

## Dogwood Lake (Daviess County) and Hardy Lake (Scott and Jefferson Counties)

### Supplemental Crappie Survey

#### Dates of Survey:

Dogwood Lake: February 28 to March 15, 2017

Hardy Lake: October 31 to December 7, 2017

Assistant Biologist: Andrew Bueltmann

Survey Objectives: Conduct monitoring of Dogwood and Hardy Lake crappie populations following a 2016 implementation of a 9-in minimum length limit.

Methods: Trap nets were used at both lakes; Michigan style nets at Dogwood Lake and both Indiana standard and Michigan style nets at Hardy Lake. Nets were soaked overnight and every 24 hour period was considered a unit of effort (i.e., net lift). Dogwood Lake consisted of 10 Michigan style net lifts; Hardy Lake consisted of 14 Michigan style and 23 Indiana standard net lifts. All Crappie collected were measured to the nearest 0.1 inches (in.), weighed to the nearest 0.01 pounds (lb.), and otoliths were removed from a subsample of Crappie for ageing purposes. Size structure was evaluated using indices provided by Anderson and Neumann (1996) to establish proportional size distributions (PSDs). Relative weights ( $W_r$ ) were used to evaluate body condition using the standard weight equations provided by Murphy et al (1991). An age length key was constructed, using otolith ages from the subsample, in the Fishery Analysis and Modeling Simulator (FAMS) to assign ages to unaged fish (Slipke and Maceina 2014). Mean length at age was then used to evaluate growth rates. A weighted catch curve was used to estimate total annual mortality (AM) and an average of FAMS estimators was used to estimate conditional natural mortality (cm). Lastly, a comparison between size distribution and catch per unit effort (CPUE) was conducted for Hardy Lake Black Crappie to provide guidance on which gear to use in future surveys. To do so, a two sample Kolmogorov Smirnov test was used to compare size distribution between gear types (i.e., Indiana standard and Michigan style trap nets) and CPUE was anecdotally evaluated based on which gear type had the higher value.

Dogwood Lake Summary: A total of 207 Black Crappie (BLC) was collected and throughout the rest of this summary all information will pertain to Black Crappie since White Crappie (WHC)

were not collected. Lengths ranged from 7.0 in to 12.4 in and weighed a total of 87.48 pounds (Figure 1). Proportional size distribution was 90, PSD-9 was 64, and PSD-10 was 23 which were all higher, except PSD-10, than in 2016 which were: PSD of 77, PSD-9 of 56, and PSD-10 of 30 (Table 1). Body condition was poorest of all years given the following relative weights: Wr-5 was 85, Wr-8 was 88, Wr-10 was 88, and Wr-12 was 82. The following relative weights were from 2016 and 2014: Wr-8 was 104 and 101, Wr-10 was 95 and 101, and 2014 Wr-12 was 97. Ages ranged from 2 to 7 years old (Figure 2) with mean length at ages as follows: age 2 was 8.2, age 3 was 9.6, and age 4 was 10.6 inches. In 2016 mean length at ages were similar: age 2 was 8.1, age 3 was 9.7, and age 4 was 10.3 inches (Table 2). Total annual mortality (AM) was 0.64 and conditional natural mortality (cm) was 0.44. Total annual mortality was higher than previous years: 2016 was 0.56 and 2014 was 0.50 and cm was slightly lower than in 2016 which was 0.46.

#### Hardy Lake Summary:

**Black Crappie:** A total of 358 Black Crappie was collected, of which, 288 were collected with Michigan style trap nets and 70 were collected with Indiana standard trap nets. Lengths ranged from 3.7 to 12.0 in and weighed a total of 141.96 pounds (Figure 3). Proportional size distribution was 86, PSD-9 was 75, PSD-10 was 31, and PSD-12 was 1 which were higher than in 2016 and 2014. In 2016 PSD was 59, PSD-9 was 36, and PSD-10 was 7; and in 2015 PSD was 20, PSD-9 was 11, and PSD-10 was 5 (Table 3). Body condition was poorest of all years given the following relative weights: Wr-5 was 88, Wr-8 was 82, Wr-10 was 81, and Wr-12 was 77. The following relative weights were from 2016 and 2015: Wr-8 was 102 and 92, Wr-10 was 95 and 85. Ages ranged from 0 to 4 (Figure 4) with mean length at ages as follows: age 0 was 4.8 in, age 1 was 7.7 in, age 2 was 9.5 in, age 3 was 10.2 in, and age 4 was 11.1 in. All mean length at ages were higher than in 2016, except for age 3: age 0 was 3.9 in, age 1 was 7.6 in, age 2 was 9.2 in, and age 3 was 10.7 in (Table 4). Annual mortality was 0.67 and cm was 0.54. Annual mortality was lower than in 2016 (i.e., 0.75) and cm was higher than in 2016 (i.e., 0.51).

**White Crappie:** A total of 153 White Crappie was collected, of which, 118 were collected with Michigan style trap nets and 35 were collected with Indiana standard trap nets. Lengths ranged from 5.2 to 12.5 in and weighed a total of 55.12 pounds (Figure 5). Proportional size distribution was 85, PSD-9 was 58, PSD-10 was 33, and PSD-12 was 3. Relative weights were: Wr-5 was

84, Wr-8 was 81, Wr-10 was 81, and Wr-12 was 84. Ages ranged from 1 to 3 years old (Figure 6) with mean length at ages as follows: age 1 was 8.8 in, age 2 was 10.1 in, and age 3 was 11.3 in. Annual mortality was 0.50 and cm was 0.60. In previous years, White Crappie were collected; however, samples were not sufficient to analyze population parameters. As such, this was the first year population parameters were evaluated for White Crappie at Hardy Lake.

**Gear Comparison:** Results of the Kolmogorov Smirnov indicated the size structure collected was not significantly different between gears (Dstat: 0.097; Critical D: 0.181) (Figure 7). Further, the CPUE is greater for Michigan style trap nets (CPUE: 20.6) than Indiana standard trap nets (CPUE: 3.0). Since size structures do not differ and CPUE is greater for Michigan style trap nets, it is suggested that future efforts use Michigan style trap nets to carry out Crappie surveys on Hardy Lake.

**Overall Summary:** Both lakes seem to be exhibiting similar growth rates as in previous years given the aforementioned mean length at ages. Further, an increase in PSD values were observed indicating the size structure collected has shifted towards a composition of larger crappie. Such an observation may be indicative of positive effects from the 9 in minimum length limit; however, more data is needed to support such an inference. Although it may be too early to infer the effects on crappie size and growth since the minimum length limit, a decline in body condition for both lakes was observed. Given the variable nature of crappie populations, these observations may have been caused by numerous different factors and as such may not be related to the minimum length limit change. Therefore, monitoring should continue as outlined in Bueltmann (2015) to investigate if numbers of large crappie continue to increase and if the decline in body condition is a trend or just a variable year due to other factors (e.g., prey abundance, habitat, etc.).

Literature Cited

- Anderson, R. O. and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-481 in B.R. Murphy and D.W. Willis, editor. Fisheries techniques. 2nd edition. American Fisheries Society, Bethesda Maryland.
- Buelmann, A. T. 2015. Dogwood Lake (Daviness County) and Hardy Lake (Scott and Jefferson Counties) supplemental crappie survey. Indiana Department of Natural Resources. Fisheries Section. 17 pp.
- Murphy, B.R., D.W. Willis, and T.A. Springer. 1991. The relative weight index in fisheries management: status and needs. Fisheries, 16.2:30-38.
- Slipke, J. W., and M. J. Maceina. 2014. Fishery Analysis and Modeling Simulator (FAMS). Version 1.64. American Fisheries Society, Bethesda, Maryland.

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Dan Carnahan, South Region Supervisor

Date: August 17, 2018

Table 1. Dogwood Lake Black Crappie PSDs and relative weights (Wr) from spring samples.

| Year | PSD | PSD-9 | PSD-10 | PSD-12 | Wr-8 | Wr-10 | Wr-12 |
|------|-----|-------|--------|--------|------|-------|-------|
| 2014 | 60  | 43    | 19     | 3      | 101  | 101   | 97    |
| 2016 | 77  | 56    | 30     | -      | 104  | 95    | -     |
| 2017 | 90  | 64    | 23     | 1      | 88   | 88    | 82    |

Table 2. Dogwood Lake Black Crappie mean length (in) at ages.

| Year | age 2 | age 3 | age 4 |
|------|-------|-------|-------|
| 2014 | 7.8   | 9.6   | 10.1  |
| 2016 | 8.1   | 9.7   | 10.3  |
| 2017 | 8.2   | 9.6   | 10.6  |

Table 3. Hardy Lake Black Crappie PSDs and relative weights from fall samples.

| Year | PSD | PSD-9 | PSD-10 | PSD-12 | Wr-8 | Wr-10 | Wr-12 |
|------|-----|-------|--------|--------|------|-------|-------|
| 2015 | 20  | 11    | 5      | -      | 92   | 85    | -     |
| 2016 | 59  | 36    | 7      | -      | 102  | 95    | -     |
| 2017 | 86  | 75    | 31     | 1      | 81   | 82    | 77    |

Table 4. Hardy Lake Black Crappie mean length (in) at ages.

| Year | age 1 | age 2 | age 3 |
|------|-------|-------|-------|
| 2015 | 6.9   | 9.5   | -     |
| 2016 | 7.6   | 9.2   | 10.7  |
| 2017 | 7.7   | 9.5   | 10.2  |

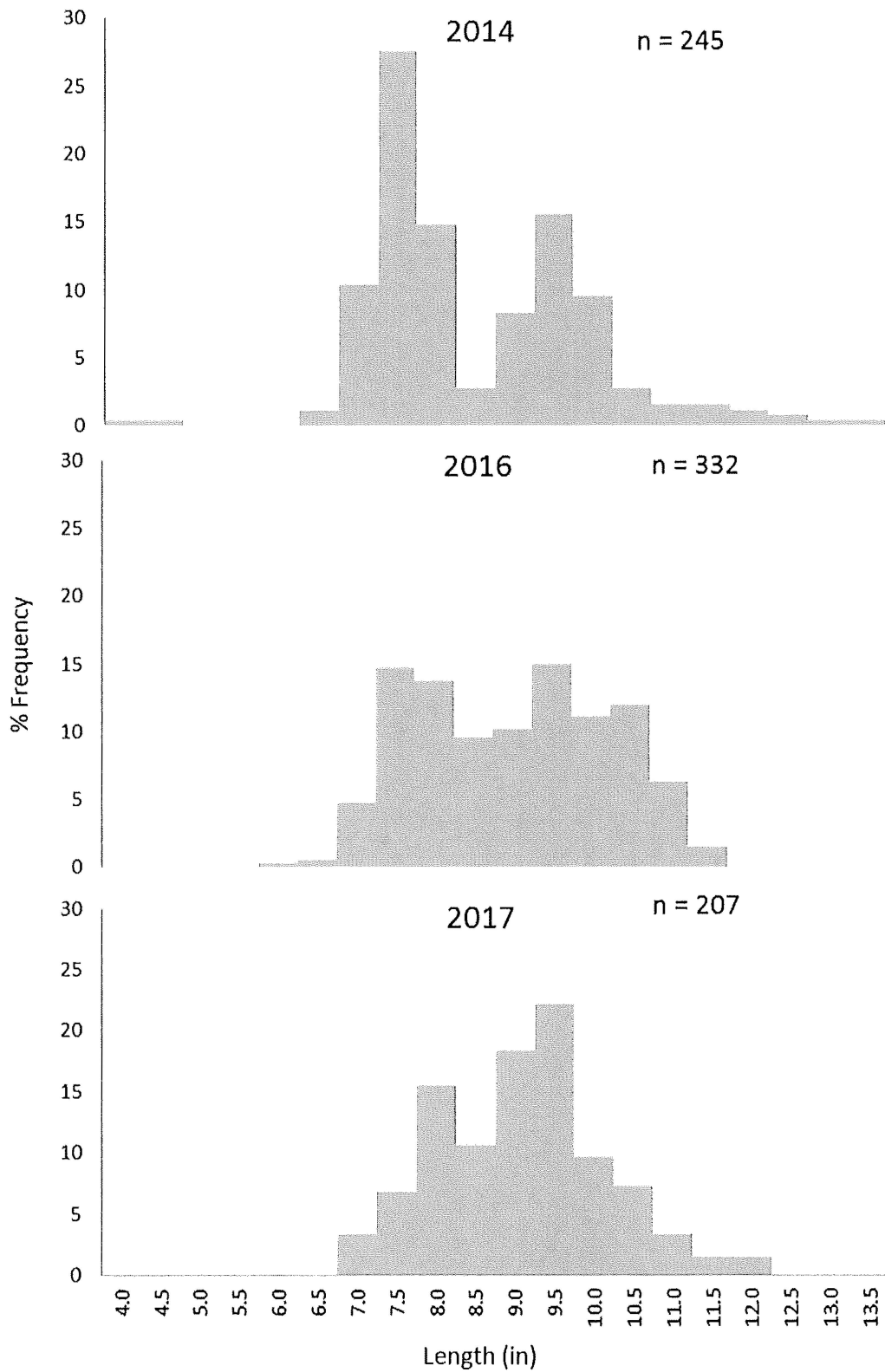


Figure 1. Dogwood Lake length (in) frequency histogram of Black Crappie from 2014, 2016, and 2017 spring samples (n=sample size).

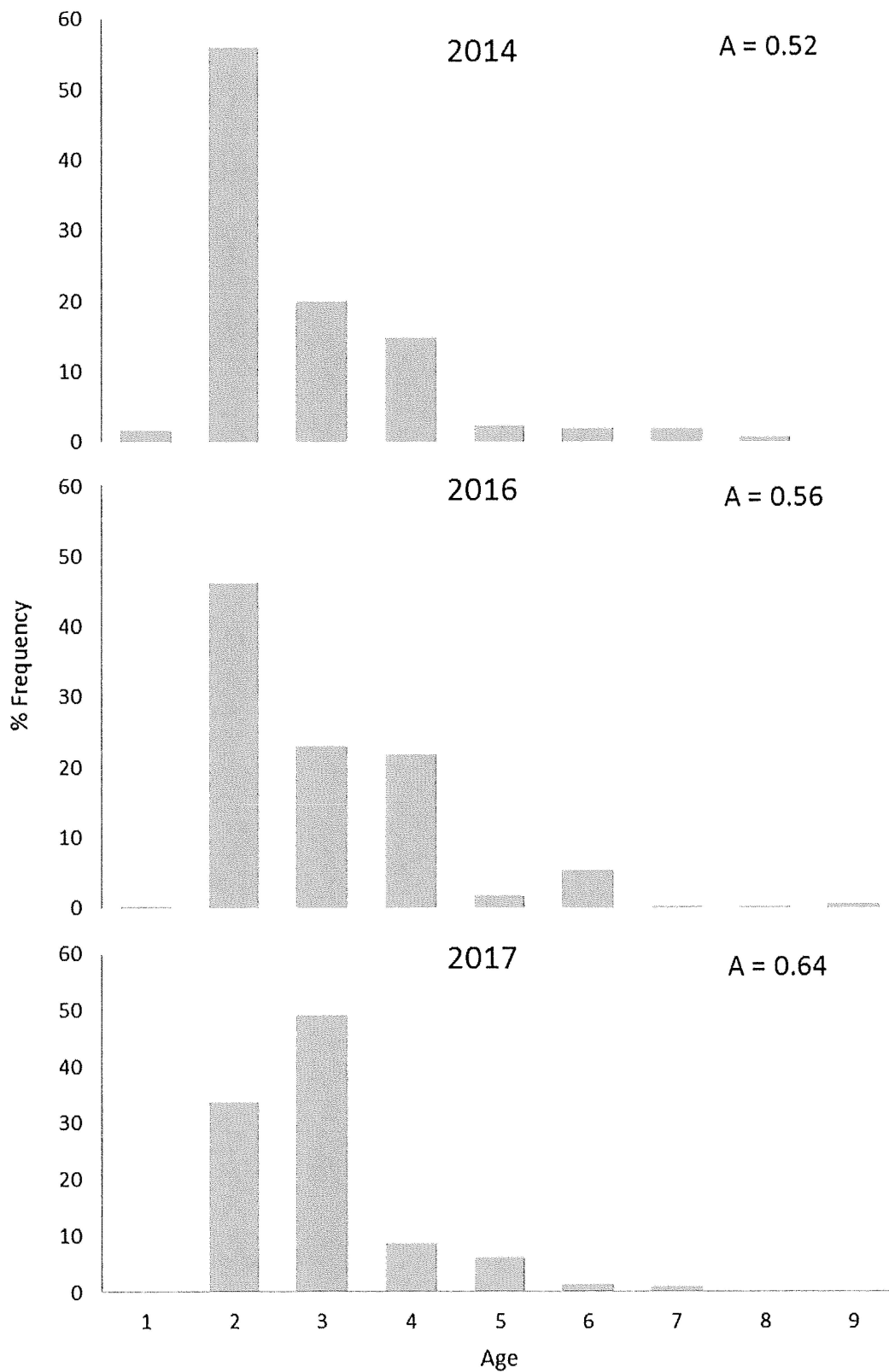


Figure 2. Dogwood Lake age frequency of Black Crappie from 2014, 2016, and 2017 spring samples (A=total annual mortality).

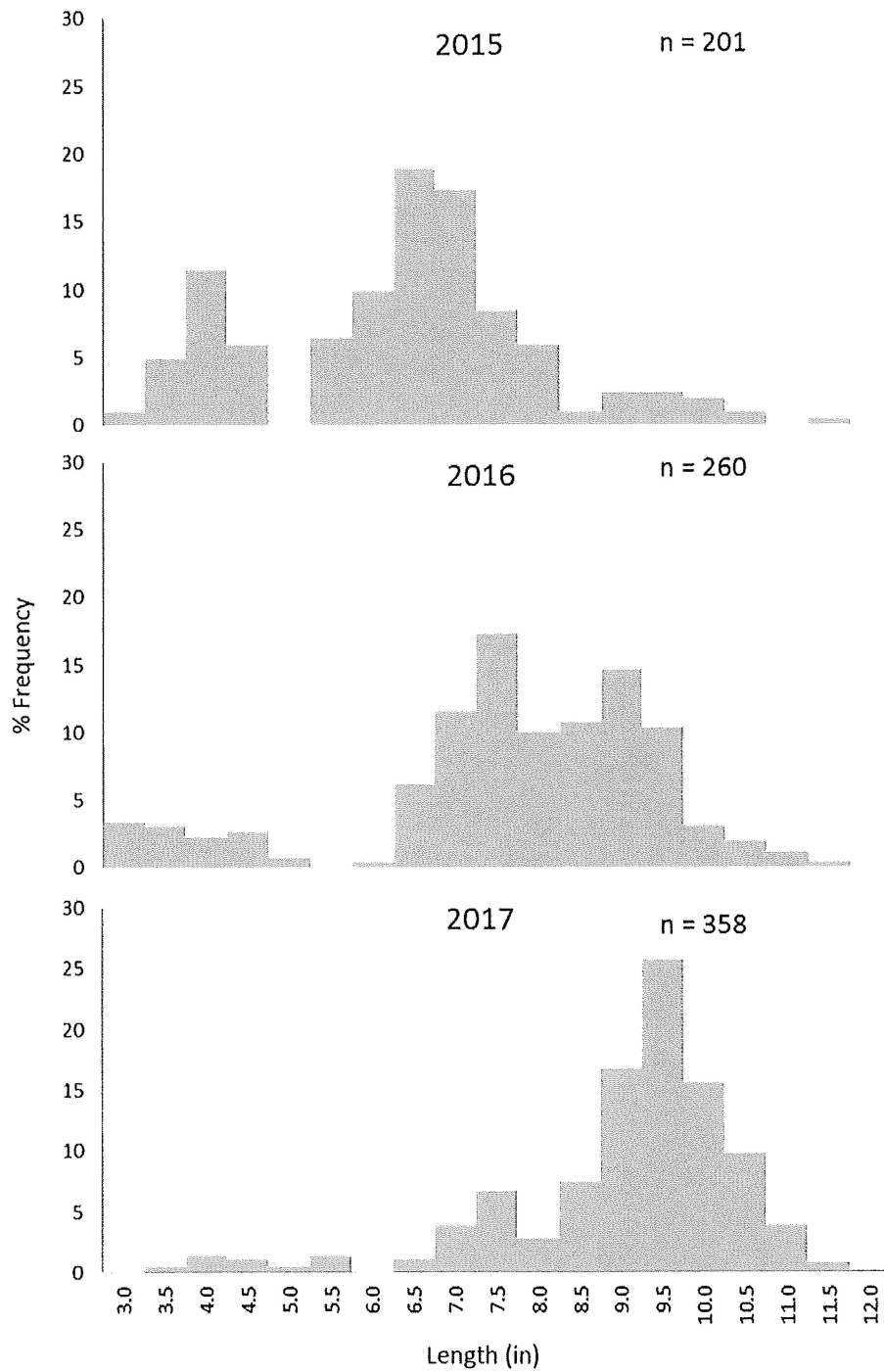


Figure 3. Hardy Lake length (in) frequency histogram of Black Crappie from 2015, 2016, and 2017 fall samples (n=sample size).



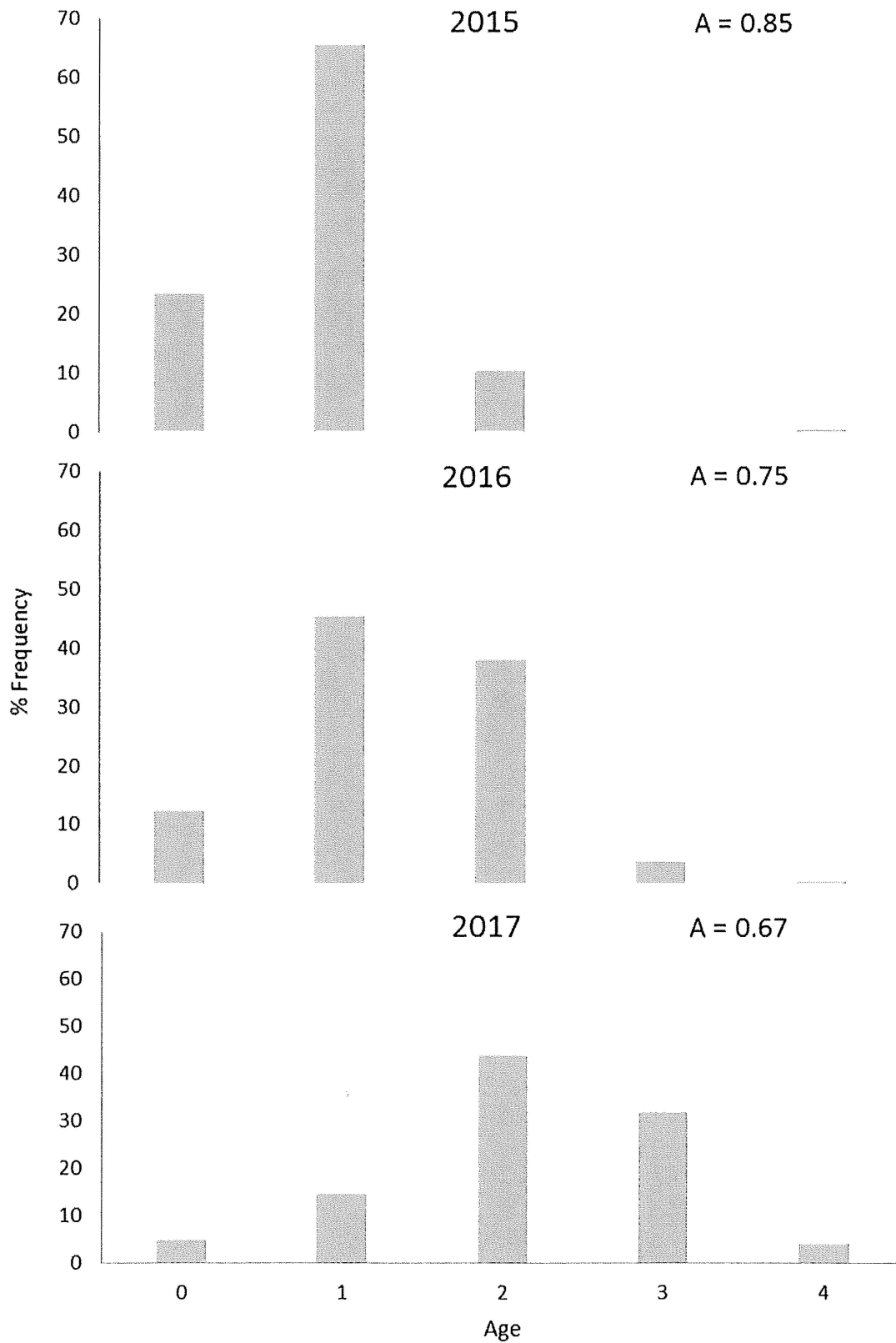


Figure 4. Hardy Lake age frequency of Black Crappie from 2015, 2016, and 2017 fall samples (A=total annual mortality).

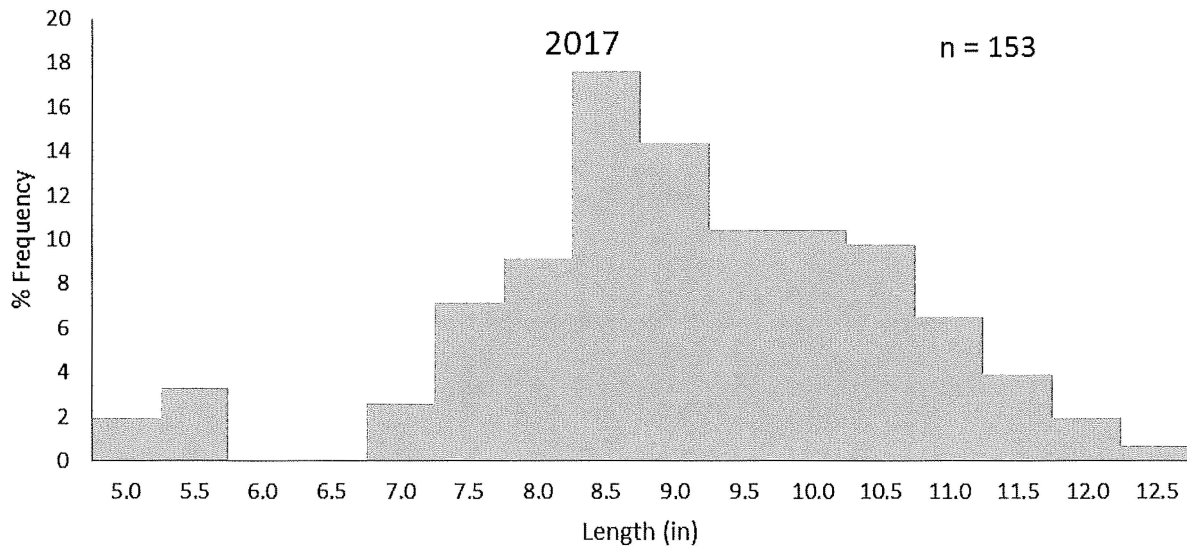


Figure 5. Hardy Lake length frequency (in) of White Crappie from 2017 fall samples (n=sample size).

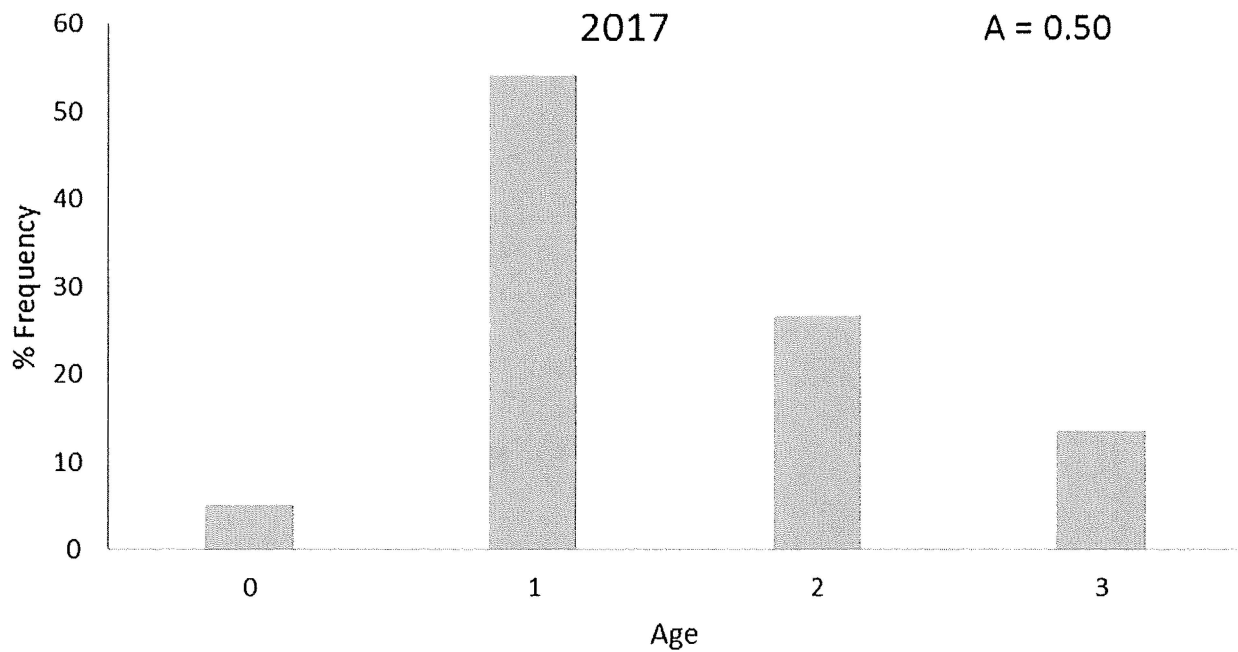


Figure 6. Hardy Lake age frequency of White Crappie from 2017 fall samples (A=total annual mortality).

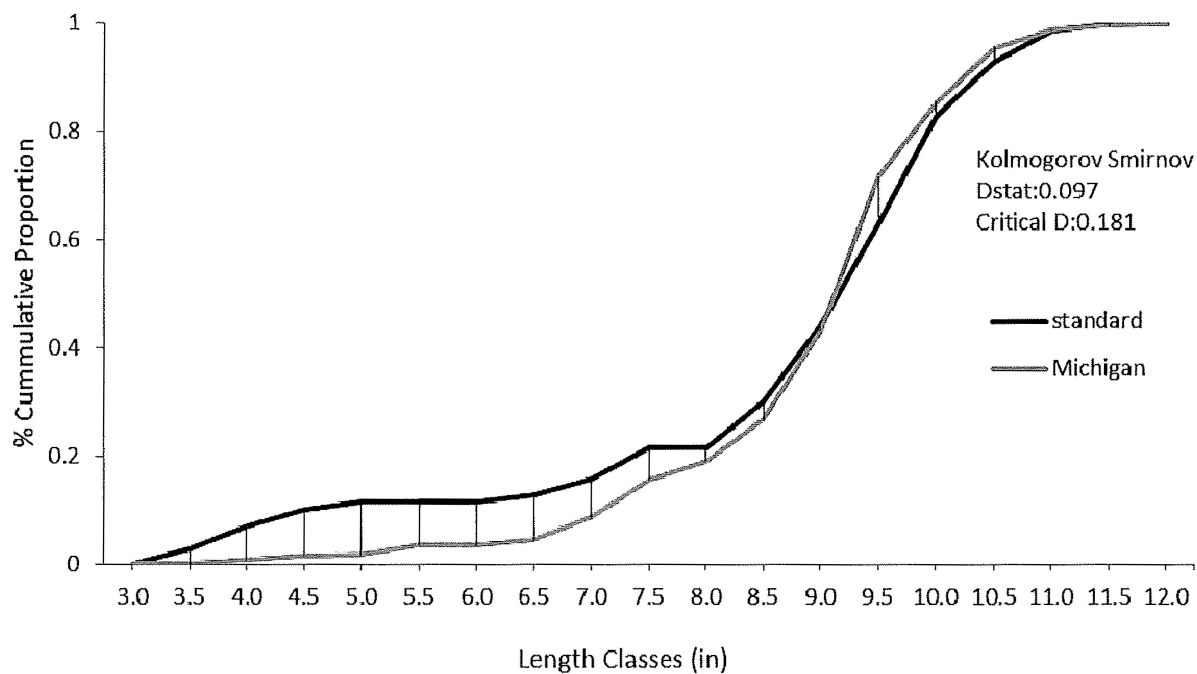


Figure 7. Hardy Lake Black Crappie two sample Kolmogorov Smirnov results with Indiana standard trap nets (standard) and Michigan style trap nets (Michigan).

|   |                               |   |  |
|---|-------------------------------|---|--|
| <b>LAKE SURVEY REPORT</b>   |                               | Type of Survey<br><input type="checkbox"/> Initial Survey <input checked="" type="checkbox"/> Re-Survey |  |
| Lake Name<br>Dogwood Lake   |                               | County<br>Daviness  | Date of survey (Month, day, year)<br>2/28-3/15, 2017   |
| Biologist's name<br>Andy Bueltmann, Sandy Clark-Kolaks, Ryan Aldridge   |                               | Date of approval (Month, day, year)<br>8/17/2018  |  |
| <b>LOCATION</b>   |                               |   |  |
| Quadrangle Name<br>Glendale   |                               | Range<br>6W   | Section<br>1,2,3,10,11, and 12   |
| Township Name<br>1N & 2N  |                               | Nearest Town<br>Montgomery  |  |
| <b>ACCESSIBILITY</b>  |                               |   |  |
| State owned public access site<br>Two boat ramps  |                               | Privately owned public access site  | Other access site  |
| Surface acres<br>1,414  | Maximum depth<br>42           | Average depth<br>10   | Acres feet<br>14,140   |
| Water level<br>470  |                               | Extreme fluctuations<br>Minor   |  |
| Location of benchmark   |                               |   |  |
| <b>INLETS</b>   |                               |   |  |
| Name  | Location                      | Origin  |  |
| Mud Creek   |                               | T1N, R5W, S6  |  |
| <b>OUTLETS</b>  |                               |   |  |
| Name  | Location                      |   |  |
| Mud Creek   | Southwest corner of the lake. |   |  |
| Water level control<br>Concrete drop box with 48 inch valve.  |                               |   |  |
| <b>POOL</b>   | <b>ELEVATION (Feet MSL)</b>   | <b>ACRES</b>  | <b>Bottom type</b><br><input type="checkbox"/> Boulder<br><input type="checkbox"/> Gravel<br><input checked="" type="checkbox"/> Sand<br><input checked="" type="checkbox"/> Muck<br><input checked="" type="checkbox"/> Clay<br><input type="checkbox"/> Marl |
| TOP OF DAM  |                               |   |  |
| TOP OF FLOOD CONTROL POOL   |                               |   |  |
| TOP OF CONSERVATION POOL  |                               |   |  |
| TOP OF MINIMUM POOL   |                               |   |  |
| STREAMBED   |                               |   |  |
| Watershed use<br>Glendale State Fish and Wildlife Area, agriculture, and surface coal mining.   |                               |   |  |
| Development of shoreline<br>Check station, two concrete boat ramps, two fishing piers, boat dock for rental boats, boat mooring sites and a 121 campsite campground area.   |                               |   |  |
| Previous surveys and investigations<br>Fisheries survey in 1968, 1970, 1973, 1976, and 1977. Creel surveys in 1978, 2001, 2006 and 2012. Total renovation and restocking, fall of 1978. Fish management survey in 1980, 1981, 1983, 1985, 1987, 1989, 1991, 1995, 2001, 2005, and 2012. Bass sampling 1991 to 2004, 2006, 2008, 2010, and 2012. Crappie sampling in 2006, 2012, 2014, 2015, and 2016. |                               |   |  |

| SAMPLING EFFORT                         |                     |            |                   |                      |            |                      |                                |            |
|---|---------------------|------------|-------------------|----------------------|------------|----------------------|--------------------------------|------------|
| ELECTROFISHING                          | Day hours           |            |                   | Night hours          |            |                      | Total hours                    |            |
| TRAP NETS                               | Number of traps     |            |                   | Number of Lifts      |            |                      | Total effort                   |            |
| MICHIGAN TRAP NETS                      | Number of nets<br>5 |            |                   | Number of Lifts<br>2 |            |                      | Total effort<br>10             |            |
| ROTENONE                                | Gallons             | ppm        | Acre Feet Treated | SHORELINE SEINING    |            |                      | Number of 100 Foot Seine Hauls |            |
| PHYSICAL AND CHEMICAL CHARACTERISTICS   |                     |            |                   |                      |            |                      |                                |            |
| Color                                   |                     |            |                   | Turbidity            |            |                      |                                |            |
|   |                     |            |                   | Feet                 |            | Inches (SECCHI DISK) |                                |            |
| Alkalinity (ppm)*                       |                     |            |                   | pH                   |            |                      |                                |            |
| Surface:                                |                     | Bottom:    |                   | Surface:             |            | Bottom:              |                                |            |
| Conductivity:                           |                     |            |                   | Air temperature:     |            |                      |                                |            |
| micromhos                               |                     |            |                   | °F                   |            |                      |                                |            |
| Water chemistry GPS coordinates:        |                     |            |                   |                      |            |                      |                                |            |
| N                                       |                     |            |                   | W                    |            |                      |                                |            |
| TEMPERATURE AND DISSOLVED OXYGEN (D.O.) |                     |            |                   |                      |            |                      |                                |            |
| DEPTH (FEET)                            | DEGREES (°F)        | D.O. (ppm) | DEPTH (FEET)      | DEGREES (°F)         | D.O. (ppm) | DEPTH (FEET)         | DEGREES (°F)                   | D.O. (ppm) |
| SURFACE                                 | 50                  |            | 36                |                      |            | 72                   |                                |            |
| 2                                       |                     |            | 38                |                      |            | 74                   |                                |            |
| 4                                       |                     |            | 40                |                      |            | 76                   |                                |            |
| 6                                       |                     |            | 42                |                      |            | 78                   |                                |            |
| 8                                       |                     |            | 44                |                      |            | 80                   |                                |            |
| 10                                      |                     |            | 46                |                      |            | 82                   |                                |            |
| 12                                      |                     |            | 48                |                      |            | 84                   |                                |            |
| 14                                      |                     |            | 50                |                      |            | 86                   |                                |            |
| 16                                      |                     |            | 52                |                      |            | 88                   |                                |            |
| 18                                      |                     |            | 54                |                      |            | 90                   |                                |            |
| 20                                      |                     |            | 56                |                      |            | 92                   |                                |            |
| 22                                      |                     |            | 58                |                      |            | 94                   |                                |            |
| 24                                      |                     |            | 60                |                      |            | 96                   |                                |            |
| 26                                      |                     |            | 62                |                      |            | 98                   |                                |            |
| 28                                      |                     |            | 64                |                      |            | 100                  |                                |            |
| 30                                      |                     |            | 66                |                      |            |                      |                                |            |
| 32                                      |                     |            | 68                |                      |            |                      |                                |            |
| 34                                      |                     |            | 70                |                      |            |                      |                                |            |
| COMMENTS                                |                     |            |                   |                      |            |                      |                                |            |
| Water chemistry was not measured.       |                     |            |                   |                      |            |                      |                                |            |
| Water Temp: 50°F                        |                     |            |                   |                      |            |                      |                                |            |
| *ppm-parts per million                  |                     |            |                   |                      |            |                      |                                |            |

| NUMBER, PERCENTAGE, WEIGHT, AND AGE OF BLACK CRAPPIE |                  |                           |                         |             |                       |                  |                           |                         |             |
|--|------------------|---------------------------|-------------------------|-------------|-----------------------|------------------|---------------------------|-------------------------|-------------|
| TOTAL LENGTH (inches)                                | NUMBER COLLECTED | PERCENT OF FISH COLLECTED | AVERAGE WEIGHT (pounds) | AGE OF FISH | TOTAL LENGTH (inches) | NUMBER COLLECTED | PERCENT OF FISH COLLECTED | AVERAGE WEIGHT (pounds) | AGE OF FISH |
| 1.0  |                  |                           |                         |             | 19.0                  |                  |                           |                         |             |
| 1.5  |                  |                           |                         |             | 19.5                  |                  |                           |                         |             |
| 2.0  |                  |                           |                         |             | 20.0                  |                  |                           |                         |             |
| 2.5  |                  |                           |                         |             | 20.5                  |                  |                           |                         |             |
| 3.0  |                  |                           |                         |             | 21.0                  |                  |                           |                         |             |
| 3.5  |                  |                           |                         |             | 21.5                  |                  |                           |                         |             |
| 4.0  |                  |                           |                         |             | 22.0                  |                  |                           |                         |             |
| 4.5  |                  |                           |                         |             | 22.5                  |                  |                           |                         |             |
| 5.0  |                  |                           |                         |             | 23.0                  |                  |                           |                         |             |
| 5.5  |                  |                           |                         |             | 23.5                  |                  |                           |                         |             |
| 6.0  |                  |                           |                         |             | 24.0                  |                  |                           |                         |             |
| 6.5  |                  |                           |                         |             | 24.5                  |                  |                           |                         |             |
| 7.0  | 7                | 3.4                       | 0.16                    | 2           | 25.0                  |                  |                           |                         |             |
| 7.5  | 14               | 6.8                       | 0.22                    | 2           | 25.5                  |                  |                           |                         |             |
| 8.0  | 32               | 15.5                      | 0.26                    | 2           | 26.0                  |                  |                           |                         |             |
| 8.5  | 22               | 10.6                      | 0.32                    | 2,3         | TOTAL                 | 207              |                           |                         |             |
| 9.0  | 38               | 18.4                      | 0.39                    | 3           |                       |                  |                           |                         |             |
| 9.5  | 46               | 22.2                      | 0.47                    | 3           |                       |                  |                           |                         |             |
| 10.0   | 20               | 9.7                       | 0.57                    | 3,4         |                       |                  |                           |                         |             |
| 10.5   | 15               | 7.2                       | 0.63                    | 3,4,5       |                       |                  |                           |                         |             |
| 11.0   | 7                | 3.4                       | 0.73                    | 4,5,7       |                       |                  |                           |                         |             |
| 11.5   | 3                | 1.4                       | 0.79                    | 3,4,6       |                       |                  |                           |                         |             |
| 12.0   | 3                | 1.4                       | 0.94                    | 5,6,7       |                       |                  |                           |                         |             |
| 12.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 13.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 13.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 14.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 14.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 15.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 15.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 16.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 16.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 17.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 17.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 18.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 18.5   |                  |                           |                         |             |                       |                  |                           |                         |             |

|                      |     |                |     |                   |           |
|----------------------|-----|----------------|-----|-------------------|-----------|
| ELECTROFISHING CATCH | N/A | GILL NET CATCH | N/A | MI TRAP NET CATCH | 20.7/lift |
|----------------------|-----|----------------|-----|-------------------|-----------|

| BLACK CRAPPE AGE-LENGTH KEY |              |            |     |    |     |    |    |   |   |   |
|-----------------------------|--------------|------------|-----|----|-----|----|----|---|---|---|
| Length group (in)           | Total number | Sub-sample | Age |    |     |    |    |   |   |   |
|                             |              |            | 1   | 2  | 3   | 4  | 5  | 6 | 7 |   |
| 7.0                         | 7            | 6          |     | 7  |     |    |    |   |   |   |
| 7.5                         | 14           | 3          |     | 14 |     |    |    |   |   |   |
| 8.0                         | 32           | 6          |     | 32 |     |    |    |   |   |   |
| 8.5                         | 22           | 4          |     | 17 | 5   |    |    |   |   |   |
| 9.0                         | 38           | 6          |     |    | 38  |    |    |   |   |   |
| 9.5                         | 46           | 5          |     |    | 46  |    |    |   |   |   |
| 10.0                        | 20           | 7          |     |    | 9   | 11 |    |   |   |   |
| 10.5                        | 15           | 5          |     |    | 3   | 3  | 9  |   |   |   |
| 11.0                        | 7            | 5          |     |    |     | 3  | 3  |   |   | 1 |
| 11.5                        | 3            | 3          |     |    |     | 1  |    |   | 2 |   |
| 12.0                        | 3            | 3          |     |    |     |    |    | 1 | 1 | 1 |
| Total                       | 207          | 53         | 0   | 70 | 101 | 18 | 13 | 3 | 3 | 2 |

| Black Crappie Age-Length Key Summary |        |         |      |      |          |          |
|--------------------------------------|--------|---------|------|------|----------|----------|
| Age                                  | Number | Mean TL | Var  | SE   | Lo 95%CI | Up 95%CI |
| 1                                    | -      | -       | -    | -    | -        | -        |
| 2                                    | 70     | 8.2     | 0.21 | 0.05 | 8.1      | 8.3      |
| 3                                    | 101    | 9.6     | 0.17 | 0.04 | 9.5      | 9.7      |
| 4                                    | 18     | 10.6    | 0.23 | 0.11 | 10.3     | 10.8     |
| 5                                    | 13     | 11.0    | 0.19 | 0.12 | 10.7     | 11.2     |
| 6                                    | 3      | 11.9    | 0.08 | 0.17 | 11.6     | 12.3     |
| 7                                    | 2      | 11.7    | 0.42 | 0.42 | 10.8     | 12.5     |

|  |  |   |   |
|--|--|---|---|
| <b>LAKE SURVEY REPORT</b>  |  | Type of Survey<br><input type="checkbox"/> Initial Survey <input checked="" type="checkbox"/> Re-Survey |   |
| Lake Name<br>Hardy Lake  |  | County<br>Scott & Jefferson   | Date of survey (Month, day, year)<br>10/31-12/07, 2017  |
| Biologist's name<br>Andy Bueltmann, Sandy Clark-Kolaks, Rebecca Munter, and Ryan Aldridge  |  | Date of approval (Month, day, year)<br>8/17/2018  |   |
| <b>LOCATION</b>  |  |   |   |
| Quadrangle Name<br>Deputy, Ind. 1968 Photorevised 1988   |  | Range<br>7E, 8E   | Section<br>13,14,18,19,24,25,30   |
| Township Name<br>4N  |  | Nearest Town<br>Deputy  |   |
| <b>ACCESSIBILITY</b>   |  |   |   |
| State owned public access site<br>Four boat ramps  |  | Privately owned public access site  | Other access site   |
| Surface acres<br>741   | Maximum depth<br>38 feet                           | Average depth<br>16 feet  | Acres feet<br>11,856  |
|  |  | Water level<br>600  | Extreme fluctuations<br>598.5-601.5 feet MSL  |
| Location of benchmark  |  |   |   |
| <b>INLETS</b>  |  |   |   |
| Name<br>Quick Creek  | Location<br>Southeast corner of lake               | Origin<br>Watershed runoff  |   |
|  |  |   |   |
| <b>OUTLETS</b>   |  |   |   |
| Name<br>Quick Creek  | Location<br>West end of lake at principal spillway |   |   |
| Water level control<br>principal spillway is a concrete tower with drawdown tubes present. Grass emergency spillway is at south end of dam |  |   |   |
| <b>POOL</b>  | <b>ELEVATION (Feet MSL)</b>                        | <b>ACRES</b>  | <b>Bottom type</b><br><input type="checkbox"/> Boulder<br><input checked="" type="checkbox"/> Gravel<br><input type="checkbox"/> Sand<br><input type="checkbox"/> Muck<br><input checked="" type="checkbox"/> Clay<br><input type="checkbox"/> Marl |
| TOP OF DAM   | 613  | 1,200   |   |
| TOP OF FLOOD CONTROL POOL  | 603  | 870   |   |
| TOP OF CONSERVATION POOL   | 600  | 741   |   |
| TOP OF MINIMUM POOL  | 570  | 90  |   |
| STREAMBED  |  |   |   |
| Watershed use<br>Watershed covers 12 square miles (50% agricultural, 37% forest, 8% residential, 5% pasture/old field)                     |  |   |   |
| Development of shoreline<br>State-owned campground, beach, marina, overlook area, two fishing piers, and four boat ramps.                  |  |   |   |
| A private campground and approximately 24 homes are located along and near the norther and eastern shoreline.                              |  |   |   |
| Previous surveys and investigations<br>Fishery surveys: 1971-1975, 1978, 1990, 1995, 1998-2000, 2003, 2007. Walleye study: 1983, 1984.     |  |   |   |
| Angler creel surveys: 1975, 1977, 1978, 1981. 1999, 2003, 2007, 2010. Submersed vegetation surveys: 2004-2013.                             |  |   |   |
| Striped bass/Hybrid striped bass surveys: 2005, 2007, 2009, 2013. Largemouth bass population estimate: 2010.                               |  |   |   |
| Crappie supplemental surveys: 2005, 2011, 2013, 2015, and 2016   |  |   |   |



| SAMPLING EFFORT                         |                       |            |                      |                   |                                |              |              |      |
|---|-----------------------|------------|----------------------|-------------------|--------------------------------|--------------|--------------|------|
| ELECTROFISHING                          | Day hours             |            | Night hours          |                   | Total hours                    |              |              |      |
| TRAP NETS                               | Number of traps<br>23 |            | Number of Lifts<br>1 |                   | Total effort<br>23             |              |              |      |
| MICHIGAN TRAP NETS                      | Number of nets<br>7   |            | Number of Lifts<br>2 |                   | Total effort<br>14             |              |              |      |
| ROTENONE                                | Gallons               | ppm        | Acre Feet Treated    | SHORELINE SEINING | Number of 100 Foot Seine Hauls |              |              |      |
| PHYSICAL AND CHEMICAL CHARACTERISTICS   |                       |            |                      |                   |                                |              |              |      |
| Color                                   |                       |            | Turbidity            |                   |                                |              |              |      |
|   |                       |            | Feet                 |                   | Inches (SECCHI DISK)           |              |              |      |
| Alkalinity (ppm)*                       |                       |            | pH                   |                   |                                |              |              |      |
| Surface:                                |                       | Bottom:    |                      | Surface:          |                                | Bottom:      |              |      |
| Conductivity:                           |                       |            | Air temperature:     |                   |                                |              |              |      |
| micromhos                               |                       |            | °F                   |                   |                                |              |              |      |
| Water chemistry GPS coordinates:        |                       |            |                      |                   |                                |              |              |      |
| N                                       |                       |            |                      | W                 |                                |              |              |      |
| TEMPERATURE AND DISSOLVED OXYGEN (D.O.) |                       |            |                      |                   |                                |              |              |      |
| DEPTH (FEET)                            | Degrees (°F)          | Date       | DEPTH (FEET)         | DEGREES (°F)      | Date                           | DEPTH (FEET) | DEGREES (°F) | Date |
| SURFACE                                 | 56                    | 10/30/2017 | 36                   |                   |                                | 72           |              |      |
| SURFACE                                 | 57                    | 11/7/2017  | 38                   |                   |                                | 74           |              |      |
| SURFACE                                 | 52                    | 11/14/2017 | 40                   |                   |                                | 76           |              |      |
| SURFACE                                 | 49                    | 11/20/2017 | 42                   |                   |                                | 78           |              |      |
| SURFACE                                 | 48                    | 11/28/2017 | 44                   |                   |                                | 80           |              |      |
| SURFACE                                 | 48                    | 12/5/2017  | 46                   |                   |                                | 82           |              |      |
| 12                                      |                       |            | 48                   |                   |                                | 84           |              |      |
| 14                                      |                       |            | 50                   |                   |                                | 86           |              |      |
| 16                                      |                       |            | 52                   |                   |                                | 88           |              |      |
| 18                                      |                       |            | 54                   |                   |                                | 90           |              |      |
| 20                                      |                       |            | 56                   |                   |                                | 92           |              |      |
| 22                                      |                       |            | 58                   |                   |                                | 94           |              |      |
| 24                                      |                       |            | 60                   |                   |                                | 96           |              |      |
| 26                                      |                       |            | 62                   |                   |                                | 98           |              |      |
| 28                                      |                       |            | 64                   |                   |                                | 100          |              |      |
| 30                                      |                       |            | 66                   |                   |                                |              |              |      |
| 32                                      |                       |            | 68                   |                   |                                |              |              |      |
| 34                                      |                       |            | 70                   |                   |                                |              |              |      |
| COMMENTS                                |                       |            |                      |                   |                                |              |              |      |
| Water chemistry was not measured.       |                       |            |                      |                   |                                |              |              |      |
|   |                       |            |                      |                   |                                |              |              |      |
|   |                       |            |                      |                   |                                |              |              |      |
| *ppm-parts per million                  |                       |            |                      |                   |                                |              |              |      |

| NUMBER, PERCENTAGE, WEIGHT, AND AGE OF BLACK CRAPPIE |                  |                           |                         |             |                       |                  |                           |                         |             |
|--|------------------|---------------------------|-------------------------|-------------|-----------------------|------------------|---------------------------|-------------------------|-------------|
| TOTAL LENGTH (inches)                                | NUMBER COLLECTED | PERCENT OF FISH COLLECTED | AVERAGE WEIGHT (pounds) | AGE OF FISH | TOTAL LENGTH (inches) | NUMBER COLLECTED | PERCENT OF FISH COLLECTED | AVERAGE WEIGHT (pounds) | AGE OF FISH |
| 1.0  |                  |                           |                         |             | 19.0                  |                  |                           |                         |             |
| 1.5  |                  |                           |                         |             | 19.5                  |                  |                           |                         |             |
| 2.0  |                  |                           |                         |             | 20.0                  |                  |                           |                         |             |
| 2.5  |                  |                           |                         |             | 20.5                  |                  |                           |                         |             |
| 3.0  |                  |                           |                         |             | 21.0                  |                  |                           |                         |             |
| 3.5  | 2                | 0.6                       | 0.02                    | 0           | 21.5                  |                  |                           |                         |             |
| 4.0  | 5                | 1.4                       | 0.03                    | 0           | 22.0                  |                  |                           |                         |             |
| 4.5  | 4                | 1.1                       | 0.04                    | 0           | 22.5                  |                  |                           |                         |             |
| 5.0  | 2                | 0.6                       | 0.06                    | 0           | 23.0                  |                  |                           |                         |             |
| 5.5  | 5                | 1.4                       | 0.07                    | 0           | 23.5                  |                  |                           |                         |             |
| 6.0  |                  |                           |                         |             | 24.0                  |                  |                           |                         |             |
| 6.5  | 4                | 1.1                       | 0.13                    | 1           | 24.5                  |                  |                           |                         |             |
| 7.0  | 14               | 3.9                       | 0.17                    | 1           | 25.0                  |                  |                           |                         |             |
| 7.5  | 24               | 6.7                       | 0.20                    | 1           | 25.5                  |                  |                           |                         |             |
| 8.0  | 10               | 2.8                       | 0.24                    | 1           | 26.0                  |                  |                           |                         |             |
| 8.5  | 27               | 7.5                       | 0.30                    | 1,2         | TOTAL                 | 358              |                           |                         |             |
| 9.0  | 60               | 16.8                      | 0.36                    | 2,3         |                       |                  |                           |                         |             |
| 9.5  | 92               | 25.7                      | 0.44                    | 2,3         |                       |                  |                           |                         |             |
| 10.0   | 56               | 15.6                      | 0.50                    | 2,3         |                       |                  |                           |                         |             |
| 10.5   | 35               | 9.8                       | 0.60                    | 3,4         |                       |                  |                           |                         |             |
| 11.0   | 14               | 3.9                       | 0.66                    | 3,4         |                       |                  |                           |                         |             |
| 11.5   | 3                | 0.8                       | 0.75                    | 3,4         |                       |                  |                           |                         |             |
| 12.0   | 1                | 0.3                       | 0.83                    | 4           |                       |                  |                           |                         |             |
| 12.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 13.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 13.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 14.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 14.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 15.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 15.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 16.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 16.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 17.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 17.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 18.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 18.5   |                  |                           |                         |             |                       |                  |                           |                         |             |

|                      |     |                         |          |                   |           |
|----------------------|-----|-------------------------|----------|-------------------|-----------|
| ELECTROFISHING CATCH | N/A | STANDARD TRAP NET CATCH | 3.0/lift | MI TRAP NET CATCH | 20.6/lift |
|----------------------|-----|-------------------------|----------|-------------------|-----------|

| NUMBER, PERCENTAGE, WEIGHT, AND AGE OF WHITE CRAPPIE |                  |                           |                         |             |                       |                  |                           |                         |             |
|--|------------------|---------------------------|-------------------------|-------------|-----------------------|------------------|---------------------------|-------------------------|-------------|
| TOTAL LENGTH (inches)                                | NUMBER COLLECTED | PERCENT OF FISH COLLECTED | AVERAGE WEIGHT (pounds) | AGE OF FISH | TOTAL LENGTH (inches) | NUMBER COLLECTED | PERCENT OF FISH COLLECTED | AVERAGE WEIGHT (pounds) | AGE OF FISH |
| 1.0  |                  |                           |                         |             | 19.0                  |                  |                           |                         |             |
| 1.5  |                  |                           |                         |             | 19.5                  |                  |                           |                         |             |
| 2.0  |                  |                           |                         |             | 20.0                  |                  |                           |                         |             |
| 2.5  |                  |                           |                         |             | 20.5                  |                  |                           |                         |             |
| 3.0  |                  |                           |                         |             | 21.0                  |                  |                           |                         |             |
| 3.5  |                  |                           |                         |             | 21.5                  |                  |                           |                         |             |
| 4.0  |                  |                           |                         |             | 22.0                  |                  |                           |                         |             |
| 4.5  |                  |                           |                         |             | 22.5                  |                  |                           |                         |             |
| 5.0  | 3                | 2.0                       | 0.05                    | 0           | 23.0                  |                  |                           |                         |             |
| 5.5  | 5                | 3.3                       | 0.06                    | 0           | 23.5                  |                  |                           |                         |             |
| 6.0  |                  |                           |                         |             | 24.0                  |                  |                           |                         |             |
| 6.5  |                  |                           |                         |             | 24.5                  |                  |                           |                         |             |
| 7.0  | 4                | 2.6                       | 0.15                    | 1           | 25.0                  |                  |                           |                         |             |
| 7.5  | 11               | 7.2                       | 0.20                    | 1           | 25.5                  |                  |                           |                         |             |
| 8.0  | 14               | 9.2                       | 0.22                    | 1           | 26.0                  |                  |                           |                         |             |
| 8.5  | 27               | 17.6                      | 0.25                    | 1,2         | TOTAL                 | 153              |                           |                         |             |
| 9.0  | 22               | 14.4                      | 0.31                    | 1           |                       |                  |                           |                         |             |
| 9.5  | 16               | 10.5                      | 0.37                    | 1,2         |                       |                  |                           |                         |             |
| 10.0   | 16               | 10.5                      | 0.44                    | 1,2         |                       |                  |                           |                         |             |
| 10.5   | 15               | 9.8                       | 0.50                    | 2,3         |                       |                  |                           |                         |             |
| 11.0   | 10               | 6.5                       | 0.64                    | 2,3         |                       |                  |                           |                         |             |
| 11.5   | 6                | 3.9                       | 0.78                    | 2,3         |                       |                  |                           |                         |             |
| 12.0   | 3                | 2.0                       | 0.80                    | 2,3         |                       |                  |                           |                         |             |
| 12.5   | 1                | 0.7                       | 0.98                    | 3           |                       |                  |                           |                         |             |
| 13.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 13.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 14.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 14.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 15.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 15.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 16.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 16.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 17.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 17.5   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 18.0   |                  |                           |                         |             |                       |                  |                           |                         |             |
| 18.5   |                  |                           |                         |             |                       |                  |                           |                         |             |

|                      |     |                         |          |                   |          |
|----------------------|-----|-------------------------|----------|-------------------|----------|
| ELECTROFISHING CATCH | N/A | STANDARD TRAP NET CATCH | 1.5/lift | MI TRAP NET CATCH | 8.4/lift |
|----------------------|-----|-------------------------|----------|-------------------|----------|

| BLACK CRAPPE AGE-LENGTH KEY |              |            |           |           |            |            |           |
|-----------------------------|--------------|------------|-----------|-----------|------------|------------|-----------|
| Length group (in)           | Total number | Sub-sample | Age       |           |            |            |           |
|                             |              |            | 0         | 1         | 2          | 3          | 4         |
| 3.5                         | 2            | 2          | 2         |           |            |            |           |
| 4.0                         | 5            | 5          | 5         |           |            |            |           |
| 4.5                         | 4            | 5          | 4         |           |            |            |           |
| 5.0                         | 2            | 2          | 2         |           |            |            |           |
| 5.5                         | 5            | 5          | 5         |           |            |            |           |
| 6.0                         |              |            |           |           |            |            |           |
| 6.5                         | 4            | 4          |           | 4         |            |            |           |
| 7.0                         | 14           | 5          |           | 14        |            |            |           |
| 7.5                         | 24           | 6          |           | 24        |            |            |           |
| 8.0                         | 10           | 3          |           | 10        |            |            |           |
| 8.5                         | 27           | 7          |           | 4         | 23         |            |           |
| 9.0                         | 60           | 4          |           |           | 45         | 15         |           |
| 9.5                         | 92           | 7          |           |           | 66         | 26         |           |
| 10.0                        | 56           | 5          |           |           | 22         | 34         |           |
| 10.5                        | 35           | 4          |           |           |            | 26         | 9         |
| 11.0                        | 14           | 5          |           |           |            | 11         | 3         |
| 11.5                        | 3            | 3          |           |           |            | 1          | 2         |
| 12.0                        | 1            | 1          |           |           |            |            | 1         |
| <b>Total</b>                | <b>358</b>   | <b>73</b>  | <b>18</b> | <b>56</b> | <b>156</b> | <b>113</b> | <b>15</b> |

| Black Crappie Age-Length Key Summary |        |         |      |      |          |          |  |
|--------------------------------------|--------|---------|------|------|----------|----------|--|
| Age                                  | Number | Mean TL | Var  | SE   | Lo 95%CI | Up 95%CI |  |
| 0                                    | 18     | 4.8     | 0.51 | 0.17 | 4.5      | 5.2      |  |
| 1                                    | 56     | 7.7     | 0.25 | 0.07 | 7.6      | 7.8      |  |
| 2                                    | 156    | 9.5     | 0.21 | 0.04 | 9.5      | 9.6      |  |
| 3                                    | 113    | 10.2    | 0.37 | 0.06 | 10.1     | 10.3     |  |
| 4                                    | 15     | 11.1    | 0.24 | 0.13 | 10.8     | 11.3     |  |

| WHITE CRAPPE AGE-LENGTH KEY |              |            |     |    |    |    |
|-----------------------------|--------------|------------|-----|----|----|----|
| Length group (in)           | Total number | Sub-sample | Age |    |    |    |
|                             |              |            | 0   | 1  | 2  | 3  |
| 5.0                         | 3            | 3          | 3   |    |    |    |
| 5.5                         | 5            | 5          | 5   |    |    |    |
| 6.0                         |              |            |     |    |    |    |
| 6.5                         |              |            |     |    |    |    |
| 7.0                         | 4            | 4          |     | 4  |    |    |
| 7.5                         | 11           | 4          |     | 11 |    |    |
| 8.0                         | 14           | 6          |     | 14 |    |    |
| 8.5                         | 27           | 5          |     | 16 | 11 |    |
| 9.0                         | 22           | 3          |     | 22 |    |    |
| 9.5                         | 16           | 6          |     | 8  | 8  |    |
| 10.0                        | 16           | 4          |     | 8  | 8  |    |
| 10.5                        | 15           | 3          |     |    | 5  | 10 |
| 11.0                        | 10           | 5          |     |    | 6  | 4  |
| 11.5                        | 6            | 5          |     |    | 2  | 4  |
| 12.0                        | 3            | 3          |     |    | 1  | 2  |
| 12.5                        | 1            | 1          |     |    |    | 1  |
| Total                       | 153          | 57         | 8   | 83 | 41 | 21 |

| White Crappie Age-Length Key Summary |        |         |      |      |          |          |
|--------------------------------------|--------|---------|------|------|----------|----------|
| Age                                  | Number | Mean TL | Var  | SE   | Lo 95%CI | Up 95%CI |
| 0                                    | 8      | 5.6     | 0.07 | 0.09 | 5.4      | 5.7      |
| 1                                    | 83     | 8.8     | 0.66 | 0.09 | 8.7      | 9.0      |
| 2                                    | 41     | 10.1    | 1.05 | 0.16 | 9.8      | 10.4     |
| 3                                    | 21     | 11.3    | 0.39 | 0.14 | 11.0     | 11.5     |