size of fish caught, but it did dramatically decrease annual yield. However, improvements to fisheries are specific to the study area and are susceptible to fluctuating year class strength (Webb and Ott 1991). In our study we noted that in every scenario presented yield would most likely decrease with an increased MLL. However, by increasing the length limit, the mean size of fish harvested would most likely increase. Keeping the "5 under rule" in place would still allow for the harvest of fish below the MLL, allowing anglers to still keep a 254 mm if, if the MLL length limit was increased.

Miranda and Allen (1995) suggest that reducing exploitation by the use of harvest restrictions does not always improve yield. They found that yield is only likely to increase due to harvest restrictions when growth is fast and natural mortality is low. However, their model does suggest that decreasing annual exploitation, or restricting harvest, can increase the average weight of fish caught, but only when growth is fast and natural mortality is low. According to the models outlined in their paper the population in Lake Washington is a fast growing population with low natural mortality. Another issue often associated with managing crappie populations is how variable recruitment into crappie populations is. This may affect the estimate of total annual mortality of the population. A catch curve analysis was used to estimate our annual mortality; this method assumes that there is constant recruitment into the population (Allen 1997). Crappie populations have been shown to experience variability in recruitment to age-1 (McDonough and Buchanan 1991: Webb and Ott 1991: Mitzner 1995). Our models do not take into account variable annual mortality rates, and yield from year to year will most likely fluctuate with fluctuating recruitment.

White Crappie are thought to grow faster than Black Crappie due to their piscivorous diet (Ellison 1984). In a 2002 study, Sammons et al. found data that supported this conclusion. They found that by age 4, Black Crappie were on average 30 mm smaller than White Crappie. Variability in size at the same age could affect the age at which one of the species is affected by the MLL. If White Crappie are reaching the MLL before Black Crappie, and are less abundant that Black Crappie in the system, catch rates could be potentially affected.

Table 1. Sample summary for Crappie captured in Lake Washington, Mississippi.

		Black	White	Both
	Number	154	62	216
Length (mm)	Minimum	105	100	100
	Maximum	359	364	364
	Mean	242.55	189.03	227.19
Weight (g)	Minimum	10	10	10
	Maximum	820	690	820
	Mean	308.61	123.87	255.59
Age (yrs)	Minimum	0	0	0
	Maximum	7	4	7
	Mean	2.16	1.24	1.90

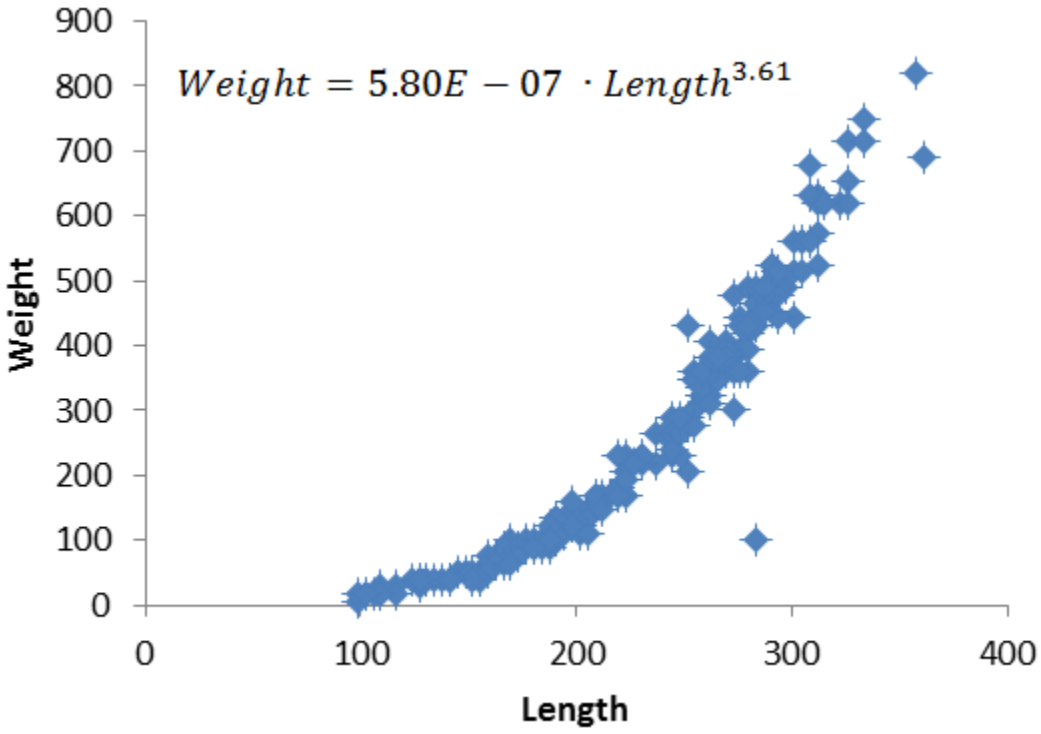


Figure 1. Length (mm; *x*-axis) versus weight (g; *y*-axis) for Crappie captured in Lake Washington, Mississippi.

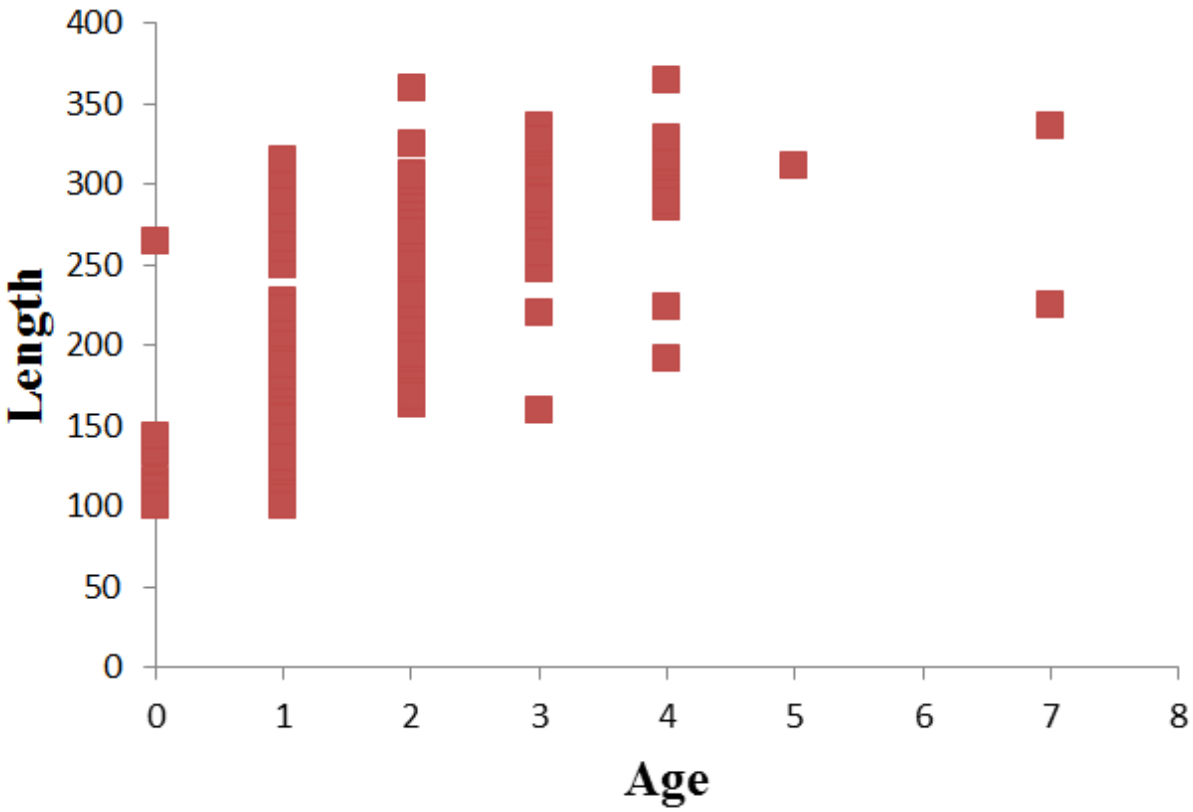


Figure 2. Estimated age (*x*-axis) versus length (mm; *y*-axis) for Crappie captured in Lake Washington, Mississippi.

Abstract submitted for presentation delivered at the 2016 annual meeting of the Mississippi Chapter of the American Fisheries Society held at Tara Lodge, Vicksburg, MS.

Christian Shirley, cas541@msstate.edu, 601-953-7009

Effects of Proposed Length Limit Changes and "5 under rule" on Lake Washington Crappie Yield

Christian Shirley[1], Michael E. Colvin[1], and Nathan Aycock[2]
[1]Wildlife, Fisheries, and Aquaculture Department. Mississippi State University, Mississippi State. MS 39762
[2] Mississippi Department of Wildlife, Fisheries, and Parks. Delta Region. Rosedale, Mississippi 38769.

Lake Washington is a popular Black and White Crappie fishery. Because of a perceived decrease in harvest rates and average weight, 595 anglers signed a petition stating that they wanted an increase in the minimum length limit from 10 inches to 12 inches last year. An additional component of this fishery is a "5 under rule" that allows anglers to harvest up to 5 fish under the minimum length limit. Harvest occurring below a minimum length limit (MLL) precludes the use of a traditional Beverton Holt yield per recruit (YPR) analysis; therefore we developed a modification to the YPR model that accounts for harvest below the MLL to evaluate minimum length limit changes. The model requires the same information as a traditional YPR analysis: length-age relationship, weight-length relationship, and natural mortality rates. We estimated parameters for the length-weight relationship (a=5.80436E-07, b=3.6) and we used otoliths to estimate age and fit a von Bertalanffy growth function ($L_{infinity}$= 344, k= 0.4, t_0 =-1.03) to size and age structure data from crappie captured in Lake Washington. Then we evaluated yield per recruit for varying conditional fishing mortality levels (0, 0.01, 0.05, 0.1, 0.2) occurring under a MLL of 10, 11, and 12 inches. Analyses indicated that that growth overfishing was not occurring in this crappie population even with high levels of harvest occurring under MLL. These results support creel survey estimates of catch rate and mean length that indicate the population has remained stable over the past 20 years and the potential for growth overfishing is low.

Effects of Proposed Length Limit Changes and "5 under rule" on Lake Washington Crappie Populations and Harvest

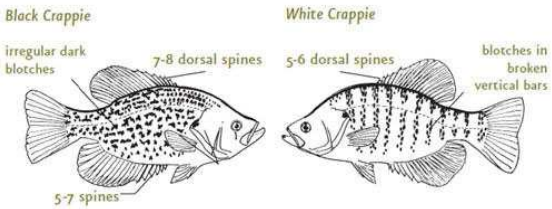
Christian Shirley
Nathan Aycock
Michael E. Colvin

Acknowledgements

- MDWFP
  - Chad Washington
  - Donte Green
- MSU-WFA
  - Madelyn Ruble
- Funding: Undergraduate Student Research Program (USRP)

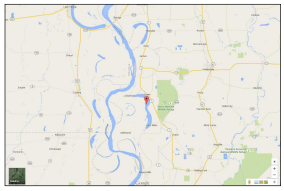
Species Description

- Black and White Crappie
- Managed as one species



Study Area

- 25 miles from Greenwood MS in Washington County
- One of state's largest natural lakes (5,000 acres)
- World renowned crappie fishing



Current Regulations

- Current length limit is 10"
  - –30 fish bag limit
  - –5 fish under 10"

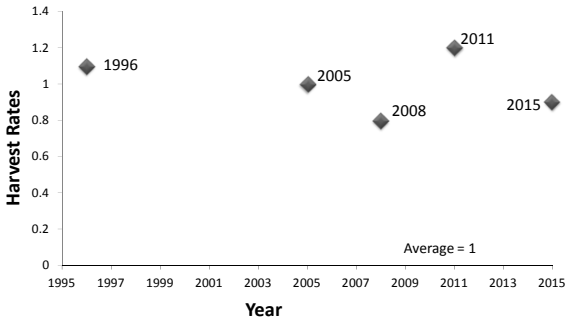
"5 Under Rule"

- Anglers allowed to keep 5 crappie under 10" limit
- Most say they would keep an 8" or above fish

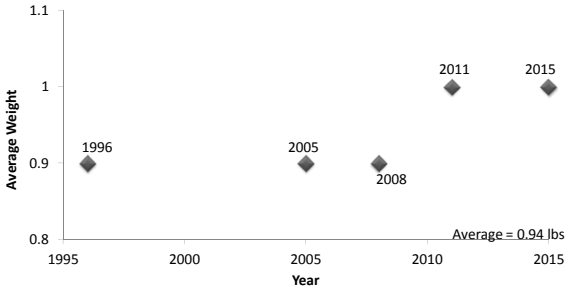
Why are we doing this?

- 595 anglers sign petition
  - Increase length limit to 12”
  - Claimed catch rates and size had decreased
- Recreational anglers and subsistence anglers

Harvest per Hour



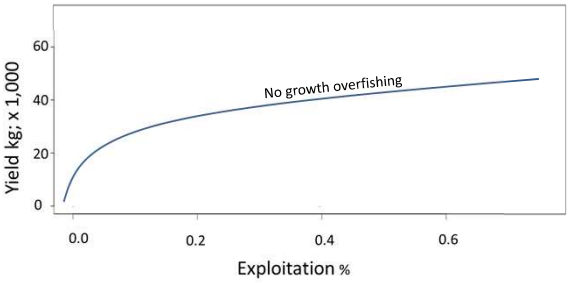
Average Weight



Objectives

- Evaluate potential for growth overfishing at current and proposed length limits
- Evaluate at different mortality rates between 8” and MLL
  - “5 under” rule

What are we looking for?



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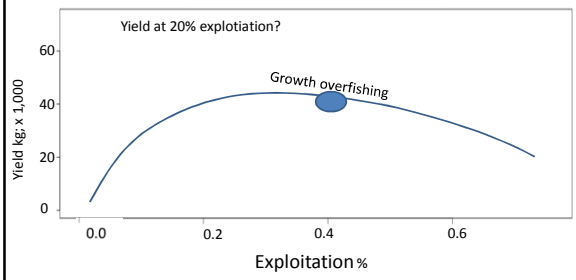
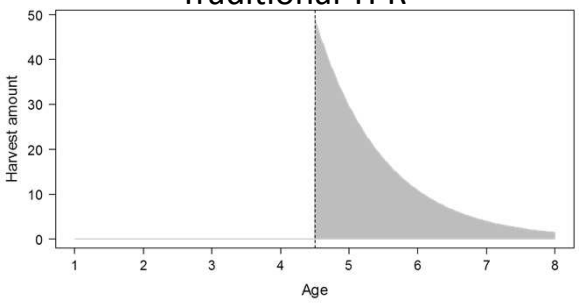
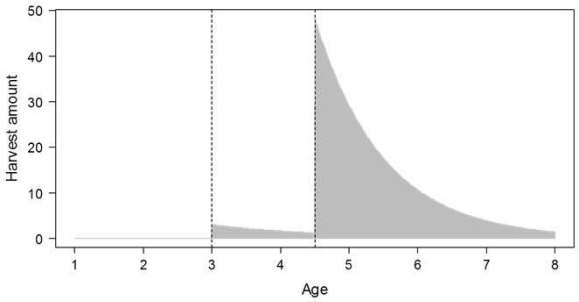


Traditional YPR



New and improved



What we need?

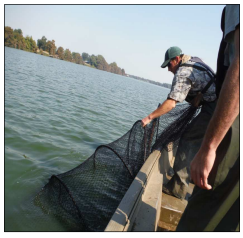
1. Mortality
2. Length Weight Relationship
3. VBGF (Age & Growth)
4. Yield per Recruit Models

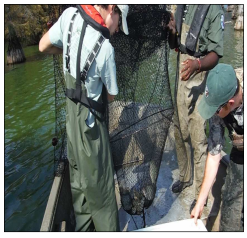
1. Mortality

- 66% annual mortality
  - Weighted catch curve done in 2012
- 41% annual exploitation rate
  - 400 tagged fish > 10”

2. Lengths & Weights

- Lead nets and trap nets
- 12 of each at 24 different locations

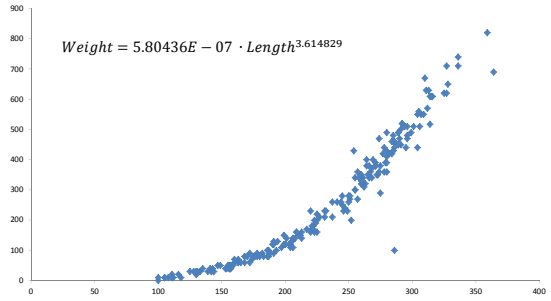




2. Lengths & Weights

- Every fish caught was measured
- Species other than crappie were released
- 5 crappie from each cm bin kept to be weighed

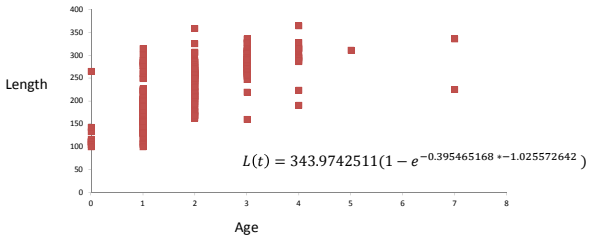
2. Length-Weight Relationship



3. VBGF

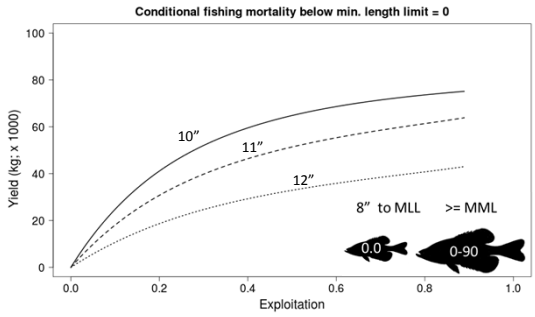
- Aged by 2 technicians and consensus reach when a disagreement occurred
- Ages used to make VBGF

VBGF

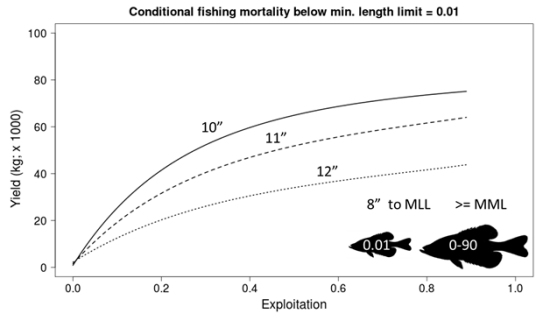


4. Models

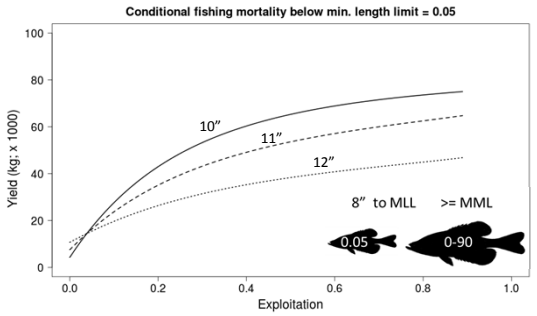
- Using length limits 10”, 11”, and 12”
- 5 models showing different rates of conditional fishing mortality below MLL
  - 0, 0.01, 0.05, 0.1, and 0.2
- Evaluate potential for growth overfishing



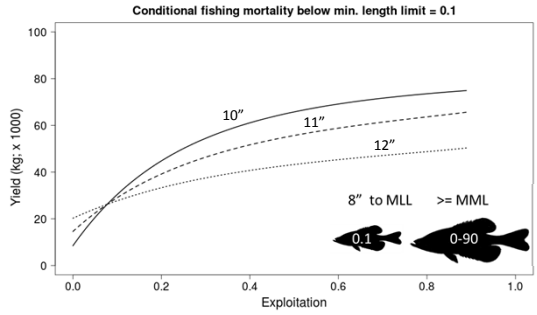
YPR: No harvest under MLL



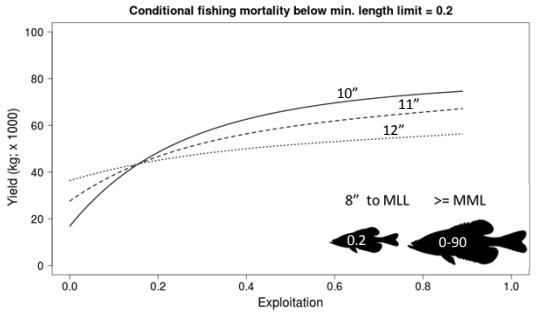
YPR: Fishing Mortality under MLL = 0.01



YPR: Fishing Mortality under MLL = 0.05



YPR: Fishing Mortality under MLL = 0.1



YPR: Fishing Mortality under MLL = 0.2

- Potential for growth overfishing
- "Free for all" on 8" to 12" fish

Take Home Message

- Growth overfishing potential-NO
- Supports data from MDWFP
  - Harvest rates and Average Weight
- Effect of "5 under" is minimal when MLL is low

Questions?


Harvest amount
0
50
100
150
1
2
3
4
5
6
7
Age


Harvest amount
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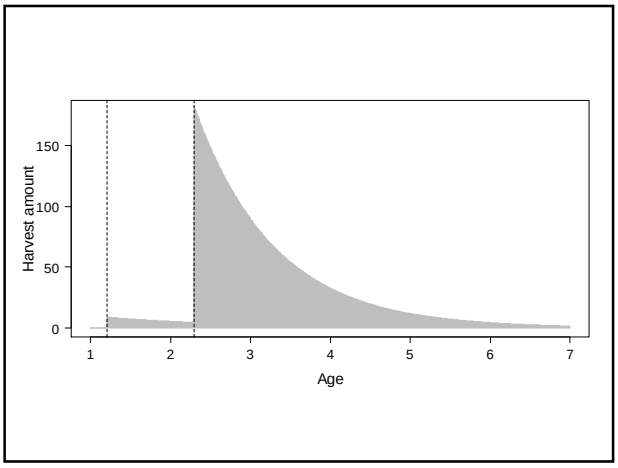
Age


Harvest amount
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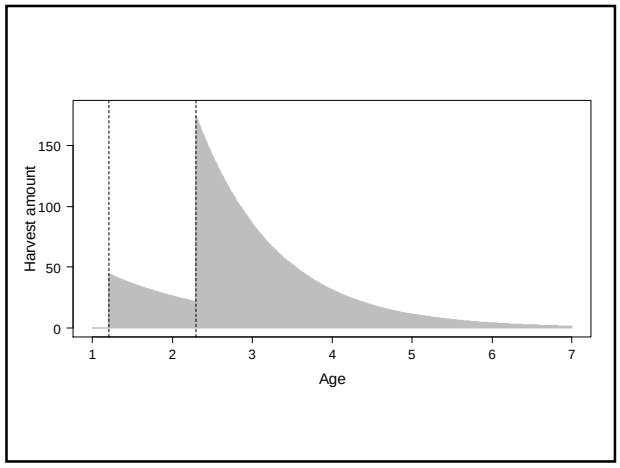
Harvest amount
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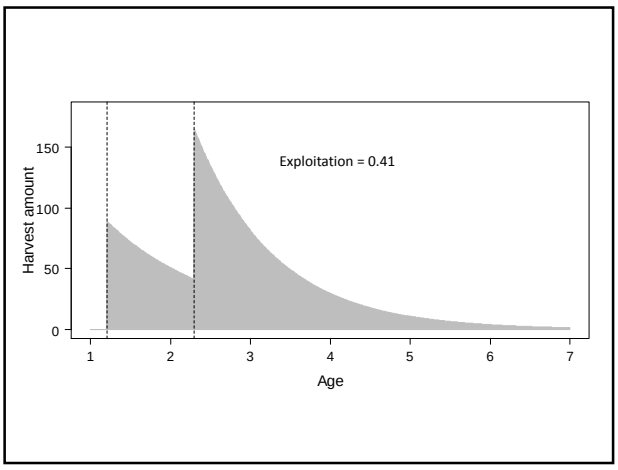
Exploitation = 0.41
Harvest amount
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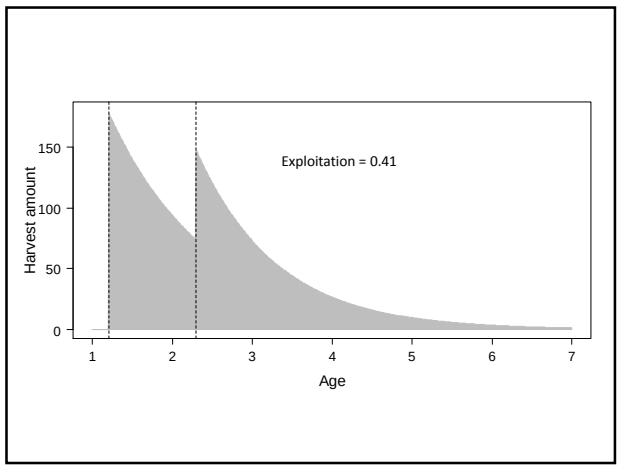
Age


Exploitation = 0.41
Harvest amount
0
50
100
150
1
2
3
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5
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Age

Effects of Proposed Length Limit Changes &“5 under rule” on Lake Washington Crappie Populations and Harvest

Christian Shirley[1], Nathan Aycock[2], and Michael E. Colvin[1]

Introduction

The problem:

- 595 anglers signed a petition to increase the minimum length limit on Lake Washington (Figure 1) from 10 inches to 12 inches because they believe overfishing is occurring based on perceived decreases in catch rates and size.
- Mississippi Department of Wildlife Fisheries and Parks survey data indicate that catch rate and size has not decreased (Figure 2)

Lake Washington is:

- 25 miles from Greenwood MS in Washington County
- One of state’s largest natural lakes (5,000 acres) providing a recreational and subsistence fishery
- World renowned crappie fishing attracting out of state anglers

Figure 1. Location of Lake Washington.

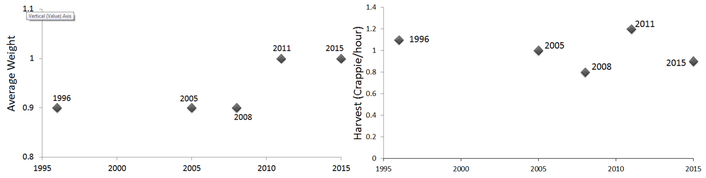


Figure 2. Average weight and catch rate for Black and White Crappie in Lake Washington for MDWFP surveys conducted from 1995 to 2015.

Current Fishing Regulations for Lake Washington Are:

- Black and White Crappie managed collectively
- 10” Minimum length limit
- 30 fish daily bag limit
- Harvest of 5 fish under 10”- this regulation is unique, providing the opportunity for subsistence harvest

MDWFP survey data indicates that overfishing is not occurring at current regulations, but a formal Yield Per Recruit analysis should be done to evaluate the potential for overfishing and evaluate the requested change from 10 to 12 inches.

About Yield Per Recruit Models

- Uses mortality and growth data to evaluate yield with for a given fishing mortality rate by calculating the area under the yield curve (Figure 3).
- If yield decreases with increasing harvest, there is a potential for overfishing
- Can evaluate harvest yields for varying minimum length limits and harvest rates
- Current yield per recruit models do not account for harvest below the minimum length limit , but this is happening at Lake Washington (Figure 4)

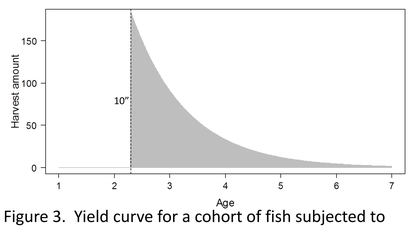


Figure 3. Yield curve for a cohort of fish subjected to a 10 inch minimum length limit. The area under the curve is total yield

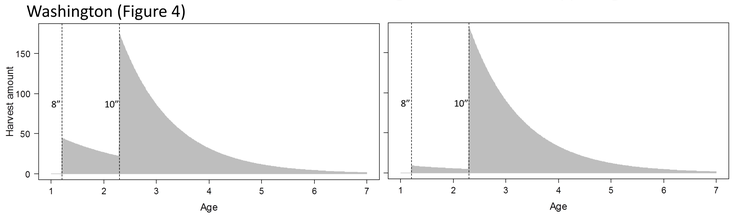


Figure 4. Yield curve for a cohort subjected to a 10 inch MLL and harvest below the MLL, simulating the “5 under rule”. Lake Washington anglers rarely harvest fish under 8 inches.

Study objectives

1. Evaluate potential for growth overfishing at current and proposed length limits
2. Evaluate at different mortality rates between 8” and MLL “5 under” rule using a new generalization of the tradition Yield Per Recruit Model

Methods

A combination of existing data and field sample was used for analysis.

What is need to evaluate Yield Per Recruit?

1. Mortality-66% annual mortality estimated by MDWFP
2. Length-Weight Relationship-based off of field collected data
3. Growth relationship-based off of field collected data

Field data collection

- Lead nets and trap nets used to capture crappie (12 each at 24 locations)
- Captured fish measured for length and weight
- Subset of fish aged using otoliths (2 readers) (Figure 6)

Figure 5. Setting and retrieving trap nets (left, center). Measuring the length of a captured Crappie (right).

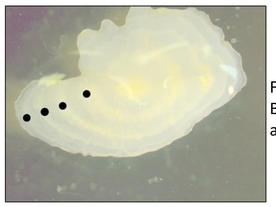


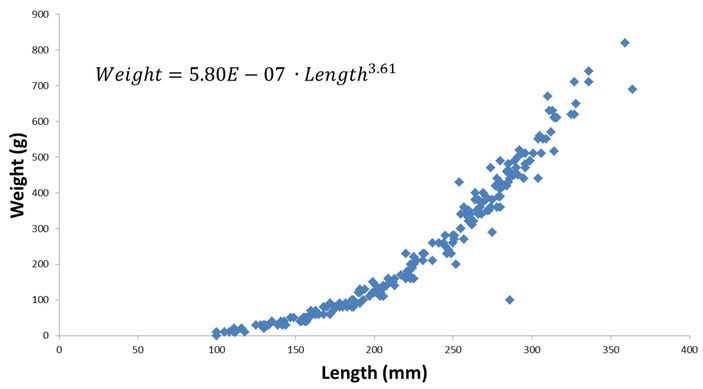
Figure 6. A Crappie otoliths used to age fish. Black dots denote annuli used to estimate age of Lake Washington Crappie

Analysis

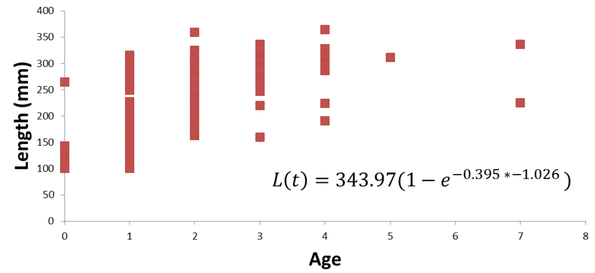
- Length-weight data used to estimate length-weight relationship
- Age-length data used to estimate growth relationship
- Mortality rate, length-weight, and growth relationship used in Yield Per Recruit model to evaluate overfishing and “5 under rule”

Results

Length weight

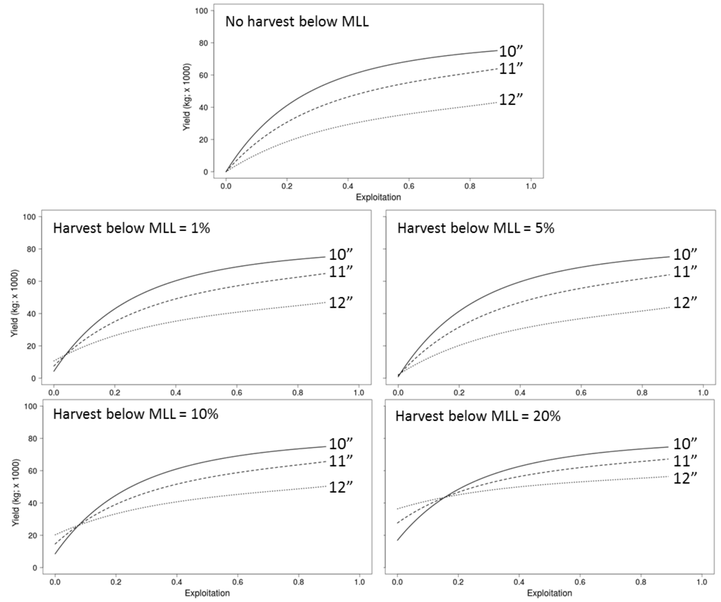


Growth



Yield Per Recruit Models

- Used MLL of 10”, 11”, and 12”
- 5 models showing different rates of conditional fishing mortality below MLL at 0, 0.01, 0.05, 0.1, and 0.2



Conclusions

- No potential for overfishing, yield increased with increasing exploitation
- If MLL is 12 inches and exploitation is high there may be a potential for overfishing, although exploitation rates this high for fish below the MLL are unlikely
- Supports MDFWP catch rate and weight data

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2. Mississippi Department of Wildlife Fisheries and Parks

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