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# Lewistown Area Fisheries Management

## 2015-2016 Annual Report

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1/1/2015 to 12/31/2016
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ABSTRACT

Twenty-nine reservoirs were sampled in the Lewistown Management Area in 2015 and 2016. Ackley Lake rainbow trout *Oncorhynchus mykiss* numbers were below the long-term average in both years, but did improve from 2015 to 2016. Rainbow trout average length increased over recent years, and was the second highest on record in 2016. White sucker *Catostomus commersoni* continue to make up a sizable portion of the catch in Ackley. Catch rates in Bair Reservoir were near normal and the fishery continues to suffer from poor condition as interspecific competition between the stocked rainbow trout and white sucker limits the quality of the fishery. Catch rates of both northern pike *Esox lucius* and yellow perch *Perca flavescens* are up in East Fork Reservoir. We continue to sample 2-3 suckers for every trout in Martinsdale Reservoir, although the trout sampled are of quality size and condition. The productivity of Petrolia Reservoir appears to be leveling off following recent high-water. The rainbow trout fishery of Yellow Water Reservoir continues to suffer from an abundance of non-game fish and has experienced an illegal introduction of yellow perch.

In the Lewistown area, Big Casino Creek Reservoir is transitioning to a largemouth bass *Micropterus salmoides* and crappie *Pomoxis* spp. fishery. Upper and Lower Carter Ponds appear to have been successfully rehabilitated and the trout fishery is reestablishing.

In the Missouri River Breaks area, Box Elder (Vogel) Reservoir continues to suffer from an illegal introduction of yellow perch at the expense of the trout fishery. Largemouth bass are present in Bubs Reservoir and Holland Reservoir; however, the status of the fisheries is uncertain due to a small sample size. Drag Creek Reservoir bluegill *Lepomis macrochirus* are stunted and stocked largemouth bass appear not to act as adequate top-down control. Dry Blood Reservoir continues to provide a quality largemouth bass fishery and the crappie are establishing, with multiple age-classes present. Sauger *Sander canadensis* and yellow perch provide a quality fishery in Jakes Reservoir. Sauger appear to be surviving well following the recent wild-fish transfers, however, yellow perch continue to exhibit signs of stunting. An illegal introduction of white sucker was also documented in Jakes. Manuel Reservoir provides a quality rainbow trout fishery, with fish in good condition and multiple age-classes present. Payola Reservoir has recovered well from the recent winterkill, with quality largemouth bass and yellow perch present. Black bullhead *Ameriurus melas* were also documented in Payola. Largemouth bass are plentiful and in good condition in South Fork Dry Blood Reservoir. Largemouth bass and crappie continue to do well in Whisker Reservoir, with fish exhibiting excellent growth rates with multiple age-classes present.

In the Denton/Winifred area, Anderson Coulee (Beavertail) Reservoir will likely be taken off the stocking list, as multiple years of stocking have not produced a fishery. Carpenter Reservoir was sampled with few fish captured and dead and dying fish were observed, suggesting a fish kill was occurring. The reservoir has a history of high conductivity and appeared to have high tannins present. Additional monitoring will be performed to determine if the reservoir will be capable of maintaining a recreational fishery. Similar conditions were also observed in Olson Reservoir and Urs Pond. Holgate Reservoir is providing a quality trout fishery, will brook trout *Salvelinus fontinalis*, brown trout *Salmo trutta,* and rainbow trout present. Rainbow trout in Kinkelaar Pond are growing very well and in excellent condition. Wolf Creek Ranch Pond – Upper is providing a productive trout fishery, with catch-rates of 5.8 fish per hour.

In the Meagher County area, Bonanza Reservoir provides a quality trout fishery, with large brook trout and rainbow trout present. Stocked westslope cutthroat trout *Oncorhynchus clarki lewisi* are overwintering in Castle Lake and provide a unique mountain fishery, however public access is extremely difficult and an alternate route should be pursued through cooperation with the Forest Service. Forest Lake is a productive mountain lake, with good catch rates of a wild hybridized cutthroat trout population.

Population estimates of the trout fishery in Big Spring Creek were performed on the Burleigh, Machler, Carroll Trail, and Hruska sections. Estimates of total trout ≥ 250 mm are trending downwards throughout the long-term monitoring sections. The species composition of the fishery in Big Spring Creek continues to change, with brown trout and mountain whitefish *Prosopiom williamsoni* increasing while rainbow trout decline.

In the Armells Creek drainage, a healthy prairie fish assemblage was present in both East Fork Armells and Armells Creek, with minnow and sucker species present.

In the Arrow Creek drainage, the westslope cutthroat trout population of Cottonwood Creek and Boyd Creek was monitored to evaluate the status of the fishery and presence of non-native salmonids.

In the Judith River drainage, the main stem Judith was sampled in an effort to develop trend data for future fisheries management. A total of 14 species were sampled, of which 10 were native species. An initial documentation of a small westslope cutthroat trout population occurred in Alpine Gulch. Genetics were collected. Additionally, westslope cutthroat trout genetics were collected from populations in East Fork Big Spring Creek, East Fork Cottonwood Creek, and South Fork Judith River. The Lost Fork and Middle Fork Judith River were sampled to document the status of the fisheries, with some severe habitat degradation observed. Routine fisheries monitoring occurred in Marcott Creek, North Fork Warm Spring Creek, Plum Creek, Yogo Creek, and Elk Creek. Warm Spring Creek was sampled and a radio telemetry study of rainbow trout and sauger was initiated.

In the Musselshell River drainage, the westslope cutthroat trout population in Collar Gulch was sampled for genetic collection. Fords Creek was evaluated to determine the status of brook trout in the creek and it's potential to connect upstream to Chicago Gulch. Whiskey Gulch was evaluated as a potential site to replicate the Alpine Gulch westslope cutthroat trout population.

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## OBJECTIVES

The purpose of this project is to implement the fisheries program in the Lewistown management area in Central Montana. Major watersheds include the Arrow, Judith, and Musselshell. The mission of the Fisheries Bureau of Montana Fish, Wildlife and Parks (FWP) is to preserve and enhance aquatic species and their ecosystems to meet public demand for recreational opportunities while assuring stewardship of aquatic life. The fisheries program is described in detail in Tews and Horn (2008).

## STUDY AREA AND PROCEDURES

The study area is in central Montana on the eastern edge of Region 4 (Figure 1). It does not include the Missouri River on its northern boundary. The southern boundary is the Petroleum, Fergus, and Judith Basin County lines, including the headwaters of the Musselshell River in Meagher County. The eastern boundary is the Musselshell River. The western boundary is the headwaters of the Musselshell, Judith and Arrow Creek drainages. It includes all of Fergus and Petroleum counties and parts of Meagher, Judith Basin and Chouteau counties.

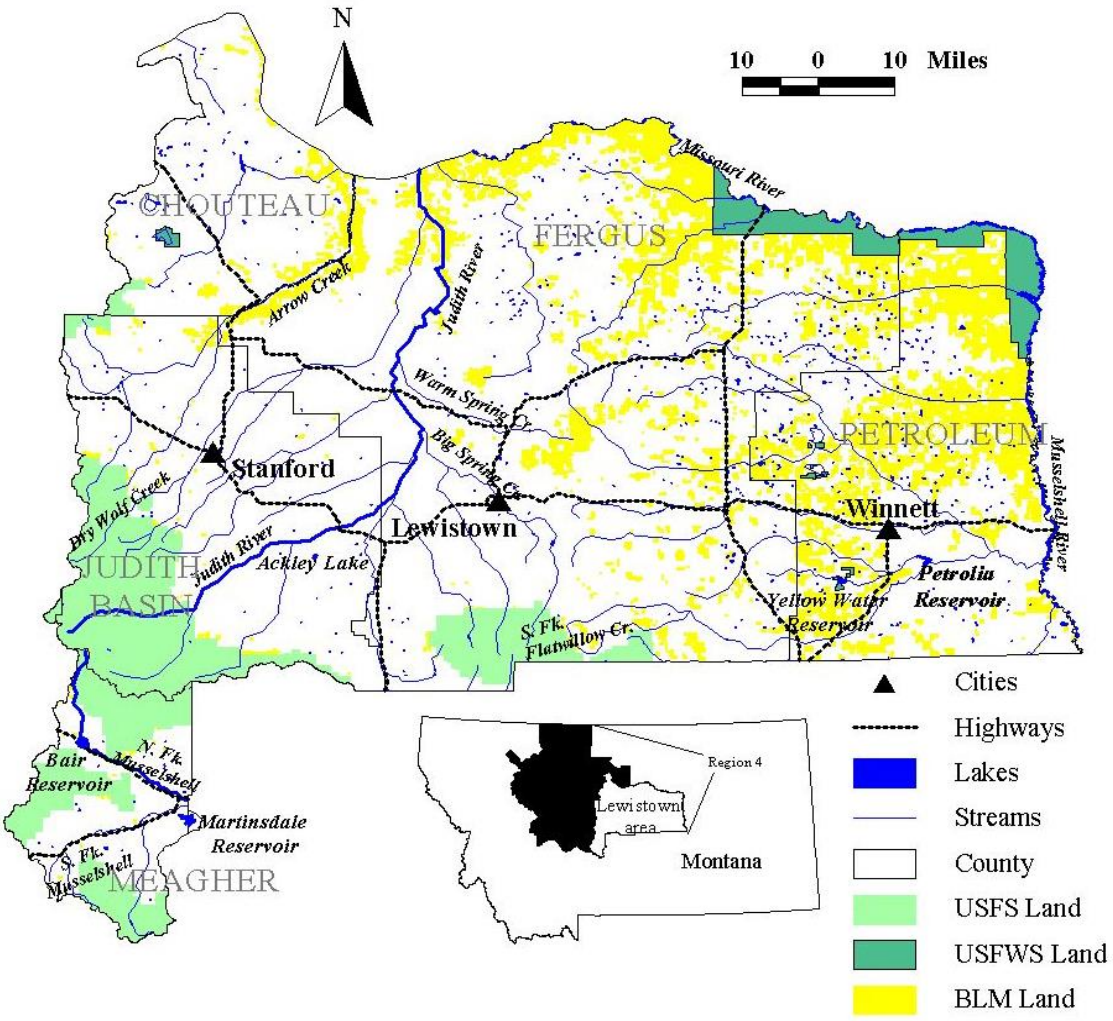


Figure 1. Map of Lewistown fisheries management area.

In still water, fish populations were sampled using 125 x 6-foot experimental multifilament nylon gill nets with 25-foot sections of 0.75, 1.0, 1.25, 1.5 and 2.0-inch square mesh, 2 x 3-foot frame fyke nets (0.25-inch mesh), and 4 x 6-foot frame fyke nets (1.0-inch square mesh). Gill nets were fished either sinking or floating. A 30 x 6-foot bag seine of 0.75-inch bar mesh was used to sample juvenile and forage fish is still water.

Trout populations on Big Spring Creek were surveyed using a drift boat equipped with a mobile anode or a plastic tote barge equipped with a mobile anode and a Smith-Root VVP15 (or similar) to rectify AC to DC. Power was obtained from a 5,000-watt generator. Fish populations in small streams were sampled with a Smith-Root Model 12-B battery powered backpack electrofishing unit or 3-foot diameter baited hoop nets with 0.5-inch or 1.0-inch mesh. Fish total length was measured to the nearest 1 millimeter and weighed to the nearest 1 gram. All game fish were measured. The first 50 fish of other species were measured from each net or sampling event. Big Spring Creek mark-recapture estimates from 2012-2015 were analyzed with the FIS program (MFWP 2011). Mark-recapture estimates from 2004 – 2011 were analyzed with the FA+ program (MFWP 2004). Older estimates utilized the MR-4 program (MFWP 1994) or the FA+ program. Most estimates were completed using partial log-likelihood statistics. Modified Peterson estimates were used when data sets did not fit the partial log-likelihood model. Anal or dorsal spines from yellow perch *Perca flavescens*, walleye *Sander vitreus*, largemouth bass *Micropterus salmoides*, black bullhead *Ameiurus melas*, crappie *Pomoxis sp.* and bluegill *Lepomis macrochirus* were collected. Spines were cross-sectioned with an Isomet Low Speed Saw and prepared as described in Tews (2006). The samples were air dried and read under a dissecting microscope against a black background using reflected light. Year classes were based on size structure and age-structure analysis. Equations from Anderson and Neuman (1996) and Bister et al. (2000) were used to calculate relative weight ($W_r$).

Reservoir water levels are from Montana Department of Natural Resources and Conservation (DNRC) reservoir contents reports at http://www.dnrc.mt.gov/wrd/water_op/water_measurement_prog/default.asp (DNRC 2013).

Discharge on Big Spring Creek was measured at three gaging locations. Stage height at the Ash Street Bridge was measured with a Stevens Recorder. Stage height at the Hatchery and Mill Ditch locations were measured electronically with a Trutrack data logger encased in a pipe. Flow was measured at different discharges with a Marsh McBirney Flowmate model 2000 to develop or confirm rating curves. Water temperatures on area waters were monitored using Onset temperature loggers.

## RESULTS AND DISCUSSION

### Large Reservoirs

October water levels of most area DNRC reservoirs were above the long-term average in both 2015 and 2016 (Figure 2). Ackley Lake was at 117% and 100% of the long-term average in 2015 and 2016, respectively. The October storage in Bair was at 188% and 95% of the long-term average. Martinsdale was 165% of the long-term average in 2015, but experienced significant drawdowns in 2016 and was at only 61% of the long-term October storage average. Yellow Water Reservoir continues to hold more water than has been typical, with 236% and 307% of long-term storage present in October 2015 and 2016.

Spring snowpack in the Judith and Musselshell basins has been slightly below average the past 2 years, as indicated by March snow-water equivalents (Figure 3). The total annual accumulated precipitation has been close to average for both the Judith and Musselshell drainages in both 2015 and 2016 (Figure 4).

A summary of the 2015 and 2016 large reservoir sampling can be found in Table 1 and Table 2, respectively.

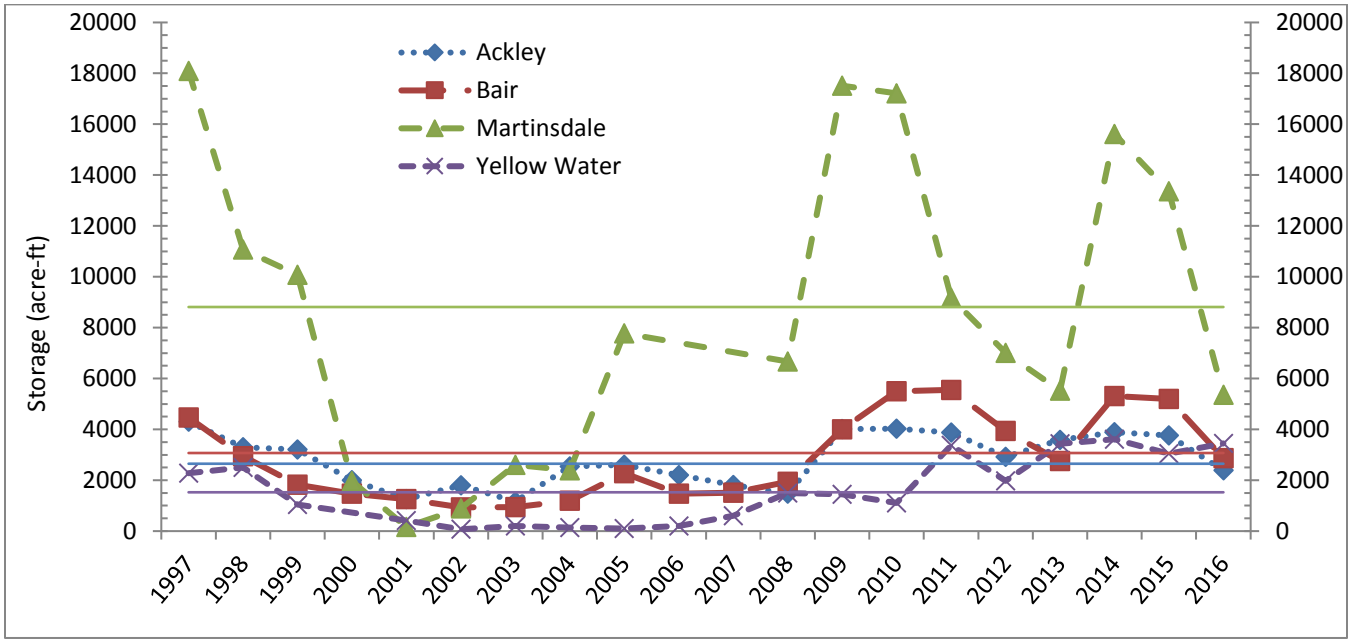


Figure 2. October water storage of Lewistown area DNRC reservoirs in acre-feet. Solid lines represent long-term average storage.

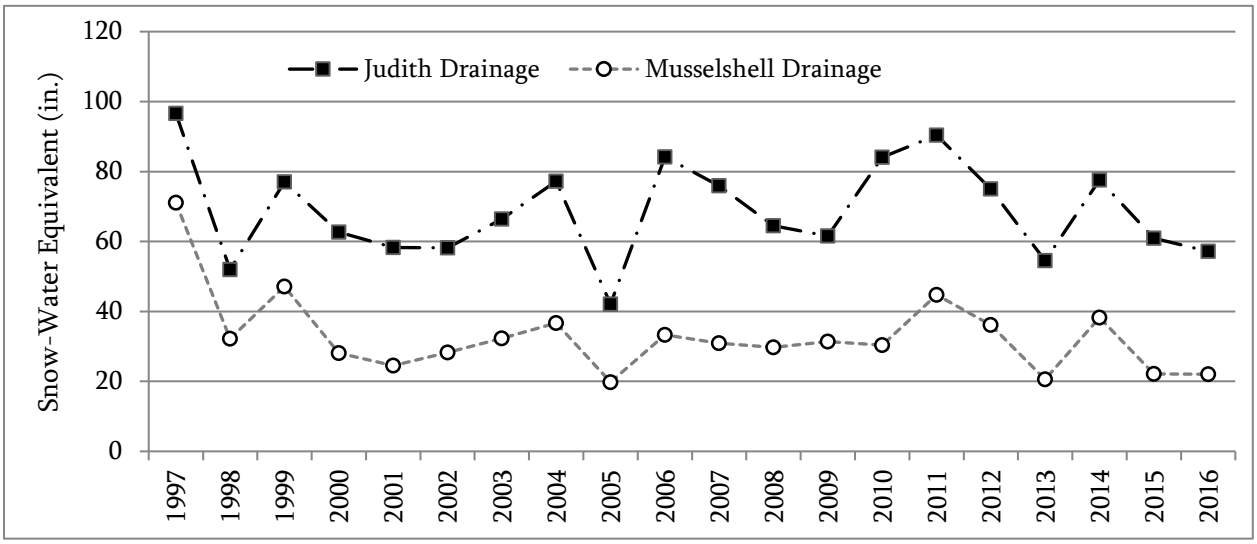


Figure 3. March snow-water equivalents in the Judith and Musselshell drainage taken from NRCS SNOTEL sites. Data available at National Resource and Conservation Service (NRCS).

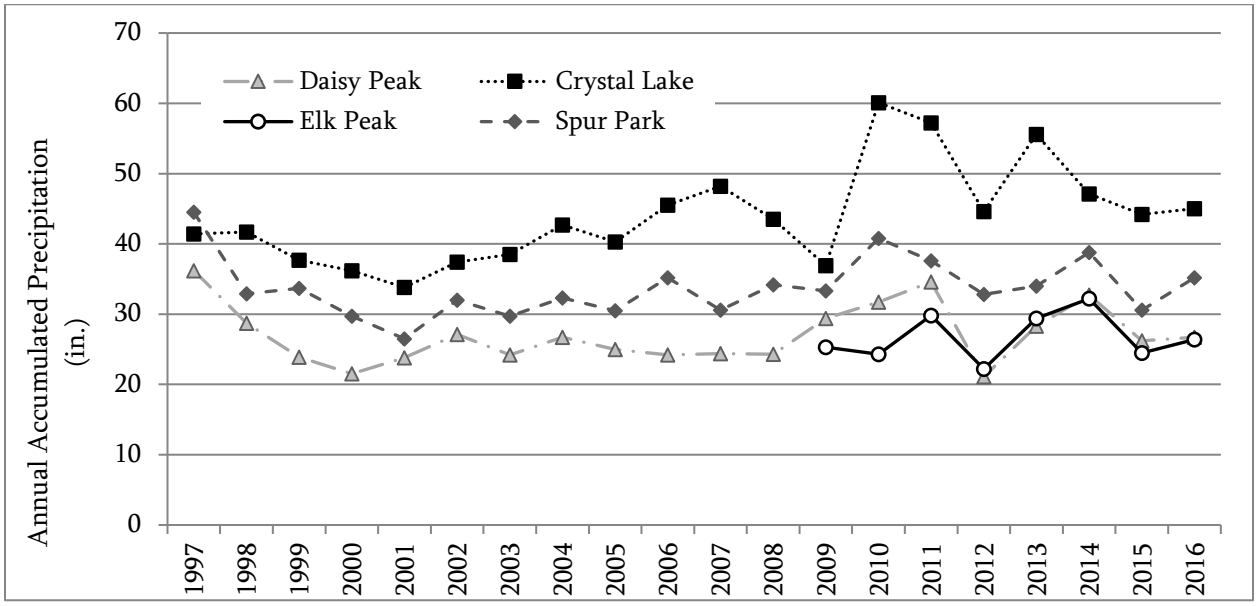


Figure 4. Annual accumulated (October 1 – September 30) precipitation at four NRCS monitoring locations. Daisy Peak and Spur Park are located in the Little Belt Mountains at the heads of the Judith and Musselshell basins. Elk Peak is located in the Castle Mountains in the Musselshell basin. Crystal Lake is located in the Big Snowy Mountains in the Judith drainage. Data available at National Resource and Conservation Service (NRCS).

Table 1. Summary of 2015 fisheries sampling on seven large reservoirs in the Lewistown management area.

| Location (Date) Nets | Species (Stocking Year) | N | Length (millimeters) Min | Max | Mean | Weight (grams) Mean | Wr |
|---|---|---|---|---|---|---|---|
| Ackley | Brown trout | 3 | 184 | 196 | 191 | 65 | 84.3 |
| 9/28/2015 | Longnose sucker | 1 | - | - | 173 | 56 | - |
| 1 Sinker | Tiger muskie | 1 | - | - | 437 | 568 | 117.2 |
| 1 Floater | Rainbow trout | 25 | 161 | 426 | 286 | 275 | 90.7 |
| | 2015 | 14 | 161 | 260 | 209 | 103 | 100.2 |
| | 2014+ | 11 | 313 | 426 | 383 | 493 | 78.5 |
| | White sucker | 69 | 156 | 486 | 379 | 726 | 99.5 |
| 9/28/2015 | Brown trout | 1 | - | - | 480 | 1136 | 96.8 |
| 2 Large Fyke | Rainbow trout | 2 | 218 | 392 | 305 | 267 | 71.8 |
| | White sucker | 4 | - | - | - | - | - |
| Bair | Brook trout | 1 | - | - | 240 | 128 | 89 |
| 9/23/2015 | Rainbow trout | 41 | 198 | 392 | 312 | 299 | 85 |
| 1 Sinker | 2015 | 13 | 198 | 263 | 232 | 126 | 92.6 |
| 1 Floater | 2014+ | 28 | 304 | 392 | 349 | 380 | 81.5 |
| | White sucker | 113 | 194 | 436 | 330 | 400 | 85.3 |
| | Westslope cutthroat | 2 | 321 | 368 | 345 | 394 | 82.4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9/23/2015 | Brook trout | 1 | - | - | 216 | 100 | 95.8 |
| 2 Large Fyke | Rainbow trout | 17 | 212 | 390 | 350 | 361 | 75.4 |
| | White sucker | 227 | - | - | - | - | - |
| East Fork | Brown trout | 2 | - | - | 257 | 158 | 85.6 |
| 4/7/2015 | Longnose sucker | 1 | - | - | 511 | 1399 | - |
| 5 Large Fyke | Northern pike | 32 | 468 | 785 | 606 | 1618 | 101 |
| | Rainbow trout | 6 | 386 | 455 | 418 | 788 | 97.1 |
| | White sucker | 81 | 301 | 498 | 425 | 1074 | 108.4 |
| | Yellow perch | 319 | 165 | 297 | 229 | 157 | 88.9 |
| 9/14/2015 | Brown trout | 2 | 479 | 575 | 527 | 1853 | 118.1 |
| 2 Sinker | Northern pike | 17 | 400 | 771 | 590 | 1579 | 101.2 |
| 2 Floater | White sucker | 25 | 341 | 480 | 428 | 981 | 100.3 |
| | Yellow perch | 54 | 147 | 318 | 201 | 129 | 91.8 |
| Martinsdale | Rainbow trout | 71 | 346 | 513 | 452 | 938 | 92.6 |
| 4/13/2015 | White sucker | 1016 | - | - | - | - | - |
| 3 Large Fyke | | | | | | | |
| 9/23/2015 | Brown trout | 2 | 452 | 524 | 488 | 1303 | 102.8 |
| 1 Sinker | Longnose sucker | 3 | 209 | 419 | 331 | 448 | - |
| 1 Floater | Rainbow trout | 32 | 210 | 492 | 346 | 525 | 100.5 |
| | White sucker | 78 | 161 | 442 | 364 | 627 | 92.4 |
| Petrolia | Carp | 39 | 328 | 675 | 483 | 1336 | 96.7 |
| 3/30/2015 | Norther pike | 7 | 625 | 985 | 809 | 1919 | 92.8 |
| 5 Large Fyke | White sucker | 1 | - | - | 368 | 632 | 102.8 |
| | Walleye | 69 | 212 | 714 | 435 | 753 | 79 |
| | Yellow perch | 82 | 154 | 302 | 227 | 168 | 92.4 |
| 9/21/2015 | Bluegill | 3 | 93 | 162 | 119 | 50 | 127.6 |
| 2 Sinker | Carp | 6 | 380 | 517 | 460 | 1333 | 92.5 |
| 2 Floater | Northern pike | 2 | 711 | 779 | 745 | 2626 | 92.7 |
| | White sucker | 5 | 270 | 385 | 337 | 439 | 87.1 |
| | Walleye | 14 | 203 | 588 | 318 | 415 | 79.6 |
| | Yellow perch | 59 | 147 | 295 | 235 | 176 | 88.3 |
| Yellow Water | Carp | 32 | 120 | 517 | 255 | 413 | 93.3 |
| 4/21/2015 | White sucker | 85 | 222 | 392 | 297 | 369 | 95.6 |
| 3 Large Fyke | Yellow perch | 3 | 280 | 291 | 284 | 314 | 90.3 |
| 9/21/2015 | Carp | 5 | 455 | 590 | 514 | - | - |
| 2 Large Fyke | White sucker | 51 | 282 | 414 | 328 | - | - |

Table 2. Summary of 2016 fisheries sampling on seven large reservoirs in the Lewistown management area.

| Location (Date) Nets | Species (Stocking Year) | N | Length (millimeters) Min | Max | Mean | Weight (grams) Mean | Wr |
|---|---|---|---|---|---|---|---|
| Ackley | Brown trout | 3 | 452 | 683 | 561 | 2491 | 117.9 |
| 9/27/2016 | Longnose sucker | 3 | 392 | 442 | 416 | 845 | - |
| 1 Sinker | Tiger muskie | 4 | 644 | 666 | 655 | 1915 | 102.1 |
| 1 Floater | Rainbow trout | 30 | 164 | 447 | 357 | 421 | 82.6 |
| | 2016 | 1 | 164 | - | - | 44 | 93.1 |
| | 2015+ | 29 | 325 | 447 | 364 | 434 | 82.3 |
| | White sucker | 53 | 373 | 498 | 425 | 958 | 100.3 |
| 4/18/2016 | Rainbow trout | 74 | 321 | 461 | 396 | 578 | 84.9 |
| 2 Large Fyke | Unspecified Sucker | 344 | - | - | - | - | - |
| | White sucker | 17 | - | - | - | - | - |
| Bair | Brook trout | 4 | 273 | 313 | 292 | - | - |
| 9/26/2016 | Rainbow trout | 80 | 207 | 400 | 334 | - | - |
| 1 Sinker | White sucker | 160 | 205 | 430 | 330 | - | - |
| 1 Floater | Westslope cutthroat | 1 | - | - | 394 | - | - |
| 4/11/2016 | Rainbow trout | 26 | 200 | 405 | 349 | 385 | 80.8 |
| 2 Large Fyke | White sucker | 268 | - | - | - | - | - |
| East Fork | Northern pike | 16 | 499 | 800 | 642 | 1899 | 101.3 |
| 10/12/2016 | Rainbow trout | 2 | 499 | 563 | 531 | 2067 | 123.4 |
| 2 Sinker | White sucker | 7 | 346 | 476 | 415 | 895 | 98.7 |
| 2 Floater | Yellow perch | 11 | 163 | 282 | 230 | 165 | 86.2 |
| Martinsdale | Brown trout | 12 | 422 | 562 | 495 | - | - |
| 9/26/2016 | Longnose sucker | 8 | - | - | - | - | - |
| 1 Sinker | Rainbow trout | 9 | 435 | 451 | 443 | - | - |
| 1 Floater | White sucker | 88 | - | - | - | - | - |
| 4/11/2016 | Brown trout | 4 | 422 | 562 | 495 | 1197 | 88.9 |
| 2 Large Fyke | Longnose sucker | 15 | - | - | - | - | - |
| | Rainbow trout | 3 | 435 | 451 | 443 | 914 | 95.7 |
| | White sucker | 191 | - | - | - | - | - |
| Petrolia | Bluegill | 3 | 100 | 120 | 108 | 24 | 99.4 |
| 9/29/2016 | Carp | 7 | 392 | 612 | 467 | 1525 | 93.7 |
| 2 Sinker | Northern pike | 3 | 742 | 895 | 841 | 3800 | 90.9 |
| 2 Floater | Shorthead Redhorse | 2 | 182 | 341 | 262 | 260 | - |
| | White sucker | 17 | 315 | 392 | 364 | 516 | 86 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Walleye | 16 | 220 | 661 | 324 | 415 | 79.1 |
| | Yellow perch | 40 | 152 | 287 | 222 | 159 | 89 |
| 3/22/2016 | Bluegill | 1 | - | - | 163 | 115 | 125.6 |
| 5 Large Fyke | Carp | 53 | 395 | 683 | 514 | 1850 | 92.9 |
| | Northern pike | 4 | 684 | 974 | 806 | 3575 | 90.6 |
| | White sucker | 1 | - | - | 503 | 1764 | 114.5 |
| | Walleye | 37 | 236 | 525 | 327 | 287 | 74 |
| | Yellow perch | 61 | 159 | 303 | 223 | 167 | 93.3 |
| Yellow Water | Carp | 3 | - | - | - | - | - |
| 10/17/2016 | White sucker | 12 | - | - | - | - | - |
| 2 Large Fyke | | | | | | | |

Ackley Lake

The fishery in Ackley Lake continues to be dominated by white suckers *Catostomus commersoni* to the detriment of the rainbow trout *Oncorhynchus mykiss* population. Catch rates of white suckers appear to be in decline, with 2016 being the lowest catch rate since 2010 (Figure 5). Average size of white suckers has increased in recent years, with a 12% increase from 2015 to 2016, resulting in the highest white sucker average length in Ackley on record (Figure 6). The rainbow trout catch-per-unit-effort (CPUE) continues to be below average, however, we did note an increase in CPUE from 2015 to 2016. Rainbow trout average length has been increasing since the low in 2014, with the 2015 and 2016 average lengths being 287 mm and 357 mm, respectively. Average relative weight (Wr) of rainbow trout shows a lot of inter-annual variation, with the above average Wr of 2015 (90.4) followed by a low Wr in 2016 (82.7; Figure 7). The difference in both average length and relative weight between 2015 and 2016 are likely heavily influenced by the introduction of tiger muskie *Esox lucius* x *Esox masquinongy*. Tiger muskie were stocked as fry (32 mm average) and fingerlings (150 mm average) in April and June of 2015. These fish were stocked to improve the trout fishery in Ackley by acting as a biological control of the white suckers, thereby reducing forage competition between the suckers and trout. A single tiger muskie was sampled in September 2015, measuring 437 mm, exhibiting substantial growth over a few short months. In September 2016, we sampled 4 tiger muskie which averaged 655 mm. Specific criteria have been set forth to evaluate the impacts of the tiger muskie introduction on fishery in Ackley. Early signs are that the tiger muskie are efficiently foraging on small white suckers, which most likely explains the reduced CPUE and increased average length. It also appears as though tiger muskie are foraging on small rainbow trout, which explains the increase in average length and the very low number of rainbows sampled smaller than 250 mm. Only 1 rainbow less than 250 mm was sampled in 2016, well below the long-term average of 20.4. We will continue to monitor the fishery and may have to adjust the stocking program to account for trout foraged by tiger muskie. Fyke nets were also deployed in Ackley, the summary data can be found in Table 1 & 2.

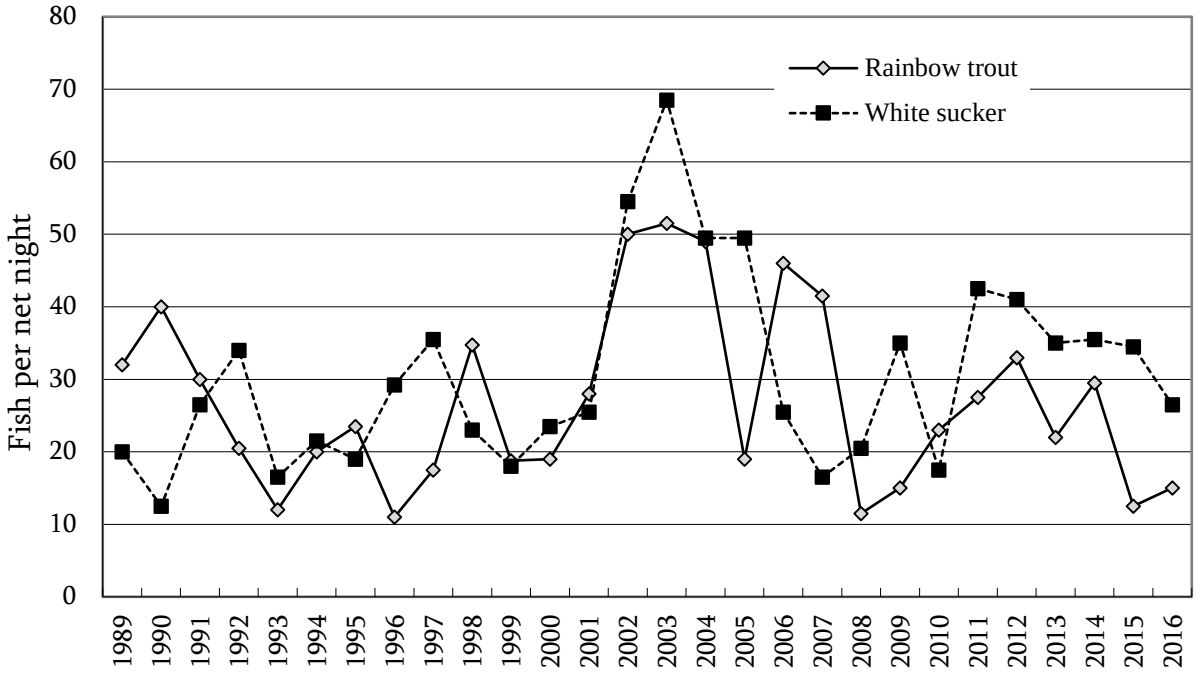


Figure 5. Fall gillnetting catch per unit effort (fish per net night) of rainbow trout and white sucker in Ackley Lake from 1989 to 2016.

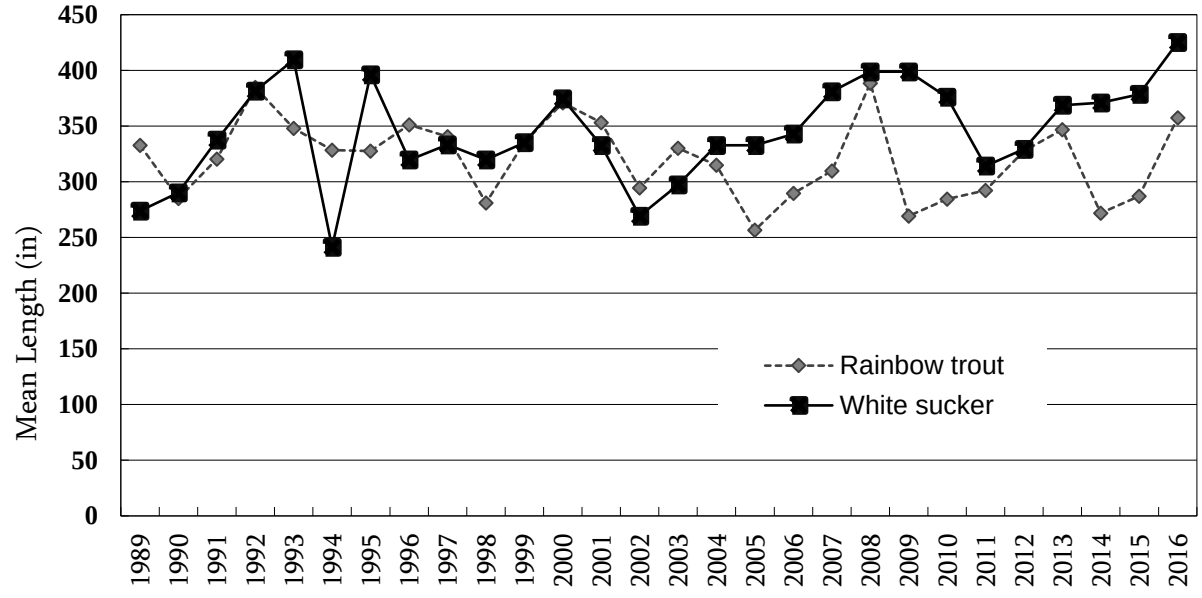


Figure 6. Mean length (millimeters) of rainbow trout and white sucker in Ackley Lake sampled during fall gillnetting from 1989 to 2016.

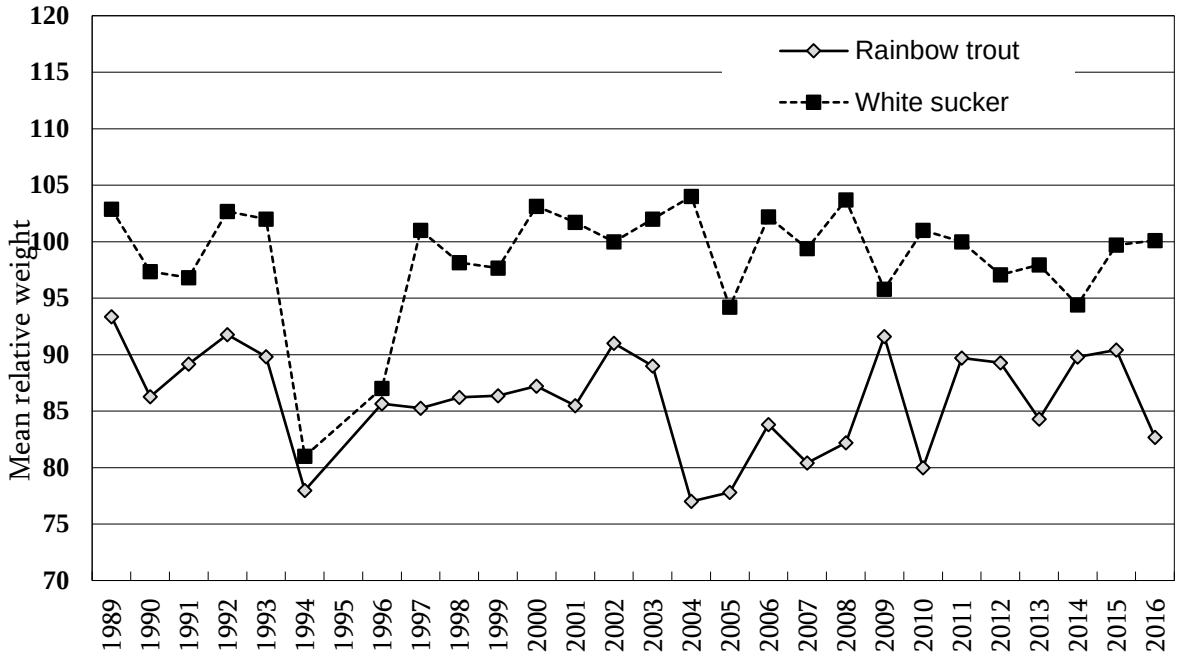


Figure 7. Mean relative weight (Wr) of rainbow trout and white sucker in Ackley Lake captured during fall gillnetting from 1989 to 2015.

Bair Reservoir

Fall gill net catch rates of rainbow trout dropped slightly in 2015, but then rebounded to well above average in 2016 (Figure 8). White sucker catch rates were up from 2014, rising to near the long-term average in 2015 and to well above average in 2016. Rainbow trout length continues to be above the long-term average, with fish averaging 312 mm in 2015 and 335 mm in 2016, which is the highest on record (Figure 9). The relative weight of rainbow trout and white suckers continues to be poor, although Wr for both species were above the long-term average in 2015 (Figure 10). Examining the long-term trends of Wr in both rainbow trout and white sucker suggest that the reservoir is forage limited, likely due to interspecific competition. Efforts to improve the condition of the trout in Bair may potentially require sucker suppression efforts in addition to reducing trout stocking rates. Large fyke nets were also deployed in Bair. A summary of the data can be found in Table 1 and 2.

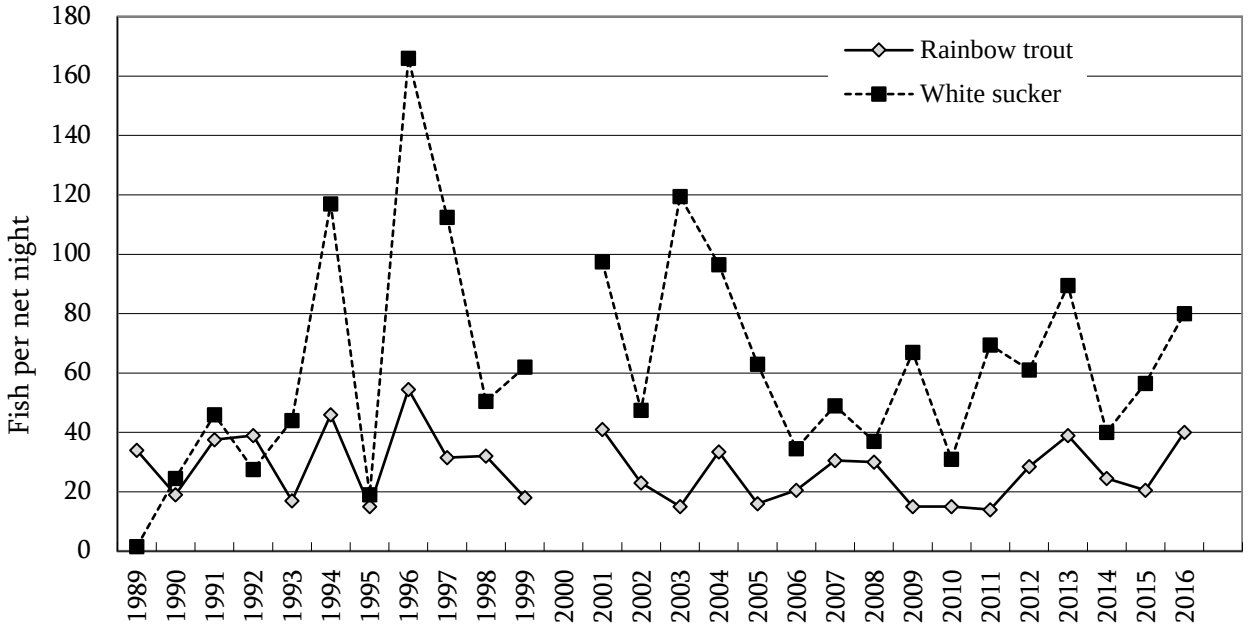


Figure 8. Fall gillnetting catch per unit effort (fish per net night) of rainbow trout and white sucker in Bair Reservoir from 1989 to 2016.

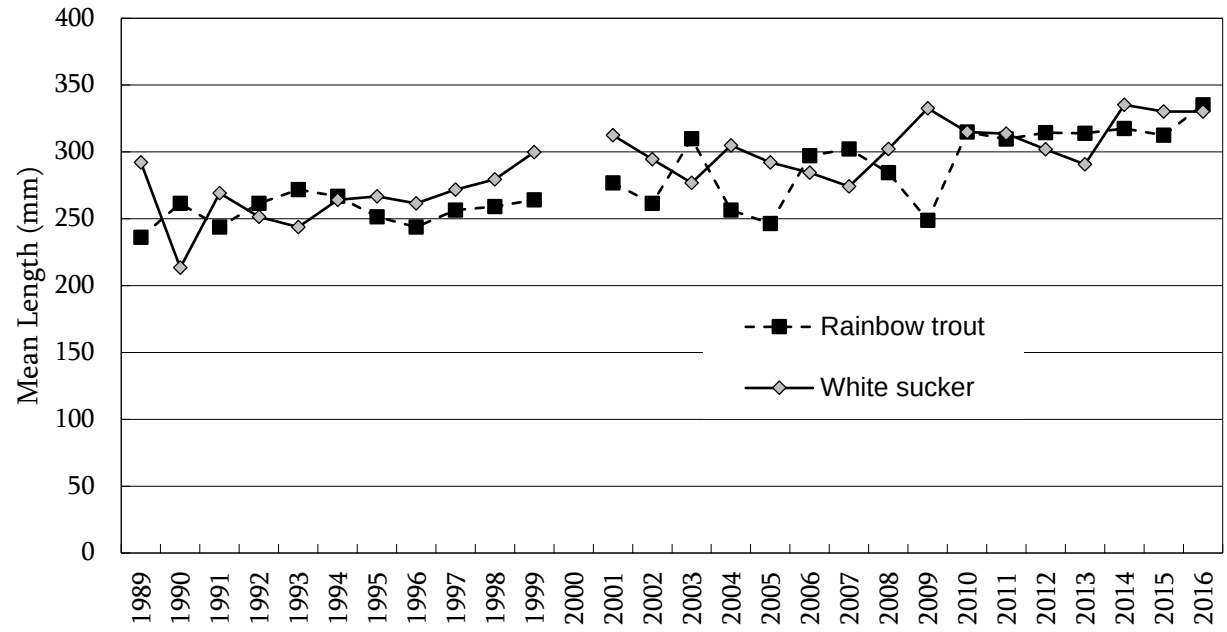


Figure 9. Mean length (millimeters) of rainbow trout and white sucker in Bair Reservoir sampled during fall gill netting from 1989 to 2016.

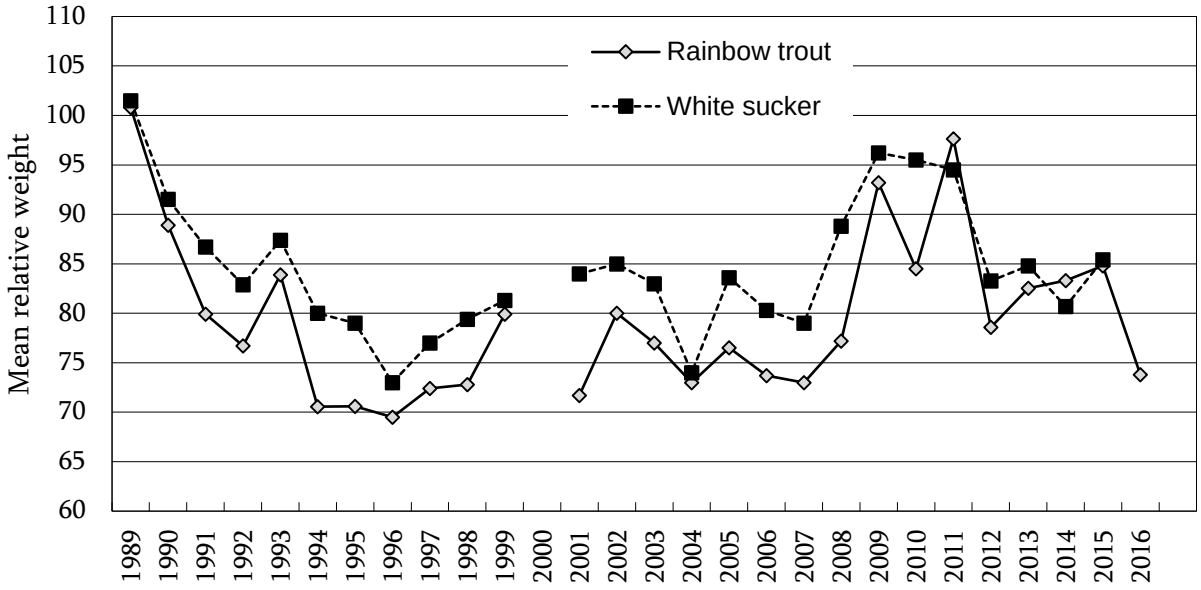


Figure 10. Mean relative weight (Wr) of rainbow trout and white sucker in Bair Reservoir captured during fall gill netting from 1989 to 2016.

East Fork Reservoir

Spring trap netting of East Fork Reservoir provides highly variable CPUE data due to spawning behavior, but it does provide valuable growth and aging data. Northern pike and yellow perch mean lengths were above average. Age-frequency data from the spring netting indicates a shift following the large spill event of 2011 (Figure 11). The data indicates a shift towards a high frequency of older individuals, likely indicating poor recruitment caused by the significant reservoir fluctuations that have occurred during the perch spawn in 2011, 2013, and 2014.

Fall gill netting in East Fork Reservoir found increased CPUE of northern pike *Esox lucius* and yellow perch *Perca flavescens* in 2015, with catch rates of northern pike being the second highest on record (Figure 12). In 2016, the CPUE of northern pike was similar to 2015, however, our catch rates of yellow perch declined to 2.8 fish per net-night, which is well below the long-term median value of 16. The yellow perch in East Fork have historically suffered from poor growth rates, primarily due to intraspecific competition. The population reductions induced by both the spill event in 2011 and the drawdown event in 2012 have resulted in improved size structure among the population, as indicated by PSD, in addition to an increase in preferred length perch within the population, as measured by RSDp (Figure 13). It is believed this will likely be a short-term benefit to the perch fishery and the size structure of the yellow perch population would benefit over the long-term from reduced intraspecific competition via increasing angler harvest or introducing a predator control.

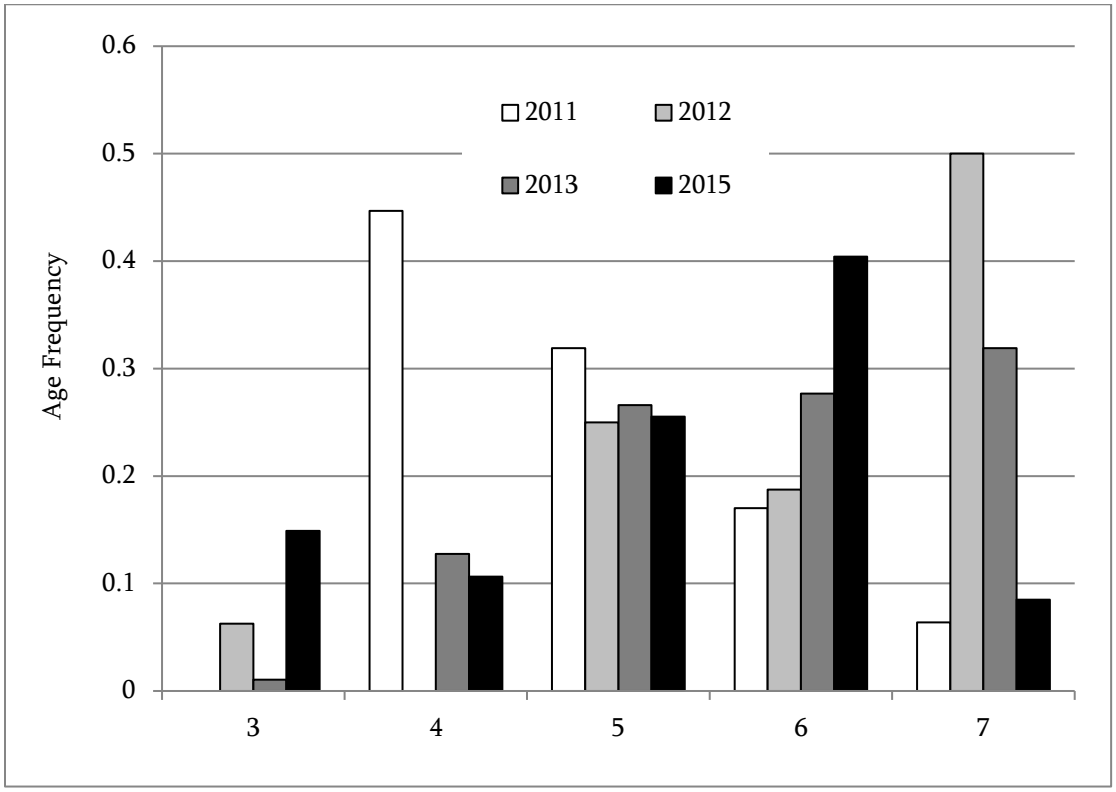


Figure 11. Age-frequency of yellow perch captured during spring fyke netting of East Fork Reservoir from 2011 to 2015.

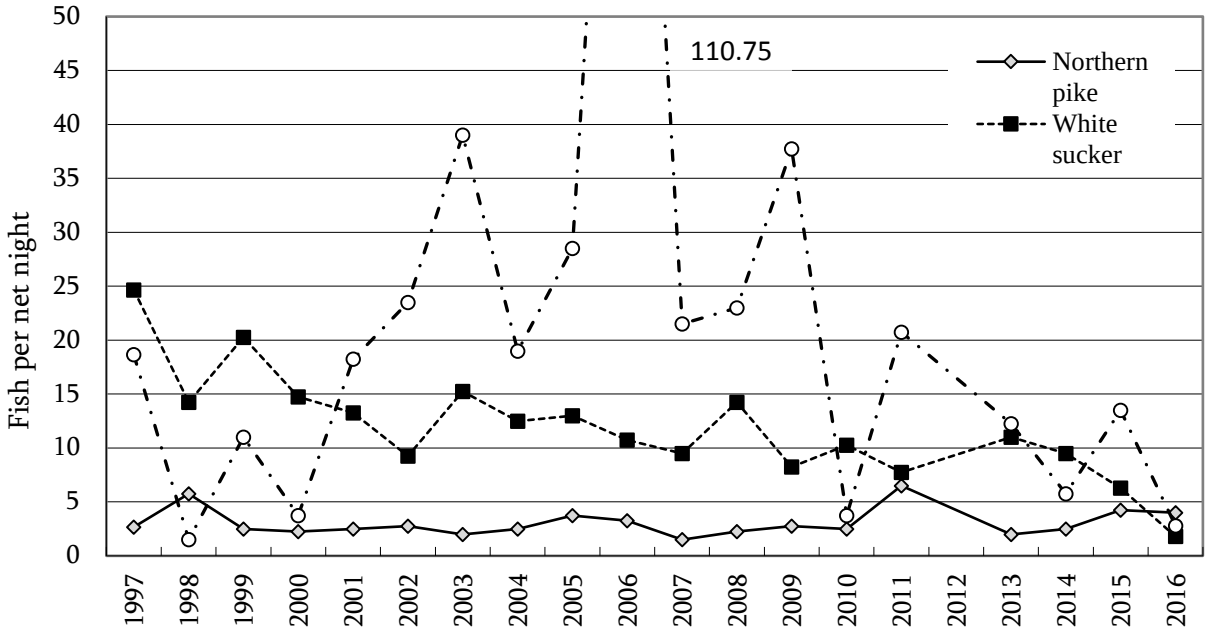


Figure 12. Fall gillnetting catch per unit effort (fish per net night) of common species in East Fork Reservoir from 1997 to 2016.

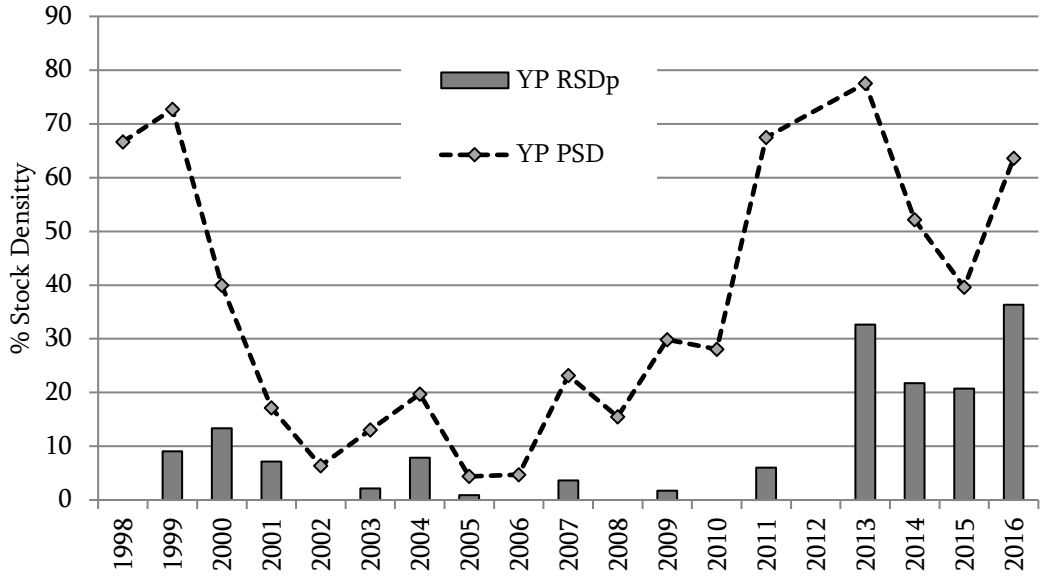


Figure 13. Proportional stock density (PSD) and relative stock density - preferred (RSDp) of yellow perch in East Fork Reservoir from 1998 to 2016.

Martinsdale Reservoir

Rainbow trout CPUE was near the long-term average and slightly above the long-term median value in 2015, but in 2016 dropped to the lowest since 2005 (Figure 14). The 2016 sampling event was impacted by very windy weather, which likely reduced capture effectiveness of the gill nets. Sampled rainbow trout have been above the long-term average in length the past 2 years and were in good condition with an average relative weight of 100.4 in 2015 (no value available for 2016 due to equipment failure of the scale). Catch rates of white suckers were up slightly from 2014 (Figure 14), however the CPUE remains below the long-term average and median. White suckers continue to compose the bulk of the fishery present in Martinsdale. Preliminary plans to introduce a top-level predator in 2015 were temporarily curtailed due to public comment during an EA process. Most public indicated catch rates and trout size were satisfactory despite the imbalance in sucker and rainbow trout proportions as measured by FWP net catches.

In an effort to more thoroughly evaluate the trout fishery in order to better direct future management decisions, we placed large fyke nets in Martinsdale in April. In 2015, the spring trap netting was effective at sampling rainbow trout, with a CPUE of 23.7 rainbows per net-night. The average length of fish sampled was 452 mm. CPUE of suckers in the spring fyke nets was 338.7 per net-night. We again sampled in 2016, with a rainbow trout CPUE of 0.5 fish per net-night and a white sucker CPUE of 31.8 fish per net-night. The initial effort of spring fyke nettings was effective and sampling more trout than the fall gill netting, however the sampling also indicated that sucker numbers in the reservoir are very high. We'll continue to utilize trap netting to further monitor the fishery.

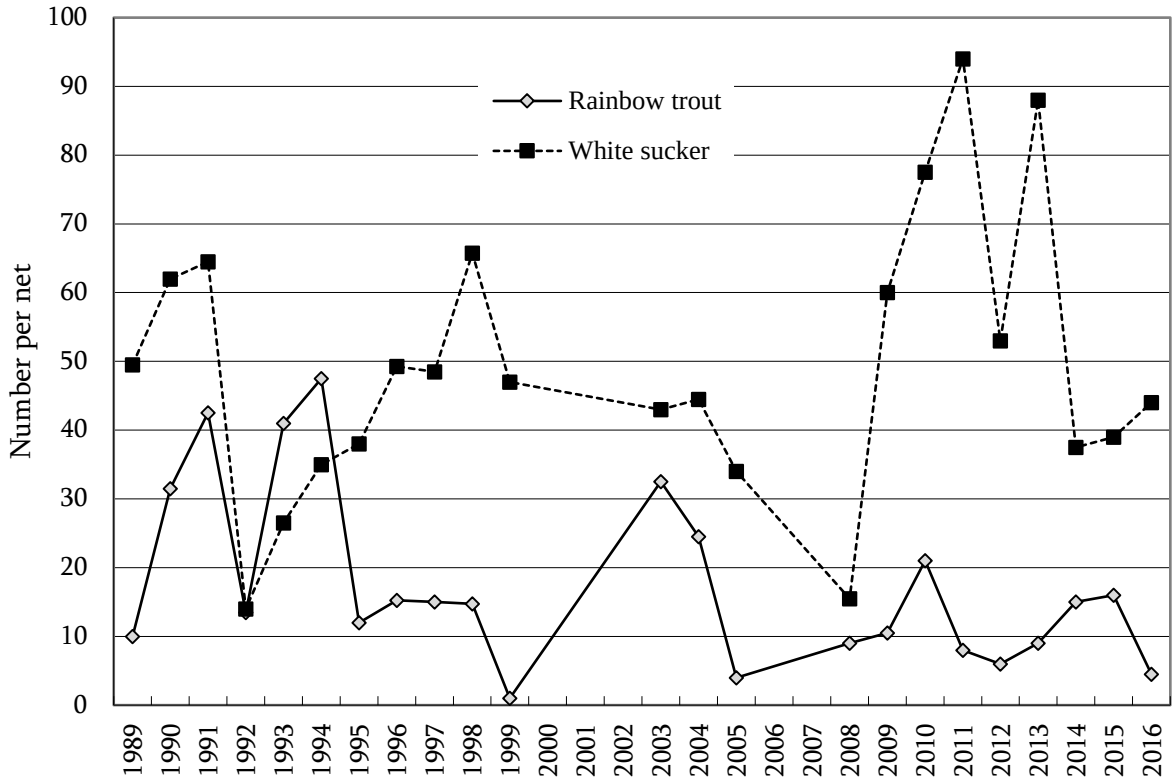


Figure 14. Fall gillnetting catch per unit effort (fish per net night) of rainbow trout and white sucker in Martinsdale Reservoir from 1989 to 2016.

Petrolia Reservoir

Petrolia Reservoir experienced a period of increased productivity following the high-water of 2011; however, it appears the benefits to the walleye *Sander vitreus* fishery are leveling off as indicated by catch rates (Figure 15) and average length (Figure 16). Yellow perch CPUE and average length remain above the long-term average, however, a recent illegal introduction of bluegill *Lepomis macrochirus*, which appear to be establishing, may have impacts on the perch fishery. Walleye escapement is believed to be an issue when the reservoir spills and we have initiated a oxytetracycline mark on walleye stocked into Petrolia so that we can identify them when performing downstream sampling. Northern pike continue to be sampled in low numbers, with an average length of 747 mm and 841 mm in 2015 and 2016, respectively. Additional species sampled during fall gillnetting included carp *Cyprinus carpio*, shorthead redhorse *Moxostoma macrolepidotum*, and white sucker.

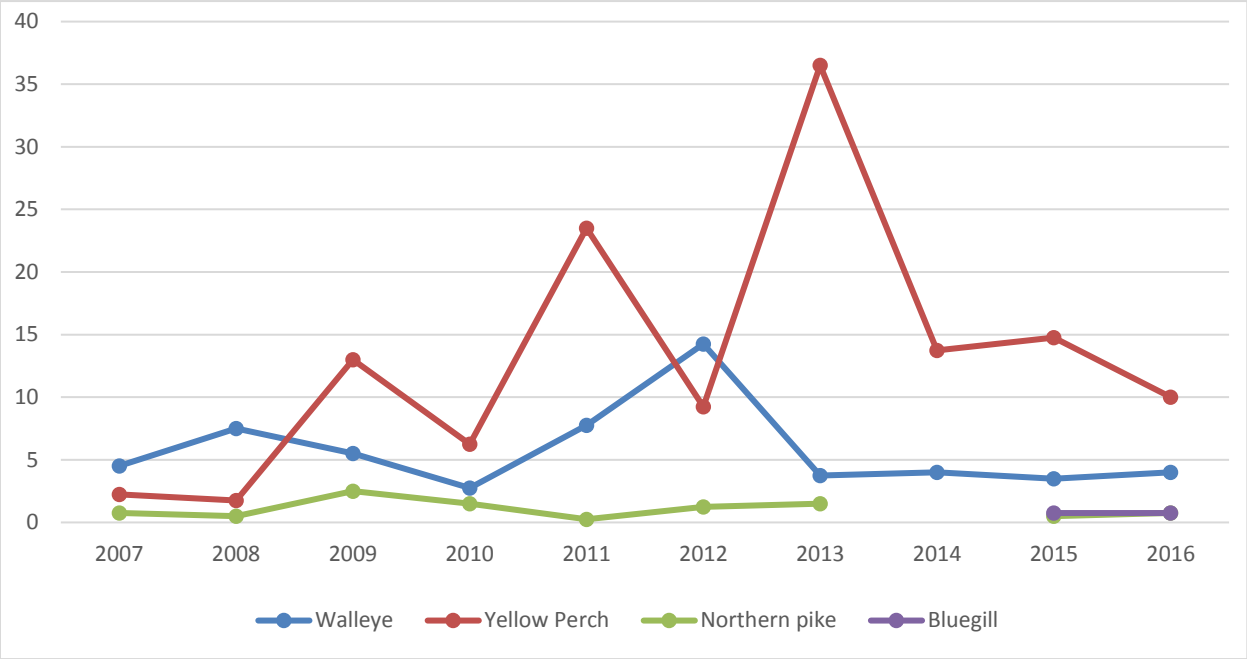


Figure 15. Fall gillnetting catch per unit effort (fish per net night) of common species in Petrolia Reservoir from 2007 to 2016.

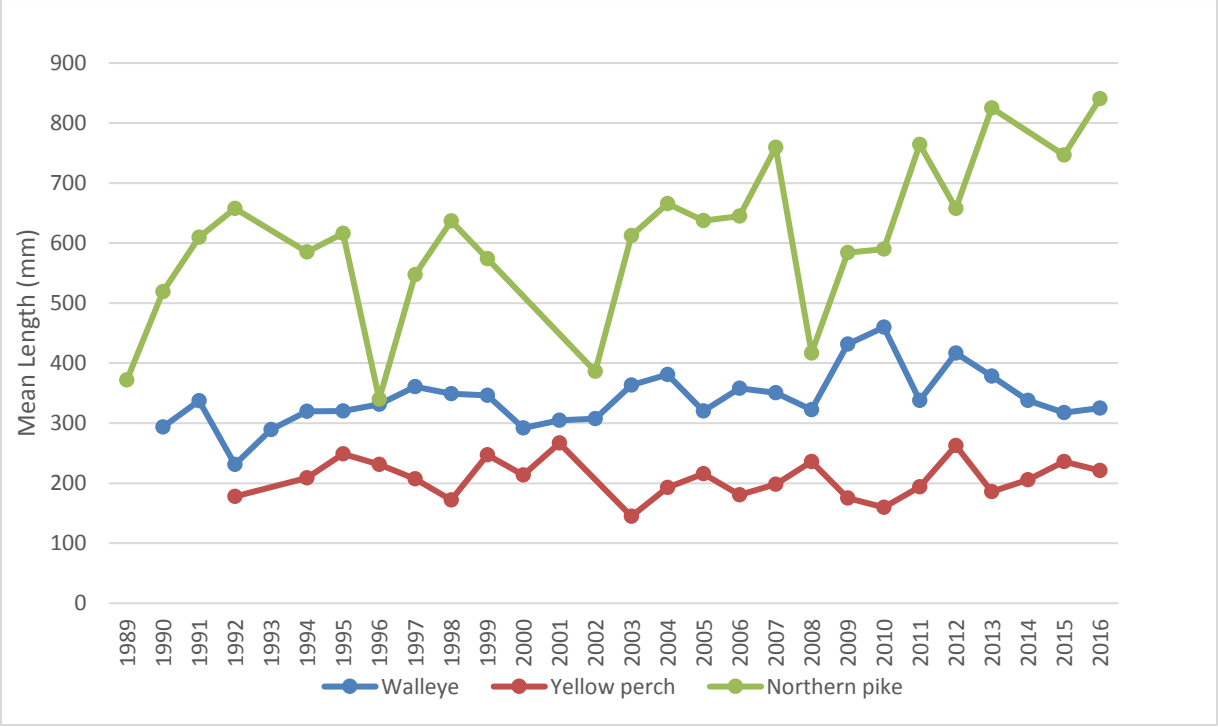


Figure 16. Fall gillnetting mean length of game species in Petrolia Reservoir from 1989 to 2016.

Catch rates of walleye in spring fyke nets are trending downward following the relative highs seen in 2013-2014 (Figure 17). CPUE of walleye was near the long-term average in 2015 and down to the third lowest on record since 2004 in 2016. The average length of walleye in spring fykes continues to trend downwards following 2011. Walleye averaged 434 mm in 2015, with a maximum of 714 mm and 328 mm in 2016, with a maximum of 525. The average Wr of walleye is also trending downward since 2011, with two consecutive low values of 79.1 in 2015 and 74.1 in 2016. These are the lowest relative weights seen since the all-time low of 71.9 in 2009. Yellow perch CPUE remained high in 2015 at 2.34/net-night and then plummeted to 0.81/net-night in 2016. In general, yellow perch CPUE (excluding the 2016 value), average length, and relative weights indicate a strong population, likely stemming from strong age-classes following the high reservoir elevations of recent years, as available spawning, nursery, and cover habitats have increased. We continue to sample low numbers of northern pike in the spring fyke nets. In 2015, 7 northern pike were sampled averaging 625 mm, with a maximum of 985 mm. In 2016, 4 northern pike were sampled, averaging 684 mm with a max of 974 mm. It should be noted that the efficiency of our sampling in 2016 was low due to early spring ice-off conditions. Early ice-off impacted the timing of our sampling relative to reservoir conditions such that we likely missed the spawning window of walleye, and to a lesser extent yellow perch. The 2016 data is not currently cause for concern unless trends continue in future years sampling.

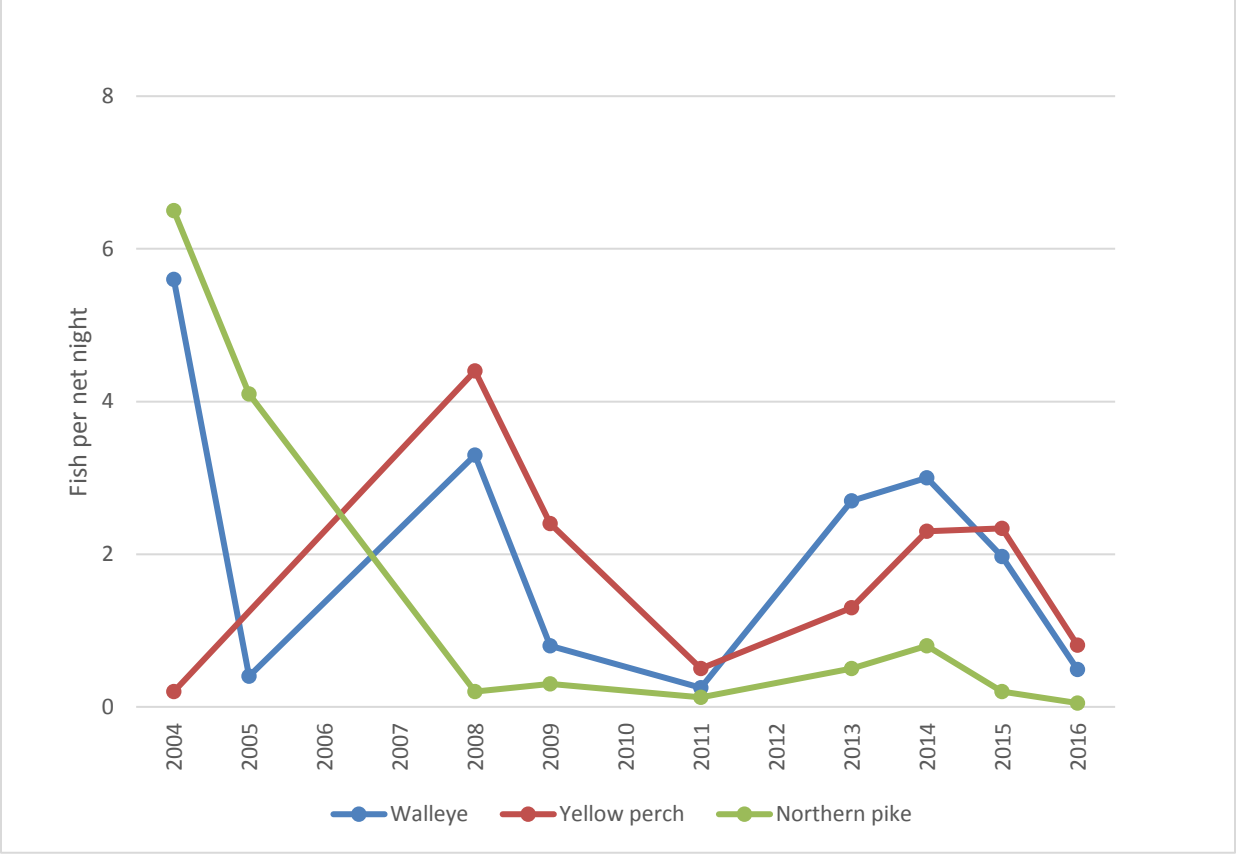


Figure 17. Spring fyke netting catch per unit effort (fish per net night) of common species in Petrolia Reservoir from 2004 to 2016.

Walleye and yellow perch sampled from spring fyke nets are aged. In 2015, 75 yellow perch and 60 walleye were aged. Fifty-five yellow perch and 36 walleye were aged in 2016. Yellow perch ranged in size from 155 to 303 mm and represented five age-classes from age-2 to age-6. Walleye ranged in size from 236 to 714 mm and represented six age-classes from age-3 to age-8. Mean length and size range for the most common age classes can be found in Table 3 for yellow perch and Table 4 for walleye.

Yellow perch growth rates are higher in Petrolia than other reservoirs in the management area. Perch reach adequate size to be recruited into sampling gear at Age-2 or Age-3, dependent on year. Low perch densities, increased nutrient availability, and warmer water temperatures are all likely factors contributing to observed growth rates. Sampling data suggests yellow perch abundance is increasing in Petrolia Reservoir. Increased catch rates in spring fyke netting and fall gill netting have been observed. The inundation of woody vegetation associated with higher reservoir elevation has increased available structure important for spawning and predator avoidance. Despite higher catch rates, aging data does not suggest that densities are impacting growth. Age-5 yellow perch average size and size range are comparable to those observed since 2008 (Table 3).

Petrolia Reservoir walleye are recruited into the sampling gear at age-3. Low catch rates reduce the availability of aging structures and result in small sample sizes; however, trends are visible. Walleye growth rates of age-4 and age-5 fish appear to trend downwards in 2015 and 2016 from 2013-2014 data (Table 4), although the 2016 sampling may be skewed due to reasons discussed above. Additionally, the age-4 and age-5 cohorts are composed of entirely naturally produced fish, as no hatchery stocking occurred in 2011 or 2012. This may partially explain the reduced length-at-age of the cohorts. The cohorts were relatively small in the 2015 sampling as well. The presence of the cohorts does document that some natural reproduction occurs in the reservoir and was likely aided by the high reservoir elevations of 2011 and 2012. We have initiated oxytetracycline marking of hatchery stocked walleye in Petrolia and will use the mark to evaluate future natural reproduction in the reservoir.

Table 3. Yellow perch age-class summary from 2004 to 2016 showing mean length in millimeters (min-max) and sample size (N) found in Petrolia Reservoir.

| Year | Age-2 | N | Age-3 | N | Age-4 | N | Age-5 | N | Age-6 | N |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | | | 272 | 1 | | | 312 | 1 | | |
| 2005 | | | | | | | | | | |
| 2006 | | | | | 216 | 1 | | | | |
| 2007 | | | | | | | | | | |
| 2008 | 117 (91-147) | 5 | 170 (147-201) | 19 | 203 (173-231) | 6 | 257 (231-277) | 4 | | |
| 2009 | | | | | 173 (147-198) | 7 | 198 (196-201) | 3 | 206 (193-221) | 12 |
| 2010 | 168 (147-201) | 15 | 229 (183-259) | 4 | 249 (224-274) | 6 | 279 (257-305) | 4 | | |
| 2027 | 150 (145-152) | 5 | 198 (147-251) | 37 | 203 (147-267) | 13 | 203 (178-229) | 7 | 282 | 1 |
| 2012 | | | | | | | | | | |
| 2013 | | | 183 (168-196) | 2 | 244 (203-282) | 4 | 241 (218-267) | 12 | 277 (272-284) | 2 |
| 2014 | 180 (132-227) | 30 | 201 (183-216) | 2 | 241 (218-272) | 7 | 251 (178-302) | 29 | 279 (249-326) | 9 |
| 2015 | 170 (155-183) | 11 | 211 (201-236) | 12 | 229 (198-287) | 26 | 257 (234-302) | 20 | 279 (269-290) | 4 |
| 2016 | | | 183 (159-222) | 20 | 222 (163-252) | 17 | 255 (239-277) | 14 | 281 (266-303) | 5 |

Table 4. Walleye age-class summary from 2004 to 2016 showing mean length in millimeters (min-max) and sample size (N) found in Petrolia Reservoir.

| Year | Age-3 | N | Age-4 | N | Age-5 | N | Age-6 | N | Age-7 | N |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 351 (320-384) | 11 | 396 (366-442) | 25 | 422 (409-439) | 6 | 442 (432-455) | 4 | --- | |
| 2005 | 394 (353-424) | 3 | 503 | 1 | --- | | --- | | --- | |
| 2006 | 295 (257-330) | 17 | 358 (323-391) | 9 | 424 | 1 | --- | | --- | |
| 2007 | | | | | | | | | | |
| 2008 | --- | | 340 (295-401) | 29 | 386 (340-414) | 13 | 455 (391-536) | 9 | --- | |
| 2009 | --- | | 335 | 1 | 351 (343-356) | 2 | 384 (356-432) | 3 | 417 (381-450) | 2 |
| 2010 | 272 (201-333) | 5 | 318 (254-475) | 27 | 445 (361-511) | 13 | 495 (381-640) | 3 | 488 (478-511) | 2 |
| 2011 | 272 (241-297) | 9 | 310 (300-330) | 5 | 348 (267-401) | 12 | 424 (411-434) | 2 | --- | |
| 2012 | | | | | | | | | | |
| 2013 | 348 | 1 | 404 (391-411) | 6 | 422 (409-446) | 4 | 460 (424-538) | 5 | 505 (452-592) | 11 |
| 2014 | 320 (292-422) | 6 | 414 (328-475) | 37 | 465 (391-556) | 31 | 513 (457-594) | 10 | 594 (538-673) | 4 |
| 2015 | 295 (246-417) | 13 | 386 (302-564) | 20 | 480 (340-638) | 15 | 566 (480-714) | 8 | 592 (526-663) | 4 |
| 2016 | --- | | 295 (236-328) | 19 | 312 (285-345) | 9 | 357 (351-364) | 3 | 413 (375-472) | 4 |

## Yellow Water Reservoir

In 2015, we performed both spring and fall fyke netting in an effort to collect rainbow trout in the reservoir. Both efforts did not collect any rainbow trout. Common carp and white suckers continue to dominate the fish assemblage. Three yellow perch were sampled in a single spring fyke net, likely the result of an illegal introduction. We again performed fall fyke netting in 2016, sampling only 2 common carp and 12 white suckers. Due to the reservoir's popularity with trout anglers, we will continue to stock a small amount of fish. We will also continue to monitor the reservoir for the establishment of yellow perch.

## Small Reservoirs

A total of 12 small reservoirs were sampled in the Lewistown area during 2015 and 11 were sampled in 2016. Reservoirs were sampled with fyke nets, gill nets, and hook & line. Table 5 provides a summary of the small reservoir sampling performed in 2015. Table 6 provides summary information of the small reservoir sampling in 2016.

Table 5. Summary of 2015 fisheries sampling on 12 small reservoirs in the Lewistown management area.

| Location (Date) Nets | Species (Stocking Year) | N | Length (millimeters) Min | Max | Mean | Weight (grams) Mean | Wr |
|---|---|---|---|---|---|---|---|
| Bonanza | Brook trout | 3 | 285 | 530 | 375 | 502 | 91.6 |
| 7/7/2015 | Rainbow trout | 4 | 359 | 539 | 418 | 783 | 104 |
| 1 Floater 1 Sinker | | | | | | | |
| Box Elder (Vogel) | White sucker | 65 | - | - | - | - | - |
| 5/5/2015 | Yellow perch | 406 | 163.0 | 278.0 | 203.0 | 102.0 | 84.3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 Large Fyke | | | | | | | |
| Bubs | Largemouth bass | 2 | 178.0 | 204.0 | 191.0 | 103.0 | 107.1 |
| 5/4/2015 | | | | | | | |
| 2 Large Fyke | | | | | | | |
| Castle Lake | Cutthroat trout | 1 | - | - | 260.0 | 193.0 | - |
| 7/21/2015 | | | | | | | |
| 1 Swedish Floater | | | | | | | |
| 7/21/2015 | Cutthroat trout | 13 | 229.0 | 362.0 | 307.0 | - | - |
| Hook & Line | | | | | | | |
| Drag | Bluegill | 72 | 97.0 | 155.0 | 131.0 | - | - |
| 6/28/2015 | Largemouth bass | 6 | 192.0 | 405.0 | 258.0 | - | - |
| 2 Large Fyke | | | | | | | |
| Dry Blood | Crappie | 5 | 125.0 | 153.0 | 138.0 | 51.0 | - |
| 5/5/2015 | Largemouth bass | 14 | 165.0 | 370.0 | 255.0 | 361.0 | 118.8 |
| 2 Large Fyke | White crappie | 1 | - | - | 335.0 | 662.0 | 112.1 |
| Forest Lake | Cutthroat trout | 19 | 165.0 | 300.0 | 228.0 | 39.0 | 75.5 |
| 7/7/2015 | | | | | | | |
| 1 Swedish Floater | | | | | | | |
| Jakes | Sauger | 15 | 305.0 | 488.0 | 361.0 | 404.0 | 85.2 |
| 4/29/2015 | Yellow perch | 32 | 133.0 | 349.0 | 185.0 | 94.0 | 80.9 |
| 2 Large Fyke | | | | | | | |
| Manuel #2 | Rainbow trout | 9 | 223.0 | 428.0 | 340.0 | 531.0 | 104.6 |
| 6/30/2015 | | | | | | | |
| 2 Large Fyke | | | | | | | |
| Payola | Black bullhead | 6 | 198.0 | 295.0 | 259.0 | 333.0 | 108.6 |
| 6/30/2015 | Largemouth bass | 38 | 141.0 | 274.0 | 223.0 | 172.0 | 109.6 |
| 2 Large Fyke | Yellow perch | 27 | 184.0 | 265.0 | 225.0 | 139.0 | 84.0 |
| S.F. Dry Blood | Largemouth bass | 6 | 191.0 | 282.0 | 216.0 | 161.0 | 110.5 |
| 4/22/2015 | | | | | | | |
| 2 Large Fyke | | | | | | | |
| Whisker | Black crappie | 127 | 121.0 | 269.0 | 152.0 | 66.0 | 128.8 |
| 5/4/2015 | Largemouth bass | 47 | 157.0 | 357.0 | 220.0 | 190.0 | 112.9 |
| 2 Large Fyke | | | | | | | |

Table 6. Summary of 2016 fisheries sampling on 11 small reservoirs in the Lewistown management area.

| Location (Date) Nets | Species (Stocking Year) | N | Length (millimeters) Min | Max | Mean | Weight (grams) Mean | Wr |
|---|---|---|---|---|---|---|---|
| Anderson Coulee<br>6/15/2016<br>Hook & Line | NO FISH | | | | | | |
| Big Casino | Largemouth bass | 7 | 72 | 92 | 83 | - | - |
| 9/19/2016 | White sucker | 165 | 192 | 328 | 255 | 157 | 70.3 |
| 1 Large Fyke | Yellow perch | 5 | 178 | 227 | 190 | 77 | 78.7 |
| 1 Small Fyke | | | | | | | |
| Carpenter | Brook trout | 2 | 220 | 248 | 234 | 163.5 | - |
| 6/15/2016 | | | | | | | |
| 1 Sinker | | | | | | | |
| Holgate | Brook trout | 2 | 175.0 | 215.0 | 195.0 | 91.0 | 114.2 |
| 6/15/2016 | Brown trout | 6 | 190.0 | 270.0 | 233.0 | 141.0 | 99.7 |
| 1 Sinker | Rainbow trout | 22 | 228.0 | 352.0 | 276.0 | 224.0 | 92.5 |
| Holland | Largemouth bass | 5 | 265.0 | 293.0 | 278.0 | - | - |
| 5/3/2016 | | | | | | | |
| Hook & Line | | | | | | | |
| Jakes | Sauger | 11 | 335.0 | 470.0 | 394.0 | 544.0 | 88.7 |
| 5/3/2016 | White sucker | 1 | - | - | 380.0 | 661.0 | 97.9 |
| 2 Large Fyke | Yellow perch | 334 | 135.0 | 343.0 | 191.0 | 80.0 | 71.7 |
| Kinkelaar | Rainbow trout | 10 | 169.0 | 350.0 | 278.0 | 348.0 | 121.9 |
| 7/14/2016 | | | | | | | |
| 1 Floater | | | | | | | |
| Hook & Line | | | | | | | |
| Olson | NO FISH | | | | | | |
| 7/14/2016 | | | | | | | |
| 1 Sinker | | | | | | | |
| Urs | NO FISH | | | | | | |
| 6/14/2016 | | | | | | | |
| 1 Sinker | | | | | | | |
| Whisker | Black crappie | 183 | 163.0 | 297.0 | 192.0 | 143.0 | 129.7 |
| 5/3/2016 | Largemouth bass | 45 | 208.0 | 344.0 | 243.0 | 218.0 | 107.0 |
| 2 Large Fyke | | | | | | | |
| Wolf Ranch - Upper | Rainbow trout | 33 | 268.0 | 365.0 | 305.0 | 315.0 | 86.9 |

6/14/2016
1 Sinker
Hook & Line

---

Lewistown Area Reservoirs

Three reservoirs were sampled in the Lewistown area in 2016.

**Big Casino Creek Reservoir** was sampled with 1 large and 1 small fyke net. We are attempting to transition the reservoir from a trout fishery to a largemouth bass / crappie *Pomoxis* sp. fishery. Stocking began in 2015 with 5,000 hatchery-raised largemouth bass fry and 100 crappie of various sizes from a wild-fish transfer. Our 2016 sampling only found recently stocked largemouth from the 2016 stocking, but we will continue to monitor the effectiveness of our stocks and the status of the fishery.

The trout fisheries in **Upper and Lower Carter Pond** have been negatively impacted by illegal introductions of bluegill and yellow perch. Following public input, it was determined that drawing the reservoirs down and treating with piscicide was necessary to restore to productive fisheries. This followed an initial attempt to induce a winterkill by drawing down the ponds over the 2014/2015 winter, which was unsuccessful. The ponds were again drained during early autumn 2015 and treated on November 12, 2015. Treatment consisted of distributing rotenone throughout the ponds and their connected waters via boat venturi, backpack sprayer, pump sprayer, and dough balls. Treatment concentration was at 1 ppm. A thin layer of ice was present the morning of the treatment and required breakup during the treatment. Sentinel cages were distributed throughout the treatment area, with fish showing symptoms within an hour of the treatment and complete sentinel fish mortality within 24 hours. Rotenone was allowed to breakdown naturally and no active detoxification was used. Monitoring of the ponds via sentinel cages continued for months post-treatment, with complete fish mortality occurring within 24 hours for the first week. We placed 2 small fyke nets for week long sets following ice-off in 2016 to determine the effectiveness of a rotenone treatment. Brook stickleback *Culea inconstans* were captured in both reservoirs, however no bluegill, yellow perch, or rainbow trout were sampled and the treatment was determined successful. The ponds were restocked with trout during the spring of 2016.

Missouri River Breaks Reservoirs

Ten reservoirs were sampled in the Missouri Breaks area during 2015 and 2016.

**Box Elder (Vogel) Reservoir** was sampled with 2 large fyke nets in May 2015. The reservoir has been managed as a put-grow-&-take rainbow trout fishery. However, an illegal introduction of yellow perch was first detected in 2011 and the trout fishery has been in decline. No rainbow trout were sampled in 2015. We sampled 406 yellow perch with a CPUE of 101.5/net-night. Yellow perch averaged 203 mm and had a Wr of 84.3. Aging data indicates 3 age-classes were present in the 2015 sampling (Table 7). Compression of growth between Age-3 and Age-4 fish suggests competition may be impacting the population. 2015 sampling also found white suckers present in the reservoir for the first time, likely resulting from a bait bucket. The growth of the

yellow perch population and the presence of white suckers will continue to negatively impact the stocked rainbow trout fishery. Rainbow trout stocking will be ceased.

Table 7. Yellow perch age-class summary from 2015 showing mean length in millimeters (min-max) and sample size (N) found in Box Elder (Vogel) Reservoir.

| Year | Age-2 | N | Age-3 | N | Age-4 | N | Age-5 | N |
|---|---|---|---|---|---|---|---|---|
| 2015 | 170 (163-175) | 8 | 213 (175-277) | 26 | 203 (183-218) | 18 | --- | |

**Bubs Reservoir** was sampled with 2 overnight fyke nets. Two largemouth bass were sampled, with an average length of 191 mm and an average Wr of 107.1.

**Drag Creek Reservoir** was sampled with large fyke nets. CPUE of bluegill was 18/net-night. Bluegill averaged 131 mm. Largemouth bass CPUE was 1.5/net-night. Largemouth bass had an average length of 258 mm, with a maximum of 405 mm. Bluegill were collected for disease testing.

The crappie population in **Dry Blood Reservoir** appears to be successfully establishing, as 2 large fyke nets found the first age-class of naturally produced fish. Crappie were first stocked in the reservoir in 2011 as a wild fish transfer. Crappie CPUE was 1.25/net-night, with fish averaging 138 mm. A single crappie from the original wild fish transfer was sampled, measuring 335 mm and 662 g. Largemouth bass continue to provide a quality fishery in Dry Blood, with an average length of 255 mm and a maximum length of 370 mm. Largemouth bass averaged 361 g. Largemouth bass CPUE was 3.50/net-night.

**Holland Reservoir** was hook and line sampled in 2016. Five largemouth bass were sampled in 2 angler hours, averaging 278 mm in length.

**Jakes Reservoir** was sampled overnight with 2 large fyke nets in both 2015 and 2016.

In 2015, fifteen sauger *Sander canadensis* (CPUE 7.5/net-night) were sampled, all of which were from recent wild fish transfers, as determined by floy tags. Sauger averaged 361 mm and had an average Wr of 85.2. Yellow perch catch rates were down slightly from 2014 at 16.0 fish/net-night. The average length and condition of perch was up from 2014 at 185 mm and 80.9 respectively. The increase in length and relative weight may be early indicators of increased predation and top-down control of the perch population by the recently transferred sauger. A total of 134 adult sauger have been stocked in Jakes in 2013 and 2014. The fish have been collected in the Missouri River, floy tagged, and stocked in Jakes to provide angler opportunity and improve the perch fishery. Special angling regulations (i.e. minimum size limit) should be enacted on Jakes so as to limit angler harvest of the sauger as they are being used as tools to control the perch fishery.

In 2016, we sampled 11 sauger (5.5/net-night), again all of which were recent wild fish transfers. The sauger averaged 394 mm and had an average relative weight of 88.9. Yellow perch catch rates increased drastically from recent years to 167 fish per net-night. Perch averaged 191 mm in length. We also sampled a single white sucker, which is the first recorded occurrence of the species in Jakes and likely the result of an unauthorized introduction.

**Manuel Reservoir** is managed as a put-grow-&-take trout fishery. We set 2 large fyke nets overnight to sample the fishery. Nine rainbow trout were sampled, having an average length of 340 mm and an average Wr of 104.6. As indicated by length frequency, it appears at least 2, more likely 3 age-classes are present in the reservoir, indicating stocked fish are overwintering and growing to adequate sizes to produce a quality recreational fishery.

**Payola Reservoir** has a history of fish kills & it is believed a significant winterkill occurred in 2011. It was sampled with 2 large fyke nets overnight. The sampling found a largemouth bass-yellow perch fishery has survived following the winterkill. Largemouth bass averaged 223 mm and were in excellent condition, with an average Wr of 109.6. The largemouth bass population is likely able to successfully reproduce in most years, however, due to the reservoirs tendency to experience fish kills it is also stocked with hatchery fry most years. The yellow perch averaged 225 mm, with a maximum length of 265 mm. Yellow perch in Payola are prone to stunting and the winterkill in 2011 likely benefited the perch population as a whole. Yellow perch exhibited tremendous growth, as indicated by length-at-age (Table 8), suggesting a low-density population not currently limited by competition. Six black bullhead were sampled in Payola for the first time since 1997. The fish sampled are believed to be remnants of the historical population and not the result of an illegal introduction. Black bullhead lengths ranged from 198 mm to 295 mm, with an average of 259 mm. The six fish were from 2 age-classes.

Table 8. Age-class summary of fish sampled in Payola Reservoir from 2015 showing mean length in millimeters (min-max) and sample size (N).

| Species | Age-2 | N | Age-3 | N | Age-4 | N | Age-5 | N |
|---|---|---|---|---|---|---|---|---|
| Black bullhead | --- | | --- | | 198 | 1 | 272 (226-295) | 5 |
| Yellow perch | 211 (183-234) | 18 | 249 (236-264) | 8 | --- | | 251 | 1 |

**South Fork Dry Blood Reservoir** was sampled with 2 large fyke nets overnight. Catch rates of largemouth bass were low, however, based on visual observation bass are plentiful in the reservoir. Sampled largemouth bass averaged 216 mm with a Wr of 110.5.

**Whisker Reservoir** was sampled with 2-overnight fyke nets in both 2015 and 2016.

2015 sampling found 47 largemouth bass and 127 crappie. Largemouth bass averaged 220 mm and were in excellent condition, with a Wr of 112.9. Crappie averaged 152 mm. The crappie population appears to be establishing a self-sustaining fishery, as multiple length groups of fish were present in the 2015 sampling.

We again sampling the fishery in 2016. We sampled 45 largemouth bass and 183 crappie. Largemouth bass averaged 243 mm and has an average Wr of 107.0. Crappie averaged 192 mm in length and were found up to 297 mm. Crappie Wr averaged 129.7. Black crappie were from 3 age-classes and largemouth bass were from two age-classes. Both species are exhibiting excellent growth in the reservoir, as indicated by mean length-at-age summarized below in Table 9.

Table 9. Age-class summary of fish sampled in Whisker Reservoir from 2015 showing mean length in millimeters (min-max) and sample size (N).

| Species | Age-2 | N | Age-3 | N | Age-4 | N |
|---|---|---|---|---|---|---|
| Black crappie | 185 (163-220) | 34 | 287 (278-295) | 2 | 297 | 1 |
| Largemouth bass | 240 (208-282) | 29 | 344 | 1 | --- | |

Denton/Winifred Area Reservoirs

Seven small reservoirs were sampled in Denton/Winifred area in 2016.

**Anderson Coulee (Beavertail) Reservoir** was sampled with hook and line equipment during the summer of 2016. The reservoir has been stocked with largemouth bass fry in 2010, 2014, and 2015. No fish were sampled and there were no signs of fish present. It appears the fish plants have not been successful at establishing a recreational fishery. The reservoir will be taken off the planting program.

**Carpenter Reservoir** was sampled with a sinking gill net. The gill net captured 2 brook trout *Salvelinus fontinalis*, which averaged 234 mm. Brook stickleback were observed dead and dying during the sampling event, indicating a fish kill was active. This would explain our low catch rates with the gill net equipment.

The reservoir has a history of high conductivity, but in 2016 the reservoir was tea-colored, indicative of high tannins present stemming from decomposing plant material. Continued monitoring of the reservoir will determine if a fishery can be maintained or if reservoir conditions have degraded too severely for fish to survive. Unfortunately, this is also occurring in other reservoirs in the Denton/Winifred area, including **Olson Reservoir** and **Urs Pond**. Sinking gill net sets in both reservoirs resulted in no fish captured and both reservoirs were off-colored, indicative of high tannins. Additional fishery and water quality sampling should be performed to determine the future viability of the reservoirs.

**Holgate Reservoir** was sampled with a single sinking gill net in 2016. Stocked brook trout, brown trout *Salmo trutta*, and rainbow trout were all sampled. Trout appear to be growing well, with an average length of 262 mm and an average relative weight of 95.4. Rainbow trout were sampled up to 352 mm.

**Kinkelaar Pond** was sampled with a floating gill net and hook and line equipment. Rainbow trout in the reservoir are providing a quality fishery, with sampled trout averaging 278 mm and a relative weight of 121.9.

**Wolf Creek Ranch Pond – Upper** was sampled with a sinking gill net and hook and line equipment. Rainbow trout catch rates were 3.5 fish per hour in the gill net and 5.8 fish per hour using hook and line. A total of 33 rainbow trout were sampled, averaging 303 mm and up to 365 mm. Brook trout and brown trout were stocked in 2015, however none were sampled in 2016.

Meagher County Reservoirs

Three small reservoirs were sampled in the Lewistown Management Area of Meagher County during 2015.

**Bonanza Reservoir** was sampled with a sinking and a floating gillnet in 2015. The sampling found a quality trout fishery present, with both brook trout and rainbow trout present. Brook trout averaged 375 mm and had an average Wr of 91.6. Rainbow trout had an average length of 418 mm and an average Wr of 104.0. CPUE of brook trout and rainbow trout was 0.38 and 0.50 fish/net-hour, respectively.

**Castle Lake** was sampled with a sinking Swedish gill net and hook and line. The stocked westslope cutthroat trout *Oncorhynchus clarki lewisi* in Castle Lake appear to provide a quality recreational fishery and fish are overwintering. CPUE in the gill net was 0.5 fish/net-hour. Catch rates using hook and line were 3.25 fish/hour. Westslope cutthroat trout averaged 303 mm and had a Wr of 97.9.

**Forest Lake** was also sampled with a sinking Swedish gill net and hook and line. The fishery of Forest Lake consists of a wild population of westslope cutthroat trout X Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* hybrids. The most recent genetic testing, performed in 2008, found the population to be 58% Yellowstone and 42% westslope cutthroat trout. Our sampling indicated a quality recreational fishery was present. CPUE of fish in the gill net was 9.5 fish/net-hour and our catch rates with hook and line were 5.0 fish/hour. Cutthroat trout averaged 234 mm, with the largest fish measuring 330 mm.

## Streams

A total of 14 streams were surveyed in the Lewistown management area during 2015 and an additional 8 streams were surveyed in 2016. A discussion of the findings from those surveys follows. Table 10 provides a summary of catch statistics from the 2015 stream surveys. Table 11 provides a summary of catch statistics from the 2016 stream surveys.

Additionally, physical parameters were monitored on streams in the Lewistown area. Flow measurements were taken at three locations on Big Spring Creek. Water temperature data was collected via thermographs at two locations on Big Spring Creek.

Table 10. Summary of 2015 fisheries sampling on 14 streams in the Lewistown management area.

| Waterbody (Date) Location Section Length (ft) | Species | N | Length (mm) Min | Max | Mean | Mean Weight (grams) | Wr |
|---|---|---|---|---|---|---|---|
| Alpine Gulch<br>10/19/2015<br>47.16156, -109.25421 | Westslope cutthroat | 26 | 66.0 | 194.0 | 134.0 | - | - |
| Armells Creek | Longnose dace | 15 | - | - | - | - | - |
| 6/24/2015 | Mountain sucker | 4 | 96.0 | 114.0 | 105.0 | - | - |
| Deer Creek Confluence<br>1100 | White sucker | 8 | 80 | 278 | 132 | - | - |
| Big Spring Creek | Brown trout | 182 | 111.0 | 449.0 | 345.0 | 427.00 | 93.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8/27/2015 & 9/2/2015 | Mountain whitefish | 33 | 334.0 | 446.0 | 392.0 | 667.00 | 110.8 |
| Burleigh | Rainbow trout | 85 | 177.0 | 405.0 | 333.0 | 364.00 | 89.1 |
| 4921 | | | | | | | |
| 8/25-26/2015 & 9/1/2015 | Brown trout | 309 | 98.0 | 454.0 | 290.0 | 271.00 | 91.5 |
| Hruska | Mountain whitefish | 266 | 124.0 | 428.0 | 346.0 | 459.00 | 101.8 |
| 5600 | Northern pike | 1 | - | - | 395.0 | 348.00 | 87.0 |
| | Rainbow trout | 35 | 162.0 | 379.0 | 313.0 | 319.00 | 90.0 |
| Boyd Creek (Arrow Drainage) | Brook trout | 13 | 68.0 | 205.0 | 111.0 | - | - |
| 7/29/2015 | Westslope cutthroat | 25 | 84.0 | 220.0 | 139.0 | - | - |
| 47.45594, -110.47950 | | | | | | | |
| 150 | | | | | | | |
| Collar Gulch | Westslope cutthroat | 30 | 103.0 | 219.0 | 149.0 | - | - |
| 10/8/2015 | | | | | | | |
| Estimate Section (47.19376, -109.20041) | | | | | | | |
| 150 | | | | | | | |
| Cottonwood Creek (Arrow Drainage) | Brook trout | 7 | 137.0 | 208.0 | 169.0 | 29.00 | 98.9 |
| 7/29/2015 | Westslope cutthroat | 99 | 77.0 | 250.0 | 158.0 | 65.00 | 84.9 |
| Barrier Site (47.44474, -110.47534) | | | | | | | |
| 250 | | | | | | | |
| East Fork Armells Creek | Fathead minnow | 12 | - | - | - | - | - |
| 6/24/2015 | Longnose dace | 69 | - | - | - | - | - |
| Landru's Ford (47.28549, -109.16290) | White sucker | 34 | 118.0 | 251.0 | 167.0 | - | - |
| 630 | | | | | | | |
| East Fork Big Spring Creek | Westslope cutthroat | 30 | 91.0 | 252.0 | 182.0 | - | - |
| 8/11/2015 | | | | | | | |
| USFS above Lewis Ranch (46.84162, -109.32243) | | | | | | | |
| 350 | | | | | | | |
| East Fork Cottonwood Creek (Judith Drainage) | Westslope cutthroat | 30 | 88.0 | 295.0 | 183.5 | - | - |
| 7/25/2015 | | | | | | | |
| Confluence upstream 3 river miles | | | | | | | |
| Hook & Line | | | | | | | |
| Elk Creek | Westslope cutthroat | 11 | 61.0 | 163.0 | 130.0 | - | - |
| 7/15/2015 | | | | | | | |
| USFS Road Crossing (46.92907, -110.49161) | | | | | | | |
| 500 | | | | | | | |
| Judith River | Flathead chub | 16 | 118.0 | 237.0 | 162.0 | 139.00 | - |
| 3/10/2015 - 3/27/2015 | Burbot | 2 | 323.0 | 323.0 | 323.0 | 180.00 | 71.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Beckman WMA (47.36951, -109.67613) | Brown trout | 3 | 380.0 | 412.0 | 400.0 | 534.00 | 77.6 |
| 2 Hoop Nets | Longnose sucker | 15 | 237.0 | 400.0 | 331.0 | 392.00 | - |
| | Rainbow trout | 1 | 447.0 | - | - | 643.00 | 65.6 |
| 3/10/2015 - 3/27/2015 | Flathead chub | 12 | 153.0 | 181.0 | 170.0 | - | - |
| Anderson Bridge (47.55705, -109.58668) | Goldeye | 8 | 323.0 | 347.0 | 337.0 | 324.00 | - |
| 2 Hoop Nets | Burbot | 12 | 343.0 | 450.0 | 379.0 | 286.00 | 69.2 |
| | Longnose sucker | 119 | 260.0 | 465.0 | 352.0 | 495.00 | - |
| | Northern pike | 1 | 595.0 | - | - | 1257.00 | 88.4 |
| | Stonecat | 3 | 120.0 | 202.0 | 175.0 | 74.00 | - |
| | Sauger | 1 | 338.0 | - | - | 290.00 | 78.5 |
| | Shorthead redhorse | 12 | 366.0 | 470.0 | 422.0 | 828.00 | - |
| | White sucker | 2 | 293.0 | 311.0 | 302.0 | 286.00 | 82.3 |
| 3/31/2015 | Channel catfish | 1 | - | - | 625.0 | - | - |
| Beckman WMA – Efish (47.32859, -109.714650) | Burbot | 4 | 278.0 | 429.0 | 334.0 | 201.00 | 70.1 |
| 17950 | Mountain whitefish | 6 | 244.0 | 312.0 | 279.0 | 239.00 | 108.7 |
| | Rainbow trout | 4 | 226.0 | 576.0 | 326.0 | 511.00 | 88.0 |
| | Stonecat | 1 | - | - | 201.0 | 91.00 | - |
| | Shorthead redhorse | 6 | 367.0 | 459.0 | 339.0 | 647.00 | - |
| Middle Fork Judith River | Brook trout | 5 | 108.0 | 155.0 | 128.0 | 48.00 | 148.7 |
| 8/5/2015 | Rainbow trout | 2 | 108.0 | 133.0 | 121.0 | 28.00 | 111.6 |
| Ranger Station (46.84639, -110.29337) | | | | | | | |
| 600 | | | | | | | |
| 8/5/2015 | Brook trout | 7 | 115.0 | 304.0 | 185.0 | 118.00 | 115.7 |
| First Ford Crossing (46.84763, -110.33249) | Brown trout | 1 | 547.0 | - | - | 1967.00 | 113.9 |
| 500 | | | | | | | |
| 8/5/2015 | Brook trout | 4 | 177.0 | 263.0 | 216.0 | 126.00 | 113.1 |
| Above Lost Fork (46.83731, -110.37948) | Rainbow trout | 4 | 190.0 | 314.0 | 240.0 | 144.00 | 91.2 |
| 650 | Westslope cutthroat | 1 | 361.0 | - | - | 461.00 | 84.5 |
| 8/5/2015 | Brook trout | 21 | 98.0 | 322.0 | 174.0 | 91.00 | 115.4 |
| Crossing before Private Land (46.83903, -110.44778) | Rainbow trout | 6 | 127.0 | 347.0 | 207.0 | 160.00 | 97.4 |
| 500 | | | | | | | |
| South Fork Judith River | Brook trout | 2 | 139.0 | 165.0 | 152.0 | - | - |
| 7/3/2015 | Rainbow trout | 9 | 177.0 | 288.0 | 218.0 | - | - |
| First Trail Crossing (46.74359, -110.34056) | Rainbow x Cutthroat | 4 | 177.0 | 238.0 | 205.0 | - | - |
| 600 | Westslope cutthroat | 18 | 99.0 | 225.0 | 138.0 | - | - |
| 7/3/2015 | Brook trout | 2 | 128.0 | 146.0 | 137.0 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Small Meadow (46.74071, -110.34294) 500 | Rainbow trout | 9 | 125.0 | 259.0 | 208.0 | - | - |
| | Rainbow x Cutthroat | 1 | 215.0 | - | - | - | - |
| | Westslope cutthroat | 32 | 75.0 | 226.0 | 136.0 | - | - |
| 7/3/2015 Below Cabin Ck (46.73751, -110.34912) 500 | Brook trout | 4 | 154.0 | 189.0 | 169.0 | - | - |
| | Rainbow trout | 6 | 200.0 | 260.0 | 236.0 | - | - |
| | Rainbow x Cutthroat | 6 | 150.0 | 230.0 | 192.0 | - | - |
| | Westslope cutthroat | 36 | 92.0 | 323.0 | 169.0 | - | - |
| 7/3/2015 Above Cabin Ck (46.73531, -110.35854) 600 | Brook trout | 8 | 120.0 | 222.0 | 171.0 | - | - |
| | Rainbow trout | 7 | 159.0 | 272.0 | 205.0 | - | - |
| | Rainbow x Cutthroat | 7 | 142.0 | 206.0 | 175.0 | - | - |
| | Westslope cutthroat | 19 | 81.0 | 251.0 | 136.0 | - | - |
| 7/3/2015 Above Smith Ck (46.72474, -110.37136) 425 | Brook trout | 7 | 171.0 | 213.0 | 195.0 | - | - |
| | Rainbow trout | 2 | 250.0 | 262.0 | 256.0 | - | - |
| | Rainbow x Cutthroat | 6 | 155.0 | 272.0 | 203.0 | - | - |
| | Westslope cutthroat | 27 | 93.0 | 245.0 | 177.0 | - | - |
| 10/7/2015 Private Bridge to Barrier (46.74839, -110.33548) 1500 | Brook trout | 65 | 73.0 | 320.0 | 200.0 | 110.00 | 103.2 |
| | Rainbow trout | 38 | 100.0 | 290.0 | 195.0 | 88.00 | 94.2 |
| | Rainbow x Cutthroat | 24 | 114.0 | 286.0 | 201.0 | 91.00 | - |
| | Westslope cutthroat | 56 | 97.0 | 285.0 | 162.0 | 55.00 | 85.8 |
| Yogo Creek 7/15/2015 Above Trailhead (46.91919, -110.48547) 850 | Brook trout | 22 | 147.0 | 278.0 | 191.0 | 89.00 | 116.9 |
| | Rainbow x Cutthroat | 9 | 136.0 | 226.0 | 182.0 | - | - |
| | Westslope cutthroat | 3 | 53.0 | 213.0 | 143.0 | 81.00 | 107.6 |

Table 11. Summary of 2016 fisheries sampling on 8 streams in the Lewistown management area.

| Waterbody (Date) Location Section Length (m) | Species | N | Length (mm) Min | Max | Mean | Mean Weight (grams) | Wr |
|---|---|---|---|---|---|---|---|
| Big Spring Creek | Brown trout | 257 | 96.0 | 495.0 | 310.0 | 338.00 | 92.6 |
| 8/31-31/2016 & 9/5-6/2016 | Mountain whitefish | 92 | 128.0 | 407.0 | 327.0 | 379.00 | 98.8 |
| Machler | Rainbow trout | 74 | 95.0 | 385.0 | 275.0 | 263.00 | 94.0 |
| 1040 | | | | | | | |
| 8/31-31/2016 & 9/5-6/2016 | Brown trout | 497 | 107.0 | 531.0 | 298.0 | 318.00 | 94.2 |
| Carroll Trail | Mountain whitefish | 200 | 110.0 | 463.0 | 351.0 | 482.00 | 103.3 |
| 1585 | Rainbow trout | 140 | 80.0 | 401.0 | 284.0 | 291.00 | 94.1 |
| 11/3/2016 | Brown trout | 81 | 122.0 | 447.0 | 313.3 | 333.00 | 92.1 |
| Spring Creek Colony | Mountain whitefish | 91 | 164.0 | 460.0 | 336.0 | 382.00 | 92.5 |
| 3700 | Rainbow trout | 5 | 291.0 | 388.0 | 351.0 | 416.00 | 87.0 |
| Fords Creek | Brook trout | 8 | 96.0 | 292.0 | 221.0 | - | - |
| 7/20/2016 | | | | | | | |
| Larson's | | | | | | | |
| 300 | | | | | | | |
| Judith River | Channel catfish | 1 | - | - | 590.0 | 2249.0 | - |
| 3/9/2016 – 4/6/2016 | Cisco | 1 | - | - | 255.0 | - | - |
| Anderson Bridge (47.55705, -109.58668) | Flathead chub | 7 | 143.0 | 200.0 | 172.7 | 74.00 | - |
| 2 Hoop Nets | Goldeye | 18 | 299.0 | 392.0 | 336.7 | 334.92 | - |
| | Burbot | 8 | 349.0 | | | | |
| | Longnose sucker | 24 | | | | | |
| | Northern pike | 1 | - | - | 789.0 | 1925.0 | 56.5 |
| | Rainbow trout | 1 | - | - | 266.0 | 163.00 | 79.9 |
| | Stonecat | 23 | 129.0 | 191.0 | 153.8 | 49.00 | - |
| | Shorthead redhorse | 2 | 217.0 | 275.0 | 246.0 | 146.5 | - |
| | White sucker | 2 | 370.0 | 380.0 | 375.0 | - | - |
| 3/9/2016 – 3/31/2016 | Goldeye | 1 | - | - | 312.0 | - | - |
| Roe Ranch (47.33864, -109.70843) | Longnose sucker | 2 | 330.0 | 345.0 | 337.5 | 363.5 | - |
| 2 Hoop Nets | Rainbow trout | 1 | - | - | 385.0 | - | - |
| | Stonecat | 2 | - | - | - | - | - |
| | Shorthead redhorse | 1 | - | - | 406.0 | 700.0 | - |
| | White sucker | 1 | - | - | 204.0 | 80.00 | - |
| Lost Fork Judith River | Brook trout | 3 | 224.0 | 267.0 | 247.0 | - | - |
| 7/19/2016 | Rainbow trout | 1 | - | - | 279.0 | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1/2 Mile Above Middle Fork Confluence<br>170 | Rainbow x Cutthroat | 1 | - | - | 173 | - | - |
| Marcott Creek | Lake chub | 2 | 93.0 | 105.0 | 99.0 | - | - |
| 7/20/2016 | Longnose dace | 15 | 52.0 | 95.0 | 68.0 | - | - |
| | Mountain sucker | 9 | 55.0 | 126.0 | 97.0 | - | - |
| 46.92691, -109.31939 | Rocky Mountain sculpin | 1 | - | - | 87.0 | - | - |
| 100 | White sucker | 7 | 70.0 | 262.0 | 140.0 | - | - |
| North Fork Warm Spring Creek | Brook trout | 65 | 56.0 | 240.0 | 141.0 | - | - |
| 7/13/2016 | Westslope cutthroat | 1 | - | - | 193.0 | - | - |
| Lincoln Gulch Confluence (47.19844, -109.26265)<br>60 | | | | | | | |
| Plum Creek<br>7/18/2016<br>BLM Boundary (47.31149, -109.4830)<br>300 | No Fish | | | | | | |
| Warm Spring Creek | Rainbow trout | 3 | 303 | 616 | 491 | 2381 | 105.6 |
| 1/5/2016 | Sauger | 3 | 404 | 498 | 464 | 1134 | 90.9 |
| Sand Rock Road – Upstream<br>1770 | | | | | | | |
| 1/19/2016 | Rainbow trout | 3 | 304 | 594 | 411 | 770 | 81.4 |
| Sand Rock Road – Downstream | Sauger | 1 | - | - | 408 | 540 | 80.2 |
| 1580 | | | | | | | |
| 1/21/2016 | Rainbow trout | 1 | - | - | 657 | 2580 | 82.1 |
| R&D Ranch (47.25778, -109.61779)<br>1600 | | | | | | | |
| 1/26/2016 | Rainbow trout | 2 | 601 | 632 | 617 | 2028 | 77.4 |
| 72 Bench Road - Upstream | Sauger | 1 | - | - | 514 | 1130 | 80.4 |
| 3500 | | | | | | | |
| 7/13/2016<br>Road crossing @ 47.1784, -109.25016)<br>5 | Brook trout | 10+ | - | - | - | - | - |
| 12/22/2016 | Rainbow trout | 2 | 406.0 | 464.0 | 435.0 | 717.00 | 78.2 |
| R&D Ranch (47.25778, -109.61779)<br>1600 | Smallmouth bass | 8 | 272.0 | 403.0 | 346.0 | 586.00 | 90.5 |

| | | |
|---|---|---|
| Whiskey Gulch<br>8/11/2016<br>Foley Cabin to BLM Boundary (47.1387, -109.24905)<br>1600 | No Fish | |

Big Spring Creek

In 2015, we performed mark-recapture estimates on the Burleigh and Hruska sections of Big Spring Creek (Table 12). This was the first such estimate performed on the Hruska section as part of an effort to increase monitoring of the lower portions of the creek.

The Burleigh section is one of two long-term monitoring sections on Big Spring Creek, with regular sampling since 1967. The 2015 population estimate of total trout larger than 250 mm per mile on the Burleigh section continues to trend downward from the recent high in 2009 (Figure 18). The estimate of 477 trout larger than 250 mm per mile is down 40% from the 2013 estimate and about 20% below the long-term average. The estimate is well within the historic range and is not cause for concern at this point. In the Burleigh section, sampled rainbow trout averaged 330 mm in length and had an average Wr of 89.1. Brown trout averaged 345 mm in length and had an average Wr of 93.7.

As mentioned above, this was the first population estimate on the Hruska section of Big Spring Creek and thus there is no trend data to report. The 2015 population estimate of total trout larger than 250 mm per mile was 403. The trout fishery was composed of primarily brown trout, with rainbow trout accounting for only 15% of the estimate. Mountain whitefish are plentiful in this section, with the species being the second most sampled (behind brown trout). In this section, sampled rainbow trout averaged 313 mm in length and had an average Wr of 90.0. Brown trout averaged 290 mm in length and had an average Wr of 91.5.

In 2016, we performed mark-recapture estimates on the Machler and Carroll Trail sections of Big Spring Creek (Table 13). Additionally, we performed sampling on the lower creek at the Spring Creek Colony section. This was a pilot study to examine the fishery and determine if it differed significantly from upstream sections and warranted a population estimate.

The Machler section continues to be monitored as pre-restoration sampling. A large restoration project to return the straightened section to a more natural meandering pattern began shortly after the 2016 estimate. The 2016 estimate of trout larger than 250 mm per mile was 732 (Figure 18). This is the lowest estimate on this section since 2009 and about 30% below the average estimate. In the Machler section, sampled rainbow trout averaged 276 mm in length and had an average Wr of 94.0. Brown trout averaged 310 mm in length and had an average Wr of 92.6.

Like the other trend sections, the most recent Carroll Trail population estimate is below the long-term average. The 2016 estimate of trout larger than 250 mm per mile was 801 (Figure 18). This estimate is about 40% below the long-term average and the lowest estimate since 1979. The estimate of rainbow trout larger than 250 mm per mile was 223, which is the second consecutive lowest estimate on record. The proportion of rainbow trout in the total trout larger than 250 mm estimate was up slightly from the 2014 estimate, however it continues to be well below the long-

Table 12. Summary statistics from 2015 Mark-Recapture population estimates on two sections of Big Spring Creek.

**Brown Trout**

| Section (Length) | Date Marked | # Marked | # Captured | # Recaptured | #/mile 6-10 inches | #/mile ≥ 10 inches |
|---|---|---|---|---|---|---|
| Burleigh (4910 ft) | 8/27 | 105 | 77 | 28 | - | 297 |
| Hruska (5600) | 8/25-26 | 208 | 101 | 40 | 132 | 341 |

**Rainbow Trout**

| Section (Length) | Date Marked | # Marked | # Captured | # Recaptured | #/mile 6-10 inches | #/mile ≥ 10 inches |
|---|---|---|---|---|---|---|
| Burleigh (4910 ft) | 8/27 | 49 | 36 | 8 | 18 | 283 |
| Hruska (5600) | 8/25-26 | 22 | 13 | 3 | - | 62 |

term average (Figure 19). In the Carroll Trail section, sampled rainbow trout averaged 284 mm and had an average Wr of 94.1. Sampled brown trout averaged 298 mm in length and had an average Wr of 94.2.

Sampling was also performed at the Spring Creek Colony section in an effort to further evaluate the lower creek and determine the presence/absence of warm water native species. No native species of interest were documented and a summary of the sampling event can be found in Table 11.

Numerous factors appear to be impacting the fishery of Big Spring Creek which are resulting in the general downward trends of the population estimates throughout the monitoring sections of the creek. The first factor is the continued presence and impacts of whirling disease, which was first documented in Big Spring Creek in 2003. Direct monitoring of whirling disease severity hasn't occurred in Big Spring Creek since autumn 2011, however monitoring throughout the late 2000's documented high whirling disease infection rates throughout the creek. This is believed to be the primary culprit in the continued decline of rainbow trout in the creek. Since 2013, 16% of sampled rainbow trout exhibited external signs of whirling disease infection, such as head deformities, spinal deformities, and shortened operculum. Rainbow trout numbers are at all-time lows throughout the monitoring sections.

Another factor believed to be impacting the trout fishery are the recent high flow events and the associated destabilization of Big Spring Creek. Two 100-year flood events occurred in 2011 and 2013, resulting in numerous meander cutoffs, channel widening, and flushing of fine sediments.

Table 13. Summary statistics from 2016 Mark-Recapture population estimates on two sections of Big Spring Creek.

**Brown Trout**

| Section (Length) | Date Marked | # Marked | # Captured | # Recaptured | #/mile 6-10 inches | #/mile ≥ 10 inches |
|---|---|---|---|---|---|---|
| Machler (3410 ft) | 8/30-31 | 146 | 160 | 49 | 71 | 609 |
| Carroll Trail (5200) | 8/30-31 | 280 | 330 | 113 | 180 | 578 |

**Rainbow Trout**

| Section (Length) | Date Marked | # Marked | # Captured | # Recaptured | #/mile 6-10 inches | #/mile ≥ 10 inches |
|---|---|---|---|---|---|---|
| Machler (3410 ft) | 8/30-31 | 36 | 53 | 15 | 32 | 123 |
| Carroll Trail (5200) | 8/30-31 | 64 | 91 | 15 | - | 223 |

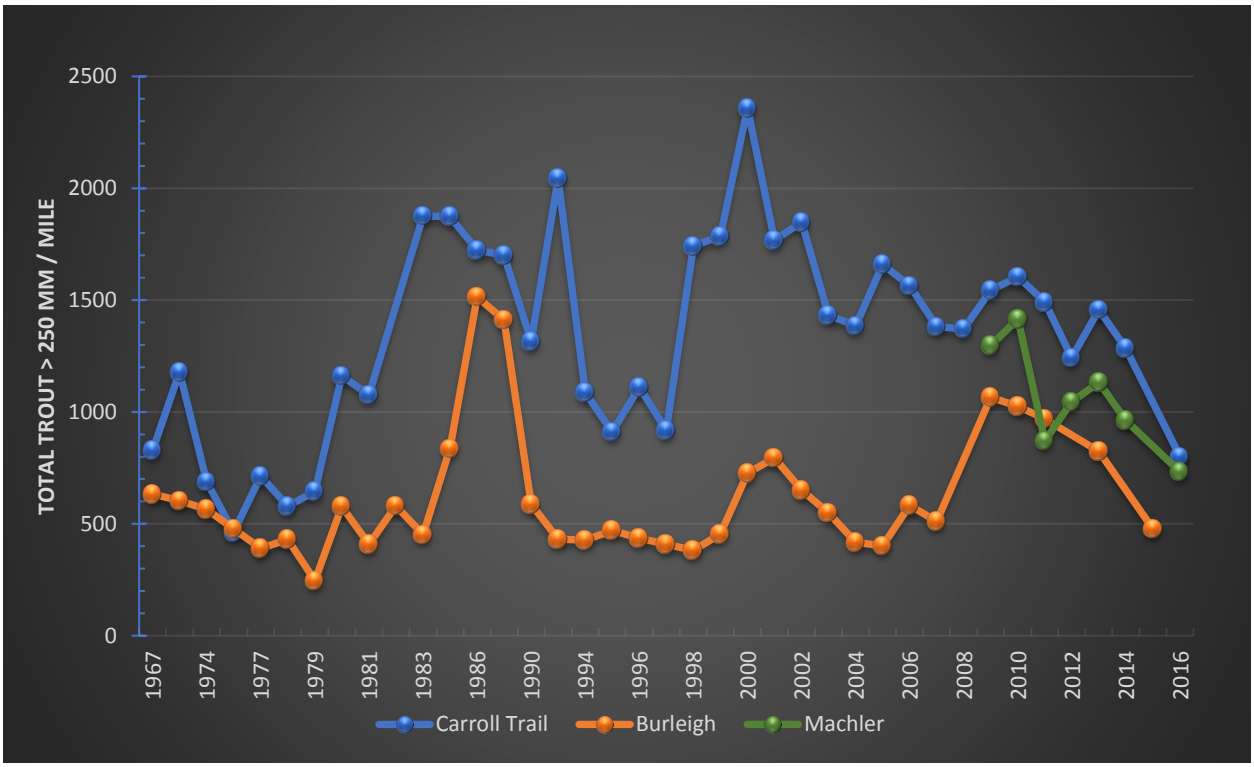


Figure 18. Population estimates of total trout larger than 10 inches per mile in three sections of Big Spring Creek from 1967 to 2016.

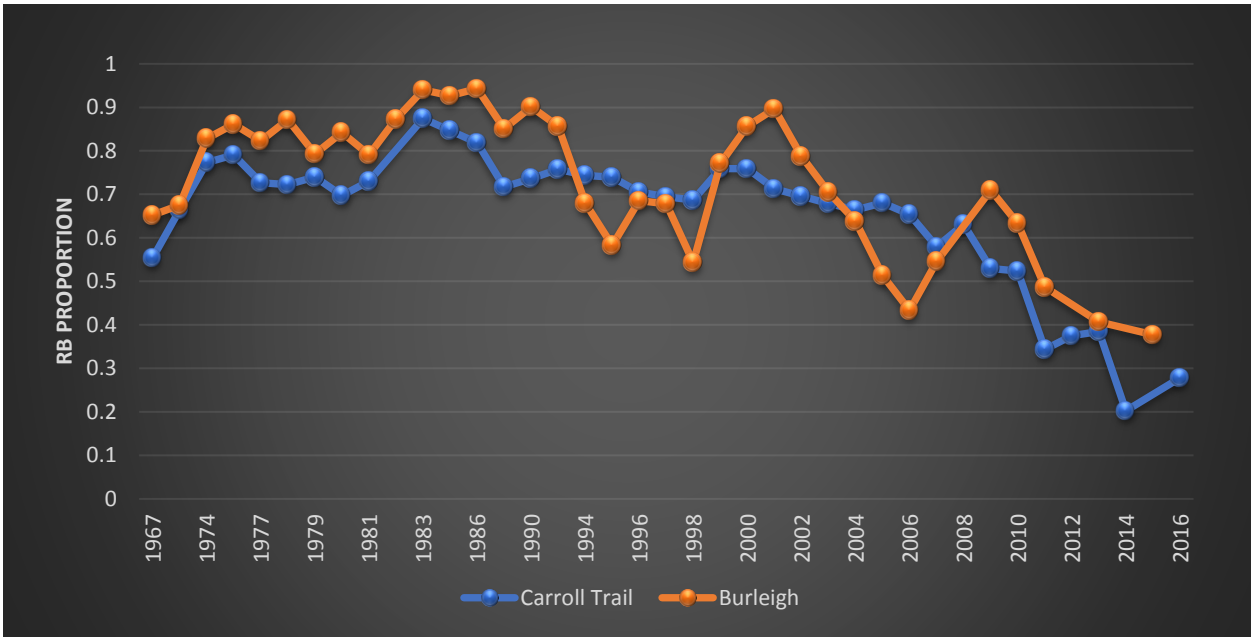


Figure 19. Proportion of rainbow trout in population estimates of total trout larger than 10 inches per mile in two long-term monitoring sections on Big Spring Creek from 1967 to 2016.

While the creek is noticeably re-stabilizing in recent years, the flow events and alterations have likely resulted in temporary decreased carrying capacity of the creek and shifts in the aquatic macroinvertebrate population, and reduced recruitment of those year classes.

The other notable factor that has been changing throughout the creek is the abundance of mountain whitefish. The species has historically been present at low densities in the creek downstream of Lewistown and was rare upstream of town. As measured by first-pass CPUE, mountain whitefish densities have increased dramatically in the Carroll Trail and Burleigh monitoring sections (Figure 20). The apparent increase in mountain whitefish density could be an artifact of the sampling effort due to fewer trout being sampled in general or the species could be increasing in density as niche space becomes available due to rainbow trout declines. While causality is lacking, the increase in mountain whitefish abundance correlates with the presence and severity of whirling disease and the associated declines in rainbow trout.

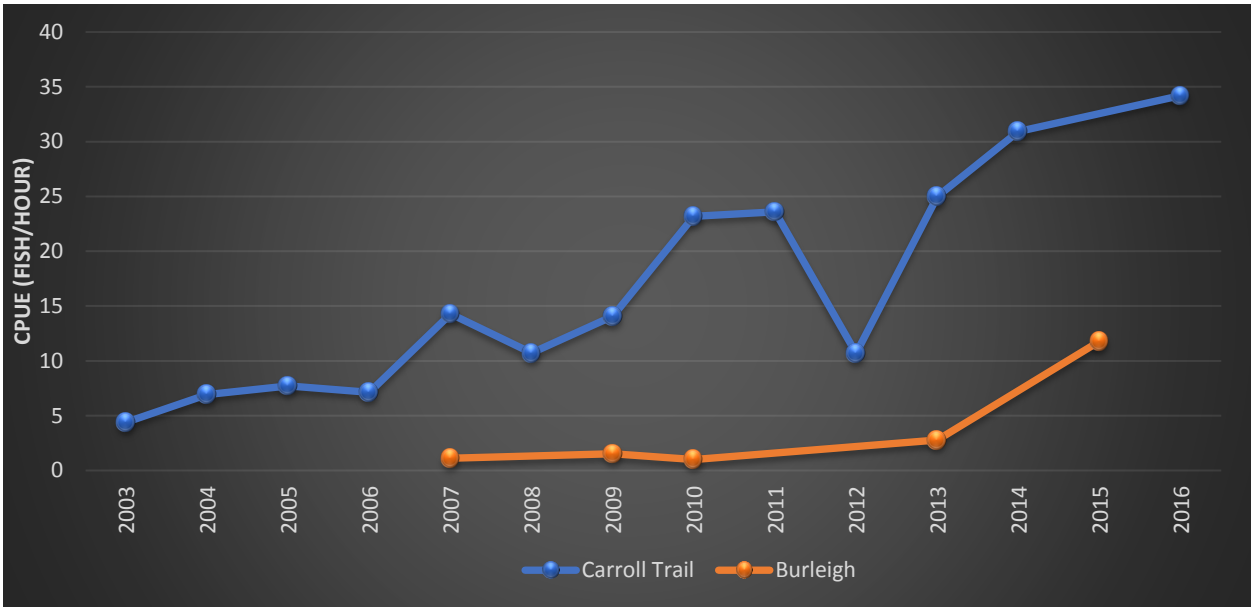


Figure 20. First pass catch per unit effort (CPUE) of mountain whitefish in two long-term monitoring sections of Big Spring Creek from 2003 to 2016.

Armells Creek Drainage Streams

Portions of the upper Armells Creek drainage were sampled to gather fisheries data in previously unsampled portions of the drainage.

A section of **East Fork Armells Creek** was sampled on the Landru Ranch's ford crossing, approximately 1.9 river miles upstream of the highway. The habitat was degraded from grazing impacts; however, fish were present, with fathead minnows *Pimephales promelas*, longnose dace *Rhinichthys cataractae*, and white suckers present.

**Armells Creek** was sampled immediately below its confluence with Deer Creek. The habitat was negatively impacted by grazing. Fish species present included longnose dace, mountain sucker *Catostomus platyrhynchus*, and white sucker. Fish densities were low.

Arrow Creek Drainage Streams

A section of **Cottonwood Creek** in the Highwood Mountains was sampled immediately upstream of a barrier that was constructed in 2001. Following installation of the barrier, multiple years of mechanical removal was performed to remove all brook trout, leaving a protected population of westslope cutthroat trout. In 2015 sampling, 99 westslope cutthroat trout were sampled, averaging 158 mm, with a CPUE of 0.40 fish/ft. Genetic samples were collected from 30 fish and the results are pending. Unfortunately, we also sampled 7 brook trout, averaging 169 mm, with a CPUE of 0.03 fish/ft. Sampling effort in 2016 focused on suppression and removal of brook trout above the barrier.

**Boyd Creek**, which is a small tributary of Cottonwood Creek downstream of the barrier, has a small population of westslope cutthroat trout. During previous sampling efforts, it had been noted that beaver dams were likely acting as barrier to brook trout expansion upstream. Recent

high flow events have removed the beaver dams, and brook trout expansion appears to be occurring. During 2015 sampling, 25 westslope cutthroat trout and 13 brook trout were sampled. Genetic samples were collected from the cutthroat trout and results are pending. Future efforts may focus on brook trout suppression and evaluation of barrier options to protect this small population of native cutthroat trout.

Judith River Drainage Streams

Multiple sampling efforts were performed on the **Judith River** in an effort to develop baseline fisheries monitoring. Trend data is lacking on the Judith River and the work in 2015 and 2016 acted as pilot data to determine effectiveness of different sampling techniques. We plan to implement annual or biannual sampling of the main stem Judith so as to develop trend data on which management decisions can be based.

A total of 14 species were captured in the Judith River sampling, 10 of which are native species. Of particular interest, was the relatively high capture rate of burbot *Lota lota* throughout the sampling effort and the presence of trout species. We plan to continue the hoop netting and we will likely make modifications to the electrofishing efforts. Additionally, future monitoring will incorporate seine netting to better document the cyprinid assemblage.

**Alpine Gulch** is a small headwater tributary of Warm Spring Creek in the Judith Mountains. We received public reports of a remnant cutthroat trout population in the drainage and sampled a small pool near the BLM parcel boundary, finding 26 westslope cutthroat trout. Genetics were taken to determine the genetic status of the population and results are still pending. The creek only flows following spring runoff and following large precipitation events. At the time of sampling, water was present only in isolated pools. A visual survey was performed from the sample site upstream and fish were present in most of the remaining pools, with multiple age-classes present, including what were most likely age-1 fish. The available habitat in Alpine Gulch is very limited and the population should be given very high priority to replicate elsewhere.

Genetics were collected on westslope cutthroat trout sampled in **East Fork Big Spring** and **East Fork Cottonwood Creek** in the Big Spring Creek drainage. Thirty fish were sampled from both locations and fish averaged 182 mm in East Fork Big Spring Creek and 184 in East Fork Cottonwood Creek. Genetic results are pending.

The **Lost Fork Judith River** was sampled following angler reports that the fishery was in decline. Our investigation found few fish present. The channel was braided and sediment aggregation was present. The channel showed signs of substantial destabilization following recent high-water years. The river will likely take a few years to re-stabilize and the fishery should recover once habitat conditions naturally improve.

**Marcott Creek** was sampled in 2016 to investigate if salmonids were present. The creek, which is a small tributary of East Fork Big Spring Creek, was thought to potentially contain cutthroat trout. Our sampling found primarily minnow and sucker species, although a sculpin was found. The creek showed signs of livestock grazing impacts which have degraded the aquatic habitat.

The **Middle Fork Judith River** was sampled at four locations in 2015. The river suffers from severe water quality issues caused by sedimentation stemming from numerous road/trail

crossings. Due to the abysmal water quality, the fishery is very poor. The US Forest Service trail along the Middle Fork contains at least 29 ford crossings, with many crossings consisting of driving up the river for extensive distances. In their 2007 Travel Management Plan, the forest service decided to reroute the road, bypassing 14 of the road crossings below river mile 5.2 (USFS 2007). This plan has not yet been implemented due to litigation and a lack of urgency from the agency. Non-government organizations, such as Trout Unlimited and the Montana Wilderness Association, have initiated efforts to motivate the Forest Service to take corrective action and reduce the sedimentation occurring throughout the Middle Fork. We performed longitudinal sampling throughout the current route to demonstrate the negative impacts to the fishery. The initial plan was to perform depletion estimates; however, catch rates were so poor that estimates were not feasible. Figure 21 shows the CPUE of all trout sampled by river mile. This figure illustrates the very poor catch rates and the improvement in the fishery above the majority of the road crossings.

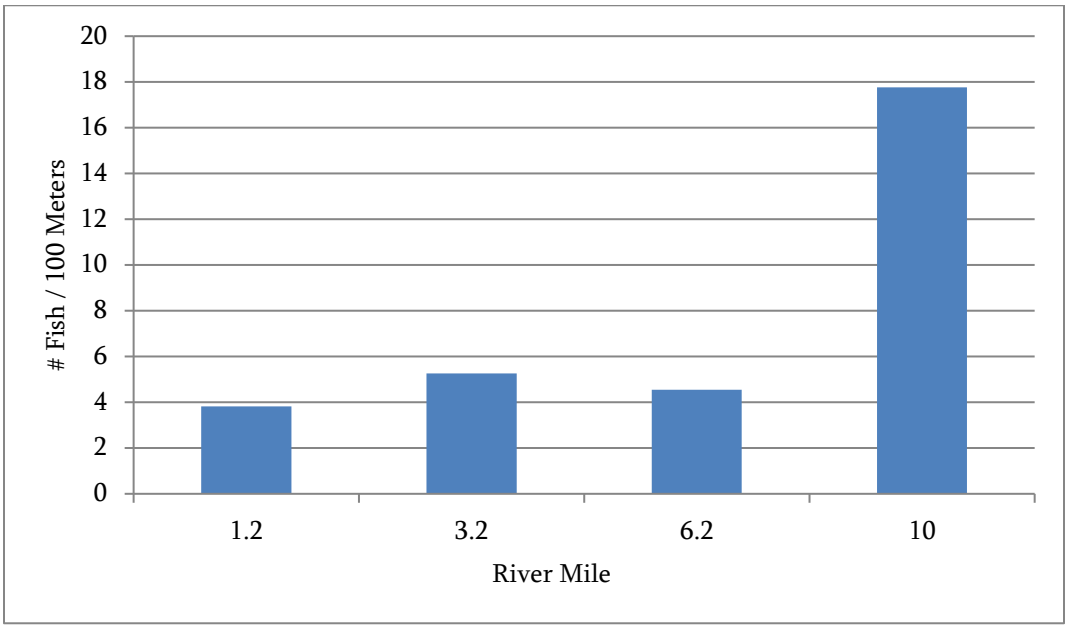


Figure 21. Catch per unit effort of all trout at four sections of the Middle Fork Judith River.

We sampled **North Fork Warm Spring Creek** following the discovery of westslope cutthroat trout in nearby Alpine Gulch. The creek is home to a very productive fishery as brook trout were very abundant. We also sampled a single westslope cutthroat trout, which may be an emigrant from Alpine Gulch. If a barrier site could be identified, North Fork Warm Spring Creek would be a great candidate for westslope cutthroat trout replication.

**Plum Creek** was sampled to determine if fish were present in the mountainous portion of the creek. No fish were captured. The creek flowed intermittently and appeared to flow sub-surface throughout the sampling reach. The creek likely does not flow in the sampling reach during dry years.

We performed longitudinal sampling of the **South Fork Judith River** for genetics collection. The South Fork contains remnant westslope cutthroat trout populations above a man-made barrier. The cutthroat population is hybridized, as the drainage also contains rainbow trout and

brook trout. FWP's conservation goal for the cutthroat population is to attempt to achieve a 90% pure westslope cutthroat population by genetically swamping with stocked hatchery fish. Additionally, mechanical suppression of non-native fish has taken place to assist the recovery and establishment of the cutthroat population. Genetic results from the sampling are still pending.

In October, fish were captured below the man-made barrier and marked with an adipose fin clip. The purpose of this work is to determine if fish are bypassing the barrier during periods of high flow. Future monitoring work will be performed to evaluate fish passage.

A small reach of **Warm Spring Creek** was sampled following a request from a private landowner to determine the identity of fish in the headwaters of the creek. It was thought that the fish may be cutthroat trout, however, the fish were identified as brook trout.

Extensive sampling of Warm Spring Creek occurred in early 2016 to capture large rainbow trout and sauger. The fish were implanted with coded radio transmitters so that their movements can be monitored. It is believed that the rainbow trout use Warm Spring Creek as a spawning tributary, then out migrate to Fort Peck Reservoir. The radio telemetry study will shed light on the movements and status of the population. Sauger hadn't been captured in Warm Spring Creek since the late 1970's and were also implanted with radio telemetry tags. Our small sample and short duration of monitoring the tagged sauger suggest that the fish move downstream to the Missouri River to spawn and then return to the Judith River and Warm Spring Creek to rear in their home territories. Continued monitoring and investigation of both species and their use and movement of Warm Spring and the Judith is planned for future years.

Routine monitoring of the fishery in **Yogo Creek** found a productive fishery present, with sampled fish in good condition. Brook trout, westslope cutthroat trout, and westslope cutthroat x rainbow trout hybrids were sampled. **Elk Creek**, a small tributary of Yogo Creek, was also sampled to evaluate the small cutthroat population present. The population appears to be hanging on, as 11 fish were sampled averaging 130 mm.

Musselshell River Drainage Streams

**Collar Gulch** is home to a small population of westslope cutthroat trout. Genetics were collected from 30 fish and the results are pending. Sampled fish averaged 149 mm.

**Fords Creek** was sampled downstream of its confluence with Collar Gulch. Prior to 2011, this portion of the creek flowed only seasonally and was thought to be a significant barrier to fish movement upstream to Chicago Gulch, which was proposed as a receiving stream for Collar Gulch westslope cutthroat trout following a rotenone project. That project was put on hold due to brook trout being found in Fords Creek. We sampled Fords Creek in 2016 to determine if brook trout were persisting and to evaluate the habitat conditions of the creek. We sampled 8 brook trout which averaged 221 mm in length. Suitable habitat and water conditions were present throughout the reach. Due to the continued persistence of brook trout and available habitat, the Chicago Gulch project is put on hold permanently until a reasonable barrier option is identified.

**Whiskey Gulch** was evaluated as a potential site to replicate the westslope cutthroat population in Alpine Gulch. Whiskey Gulch was found to be fishless. The creek is protected from upstream fish movement via an extended sub-surface reach. The creek provides roughly 1.5 to 2 miles of

potential habitat. Numerous springs and seeps are present. It was determined that Whiskey Gulch would provide an adequate site to replicate the Alpine Gulch population, at least in the short-term.

Flow Measurements and Discharge

In 2015 and 2016, Montana Fish, Wildlife, and Parks operated three gaging stations on Big Spring Creek: Hatchery, Ash Street, and Mill Ditch (Figure 22; Appendix 4). A fourth station, Reed and Bowles, is operated by the USGS and 2015 was the first calendar year for which the gage was operational. Four flood control reservoirs were constructed in the 1970's on tributaries of Big Spring Creek that receive high elevation snowpack runoff; most notable, East Fork Spring Creek Reservoir. These reservoirs collect runoff and mediate downstream release into Big Spring Creek; thus, high elevation snowmelt cannot be readily discerned at gaging site hydrographs. The hydrograph had one significant peak in 2015, occurring in early June following mountain snowpack runoff. Flow data for 2016 was still being processed at the time of writing.

Peak measured discharge at the **Hatchery Gaging Station** occurred on June 4, 2015, with an estimated discharge of 593 cfs. The gaging equipment malfunctioned throughout the autumn and early winter and thus no December base flow estimates were possible. A polynomial equation provided best fit within the range of measurements. When stage exceeded the highest measured discharge of 215 cfs at 2.46 stage, a linear equation was applied to estimate discharge that more accurately predicted the actual flows.

At the **Ash Street Gaging Station**, the spring peak occurred on June 4, 2015 at an estimated discharge of 782 cfs. Gaging equipment malfunction caused gaps in the data in 2015 and thus, winter 2015 base flow estimates are missing.

The **Mill Ditch Gaging Station** peaked at 668 cfs on June 5, 2015. Equipment malfunction caused gaps in the data in 2015.

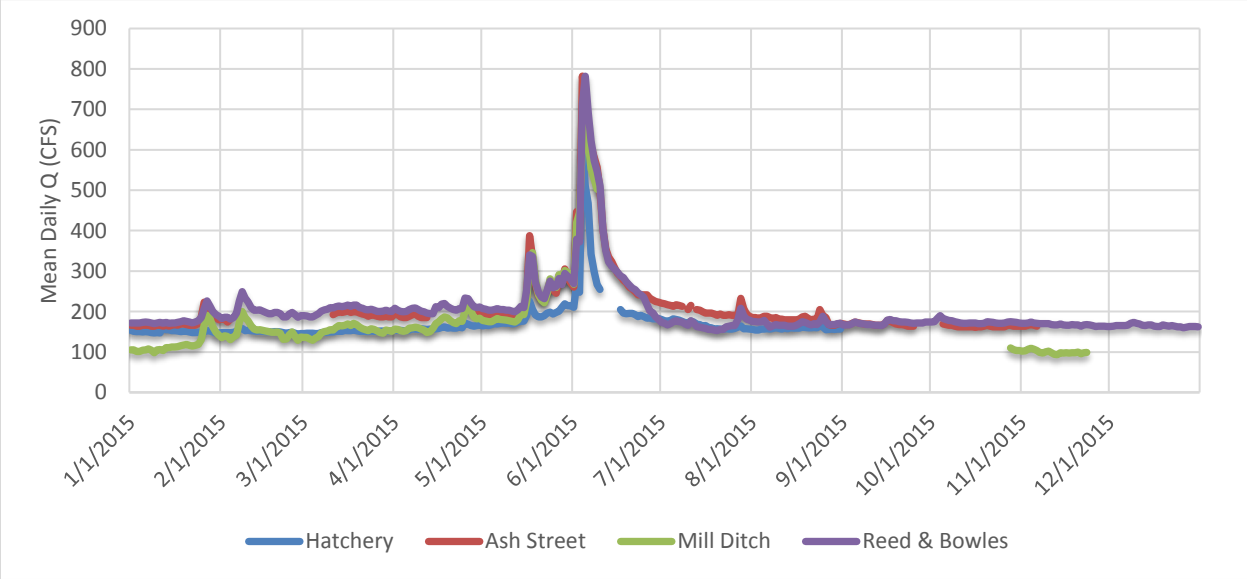


Figure 22. Big Spring Creek discharge at gaging stations during 2015.

Thermographs

In 2015 and 2016, Montana Fish, Wildlife, and Parks deployed two thermographs for temperature monitoring (Table 14; Figure 23; Appendix 4). Temperature data for 2016 was still being processed at the time of writing.

Table 14. Summary of Lewistown area thermograph deployment during 2014.

| Site | Lat/Long | Date Deployed | Date Retrieved | Avg. July | Avg. August | Status |
|---|---|---|---|---|---|---|
| Big Spring Creek (Burleigh) | N 47.02699 E -109.37709 | 1/1/2015 | 12/31/2015 | 56.4 | 54.8 | redeployed |
| Big Spring Creek (Hruska) | N 47.11312 E -109.50900 | 1/1/2015 | 12/31/2015 | 60.4 | 58.2 | redeployed |

Big Spring Creek average July and August temperatures were very near the 10-year average in 2015, within 1°F at both Burleigh and Hruska monitoring sites. Temperature at Burleigh peaked on June 10 at 65.1°F. Hruska peaked on June 28 at 70.2°F. Water temperatures exceeded 70°F on a single day at Hruska in 2015 and did not exceed 70°F at Burleigh.

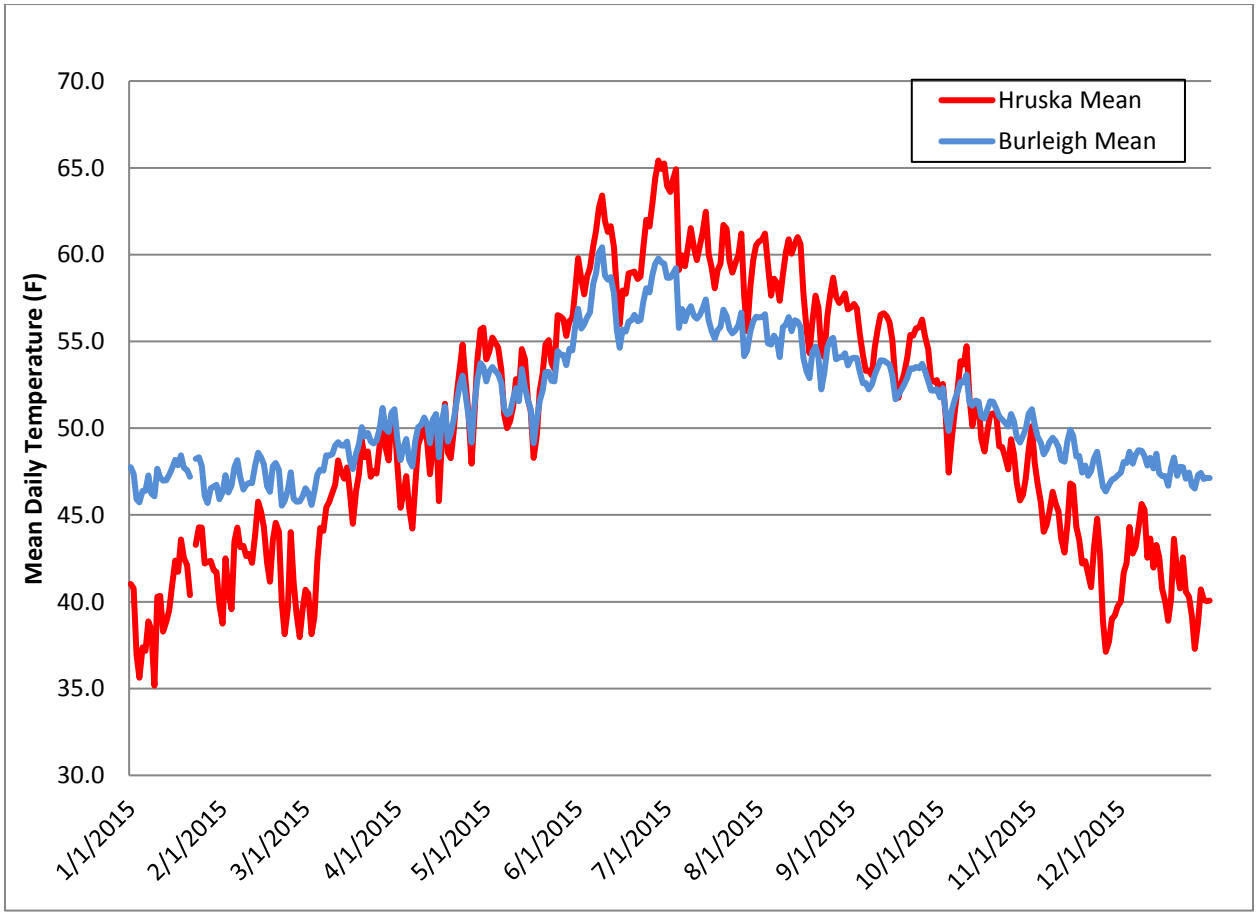


Figure 23. 2015 mean daily water temperature (°F) at two monitoring sites of Big Spring Creek.

## HABITAT PROTECTION

FWP personnel issued 5 Montana Stream Protection Act '124' permits in 2015 and 7 in 2016, 9 of which required FWP to perform an environmental assessment. Additionally, FWP personnel assisted local county conservation districts with 24 site inspections for Natural Streambed and Land Preservation Act '310' permits in 2015 and 15 in 2016.

Work continued the restoration of a straightened section of Big Spring Creek known as the Machler section. Many meetings, plans, and grant applications took place as the project continues towards implementation.

## EDUCATIONAL OUTREACH

Lewistown staff acted as chairman for the Aquatic Ecology dimension of the Montana Envirothon in 2015 and 2016. Presentations included: riparian health and grazing, Montana water law, and fish identification.

Lewistown staff administered the Montana FWP Electrofishing Safety and Policy Course. The course includes lessons on water safety, state policy and guidelines, and electrofishing theory, safety, gear, and injury to fish.

FWP, in conjunction with BLM and USFWS, hosted a Kid's Fishing Day at Upper and Lower Frog Ponds in June 2015 and 2016. Participants were educated on Montana fish identification, water safety, fly tying, and fishing techniques. FWP staff also assisted with a Kid's Aquatic Education Day for Winnett school kids held at Petrolia Reservoir in 2016.

## ACKNOWLEDGEMENTS

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Appendix 1. List of water bodies referred to in this report.

| NAME | 4th ORDER HUC | |
|---|---|---|
| Ackley Lake | Judith River | 10040103 |
| Alpine Gulch | Judith River | 10040103 |
| Anderson Coulee Reservoir | Judith River | 10040103 |
| Armells Creek | Fort Peck Reservoir | 10040104 |
| Bair Reservoir | Upper Musselshell River | 10040201 |
| Big Casino Creek Reservoir | Judith River | 10040103 |
| Bonanza Creek Reservoir | Upper Musselshell River | 10040102 |
| Boyd Creek | Arrow Creek | 10040102 |
| Box Elder (Vogel) Reservoir | Box Elder Creek | 10040204 |
| Bubs Reservoir | Lower Musselshell River | 10040205 |
| Big Spring Creek | Judith River | 10040103 |
| Carpenter Reservoir | Judith River | 10040103 |
| Castle Lake | Upper Musselshell River | 10040201 |
| Collar Gulch | Box Elder Creek | 10040204 |
| Cottonwood Creek | Arrow Creek | 10040102 |
| Drag Creek Reservoir | Lower Musselshell River | 10040205 |
| Dry Blood Reservoir | Lower Musselshell River | 10040205 |
| East Fork Big Spring Creek | Judith River | 10040103 |
| East Fork Cottonwood Creek | Judith River | 10040103 |
| East Fork Reservoir | Judith River | 10040103 |
| Elk Creek | Judith River | 10040103 |
| Fords Creek | Box Elder Creek | 10040204 |
| Forest Lake | Upper Musselshell River | 10040201 |
| Holgate Reservoir | Judith River | 10040103 |
| Holland Reservoir | Lower Musselshell River | 10040205 |
| Jakes Reservoir | Lower Musselshell River | 10040205 |
| Judith River | Judith River | 10040103 |
| Kinkelaar Reservoir | Fort Peck Reservoir | 10040104 |
| Lost Fork Judith River | Judith River | 10040103 |
| Manuel Reservoir #2 | Lower Musselshell River | 10040205 |
| Marcott Creek | Judith River | 10040103 |
| Martinsdale Reservoir | Upper Musselshell River | 10040201 |
| Middle Fork Judith River | Judith River | 10040103 |
| Musselshell River | Lower Musselshell River | 10040205 |
| North Fork Warm Spring Creek | Judith River | 10040103 |
| Olsen Pond | Bullwhacker-Dog Creeks | 10040101 |
| Payola Reservoir | Box Elder Creek | 10040204 |
| Petrolia Reservoir | Flatwillow Creek | 10040203 |
| Plum Creek | Judith River | 10040103 |
| Urs Pond | Arrow Creek | 10040102 |
| South Fork Dry Blood | Lower Musselshell River | 10040205 |

| | | |
|---|---|---|
| South Fork Judith River | Judith River | 10040103 |
| Warm Spring Creek | Judith River | 10040103 |
| Whisker Reservoir | Lower Musselshell River | 10040205 |
| Whiskey Gulch | Box Elder Creek | 10040204 |
| Wolf Ranch Pond - Upper | Judith River | 10040103 |
| Yellow Water Reservoir | Flatwillow Creek | 10040203 |
| Yogo Creek | Judith River | 10040103 |

Appendix 2. List of fish species referred to in this report.

| | |
|---|---|
| Black bullhead | *Ameiurus melas* |
| Black crappie | *Poxomis nigromaculatus* |
| Bluegill | *Lepomis macrochirus* |
| Brook trout | *Salvelinus fontinalis* |
| Brown trout | *Salmo trutta* |
| Burbot | *Lota lota* |
| Channel catfish | *Ictalurus punctatus* |
| Common Carp | *Cyprinus carpio* |
| Crappie species | *Pomoxis spp.* |
| Fathead minnow | *Pimephales promelas* |
| Flathead chub | *Platygobio gracilis* |
| Goldeye | *Hiodon alosoides* |
| Lake chub | *Couesius plumbeus* |
| Largemouth bass | *Micropterus salmoides* |
| Longnose dace | *Rhinichthys cataractae* |
| Longnose sucker | *Catostomus catostomus* |
| Mountain sucker | *Catostomus platyrhynchus* |
| Mountain whitefish | *Prosopium williamsoni* |
| Northern pike | *Esox lucius* |
| Rainbow trout | *Oncorhynchus mykiss* |
| Rocky Mountain sculpin | *Cottus bondi* |
| Sauger | *Sander canadense* |
| Shorthead redhorse | *Moxostoma macrolepidotum* |
| Smallmouth bass | *Micropterus dolomieu* |
| Stonecat | *Noturus flavus* |
| Tiger muskie | *Esox masquinongy x lucius* |
| Walleye | *Sander vitreus* |
| Westslope cutthroat trout | *Oncorhynchus clarki lewisi* |
| White sucker | *Catostomus commersoni* |
| Yellow perch | *Perca flavescens* |

Appendix 3. 2015 Mean daily discharge (cfs) at Big Spring Creek gage sites.

**Big Spring Creek – Hatchery Gaging Station**

| Day | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 153 | 148 | 146 | 155 | 164 | 210 | 180 | 156 | | | | |
| 2 | 151 | 148 | 146 | 153 | 166 | 270 | 178 | 155 | | | | |
| 3 | 151 | 148 | 147 | 154 | 165 | 248 | 176 | 155 | | | | |
| 4 | 151 | 148 | 146 | 153 | 168 | 593 | 178 | 156 | | | | |
| 5 | 150 | 149 | 146 | 153 | 170 | 511 | 182 | 156 | | | | |
| 6 | 150 | 151 | 146 | 155 | 169 | 468 | 180 | 158 | | | | |
| 7 | 149 | 158 | 148 | 157 | 171 | 342 | 179 | 156 | | | | |
| 8 | 148 | 158 | 148 | 157 | 172 | 298 | 176 | 158 | | | | |
| 9 | 148 | 153 | 149 | 156 | 171 | 267 | 173 | 160 | | | | |
| 10 | 148 | 153 | 150 | 157 | 172 | 255 | 172 | 158 | | | | |
| 11 | 147 | 153 | 150 | 156 | 169 | | 176 | 157 | | | | |
| 12 | 161 | 152 | 151 | 156 | 171 | | 174 | 159 | | | | |
| 13 | 155 | 151 | 151 | 156 | 174 | | 169 | 158 | | | | |
| 14 | 155 | 151 | 151 | 157 | 176 | | 168 | 160 | | | | |
| 15 | 153 | 151 | 154 | 158 | 176 | | 164 | 159 | | | | |
| 16 | 153 | 150 | 153 | 159 | 191 | | 165 | 159 | | | | |
| 17 | 152 | 150 | 152 | 161 | 225 | 205 | 161 | 159 | | | | |
| 18 | 150 | 150 | 154 | 163 | 206 | 196 | 160 | 161 | | | | |
| 19 | 151 | 150 | 152 | 159 | 191 | 195 | 156 | 160 | | | | |
| 20 | 151 | 150 | 151 | 160 | 187 | 195 | 158 | 160 | | | | |
| 21 | 149 | 150 | 151 | 159 | 187 | 195 | 156 | 160 | | | | |
| 22 | 148 | 148 | 151 | 159 | 190 | 192 | 156 | 161 | | | | |
| 23 | 148 | 147 | 150 | 162 | 196 | 187 | 158 | 160 | | | | |
| 24 | 149 | 148 | 152 | 160 | 199 | 190 | 157 | 165 | | | | |
| 25 | 149 | 149 | 151 | 172 | 194 | 188 | 156 | 162 | | | | |
| 26 | 151 | 146 | 151 | 168 | 198 | 183 | 158 | 155 | | | | |
| 27 | 152 | 144 | 152 | 166 | 201 | 184 | 161 | 156 | | | | |
| 28 | 152 | 145 | 152 | 164 | 210 | 182 | 164 | 157 | | | | |
| 29 | 150 | | 152 | 165 | 219 | 182 | 157 | 156 | | | | |
| 30 | 147 | | 152 | 167 | 214 | 183 | 157 | 156 | | | | |
| 31 | 147 | | 152 | | 215 | | 156 | 157 | | | | |

Appendix 3 continued. 2015 Mean daily discharge (cfs) at Big Spring Creek gage sites.

**Big Spring Creek – Ash Street Gaging Station**

| Day | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 166 | 181 | | 194 | 192 | 260 | 221 | 185 | 169 | | 164 | |
| 2 | 166 | 181 | | 192 | 190 | 447 | 219 | 185 | 167 | | 164 | |
| 3 | 164 | 174 | | 187 | 188 | 379 | 217 | 183 | 167 | | 166 | |
| 4 | 164 | 181 | | 185 | 188 | 782 | 215 | 185 | 171 | | 167 | |
| 5 | 166 | | | 185 | 188 | 688 | 213 | 188 | 174 | 169 | 166 | |
| 6 | 166 | | | 188 | 194 | 651 | 217 | 188 | 173 | 167 | 164 | |
| 7 | 166 | | | 192 | 192 | 608 | 215 | 185 | 171 | 166 | | |
| 8 | 164 | | | 194 | 190 | 581 | 213 | 183 | 169 | 166 | | |
| 9 | 164 | | | 188 | 190 | 557 | | 185 | 169 | 164 | | |
| 10 | 166 | | | 185 | 190 | 499 | 205 | 181 | 169 | 162 | | |
| 11 | 166 | | 192 | 185 | 188 | 404 | 215 | 181 | 167 | 162 | | |
| 12 | 164 | | 196 | 185 | 187 | 355 | | 180 | 166 | 162 | | |
| 13 | 166 | | 200 | | 188 | 335 | 205 | 180 | 166 | 162 | | |
| 14 | 164 | | 198 | | 198 | 323 | 203 | 180 | 166 | 162 | | |
| 15 | 166 | | 200 | | 196 | 308 | 200 | 180 | 169 | 162 | | |
| 16 | 167 | | 201 | | 233 | 294 | 196 | 180 | 178 | 161 | | |
| 17 | 166 | | 198 | | 387 | 287 | 196 | 181 | 176 | 162 | | |
| 18 | 169 | | 200 | | 335 | 278 | 196 | 187 | 173 | 162 | | |
| 19 | 169 | | 200 | | 269 | 271 | 194 | 188 | 169 | 164 | | |
| 20 | 167 | | 196 | | 239 | 260 | 190 | 183 | 167 | 166 | | |
| 21 | 166 | | 194 | | 229 | 256 | 194 | 180 | 167 | 164 | | |
| 22 | 166 | | 192 | | 225 | 249 | 190 | 181 | 166 | 162 | | |
| 23 | 166 | | 188 | | 247 | 241 | 190 | 180 | 164 | 162 | | |
| 24 | 171 | | 192 | | 276 | 241 | 192 | 205 | 164 | 162 | | |
| 25 | 187 | | 190 | | 254 | 241 | 190 | 190 | 164 | 162 | | |
| 26 | 223 | | 188 | | 245 | 241 | 190 | 185 | | 162 | | |
| 27 | 217 | | 187 | 203 | 289 | 233 | 190 | 167 | | 166 | | |
| 28 | 200 | | 187 | 198 | 271 | 229 | 233 | 166 | | 166 | | |
| 29 | 190 | | 188 | 194 | 306 | 225 | 207 | 166 | | 164 | | |
| 30 | 185 | | 187 | 194 | 282 | 223 | 194 | 169 | | 164 | | |
| 31 | 180 | | 187 | | 271 | | 188 | 171 | | 164 | | |

Appendix 3 continued. 2015 Mean daily discharge (cfs) at Big Spring Creek gage sites.

**Big Spring Creek – Mill Ditch Gaging Station**

| Day | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 46.2 | 60.5 | 60.7 | 71.8 | 83.7 | 145.4 | | | | | 44.9 | 103.6 |
| 2 | 46.0 | 62.6 | 60.6 | 71.1 | 82.8 | 288.7 | | | | | 45.0 | 104.9 |
| 3 | 44.6 | 61.9 | 58.8 | 69.5 | 81.7 | 316.6 | | | | | 46.7 | 105.9 |
| 4 | 44.4 | 58.1 | 57.2 | 68.7 | 81.9 | 555.6 | | | | | 47.8 | 106.7 |
| 5 | 46.0 | 61.7 | 59.9 | 69.2 | 84.2 | 626.0 | | | | | 46.9 | 107.0 |
| 6 | 46.2 | 63.6 | 61.4 | 72.7 | 86.4 | 551.1 | | | | | 45.7 | 108.0 |
| 7 | 47.3 | 81.0 | 66.6 | 73.4 | 85.0 | 454.4 | | | | | 43.4 | 108.0 |
| 8 | 46.0 | 97.6 | 68.0 | 74.4 | 84.8 | 417.5 | | | | | 42.8 | 114.7 |
| 9 | 43.2 | 88.2 | 69.1 | 73.4 | 84.1 | 386.5 | | | | | 44.0 | 117.6 |
| 10 | 46.4 | 83.3 | 70.6 | 71.6 | 83.4 | 384.9 | | | | | 44.9 | 116.6 |
| 11 | 46.7 | 76.0 | 70.4 | 70.1 | 82.2 | | | | | | 43.0 | 116.7 |
| 12 | 45.5 | 71.6 | 73.5 | 66.8 | 81.5 | | | | | | 41.6 | 113.0 |
| 13 | 48.6 | 70.1 | 76.3 | 68.2 | 84.4 | | | | | | 41.1 | 114.4 |
| 14 | 48.6 | 70.9 | 76.1 | 72.6 | 93.2 | | | | | | 43.3 | 115.4 |
| 15 | 49.3 | 69.8 | 76.8 | 79.1 | 92.3 | | | | | | 42.9 | 113.3 |
| 16 | 49.3 | 69.0 | 78.5 | 81.7 | 113.4 | | | | | | 43.2 | 110.5 |
| 17 | 49.7 | 68.1 | 76.3 | 85.9 | 195.0 | | | | | | 42.8 | 108.7 |
| 18 | 50.8 | 67.2 | 79.6 | 89.1 | 212.4 | | | | | | 43.2 | 113.6 |
| 19 | 51.7 | 67.4 | 78.0 | 87.5 | 155.3 | | | | | | 43.3 | 119.4 |
| 20 | 52.2 | 67.9 | 74.1 | 83.1 | 125.7 | | | | | | 43.8 | 114.8 |
| 21 | 51.1 | 66.0 | 72.2 | 80.7 | 115.7 | | | | | | 42.0 | 118.1 |
| 22 | 50.3 | 58.5 | 70.6 | 79.2 | 111.4 | | | | | | 43.2 | 118.7 |
| 23 | 51.4 | 58.8 | 69.5 | 83.2 | 127.6 | | | | | | 43.5 | 112.1 |
| 24 | 52.2 | 64.0 | 71.9 | 82.5 | 155.5 | | | | | | 69.2 | 112.7 |
| 25 | 58.1 | 67.7 | 71.2 | 97.4 | 144.3 | | | | | | 102.4 | 109.1 |
| 26 | 77.2 | 61.9 | 69.0 | 103.6 | 139.2 | | | | | 111.1 | 100.0 | 106.9 |
| 27 | 91.5 | 57.2 | 66.7 | 97.7 | 164.1 | | | | | 98.4 | 101.2 | 110.7 |
| 28 | 87.1 | 61.0 | 66.0 | 88.4 | 150.9 | | | | | 48.2 | 101.6 | 112.1 |
| 29 | 74.5 | | 70.4 | 85.9 | 173.1 | | | | | 46.5 | 103.5 | 109.2 |
| 30 | 67.3 | | 69.4 | 87.1 | 168.6 | | | | | 45.7 | 103.9 | 110.9 |
| 31 | 63.7 | | 68.6 | | 164.5 | | | | | 45.4 | | 111.5 |

Appendix 4. Minimum, mean and maximum water temperatures (ºF) from Lewistown area waters in 2015.

**Big Spring Creek - Burleigh FAS (Coordinates = N 47.026990, E 109.377089)**

| | January | | | February | | | March | | | April | | | May | | | June | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** |
| 1 | 46.6 | 47.7 | 49.2 | 44.8 | 46.3 | 48.6 | 45.4 | 46.5 | 49.3 | 47.6 | 49.4 | 51.8 | 49.7 | 52.7 | 56.8 | 53.9 | 56.9 | 60.5 |
| 2 | 45.8 | 47.4 | 49.2 | 46.4 | 47.3 | 48.2 | 45.2 | 46.3 | 48.5 | 46.7 | 48.2 | 50.0 | 50.6 | 53.3 | 56.1 | 53.8 | 55.7 | 57.5 |
| 3 | 44.5 | 45.9 | 47.2 | 45.4 | 46.3 | 47.6 | 44.7 | 45.6 | 48.0 | 46.8 | 48.9 | 52.3 | 50.9 | 53.5 | 57.8 | 53.1 | 56.0 | 59.4 |
| 4 | 45.3 | 45.7 | 46.3 | 45.6 | 46.7 | 49.5 | 45.2 | 46.4 | 49.4 | 47.4 | 49.4 | 51.8 | 50.2 | 53.3 | 57.6 | 53.7 | 56.4 | 59.8 |
| 5 | 44.6 | 46.4 | 48.0 | 47.1 | 47.8 | 48.6 | 45.4 | 47.3 | 49.9 | 47.4 | 48.2 | 49.3 | 50.5 | 53.1 | 56.6 | 54.0 | 56.7 | 60.6 |
| 6 | 45.6 | 46.4 | 47.0 | 47.2 | 48.2 | 49.4 | 46.4 | 47.6 | 50.4 | 46.7 | 47.8 | 49.9 | 50.7 | 52.6 | 55.3 | 55.0 | 58.3 | 62.6 |
| 7 | 45.9 | 47.3 | 48.8 | 45.9 | 47.2 | 47.8 | 46.3 | 47.6 | 49.0 | 45.7 | 49.2 | 53.5 | 49.2 | 51.1 | 53.9 | 55.6 | 58.9 | 63.2 |
| 8 | 45.0 | 46.2 | 47.8 | 45.4 | 46.5 | 48.4 | 46.9 | 48.4 | 51.2 | 47.5 | 50.1 | 53.6 | 49.5 | 50.8 | 52.8 | 56.4 | 60.1 | 65.1 |
| 9 | 44.5 | 46.1 | 48.1 | 45.4 | 46.7 | 48.3 | 46.4 | 48.4 | 51.6 | 47.5 | 50.2 | 53.4 | 48.1 | 50.9 | 53.9 | 56.8 | 60.4 | 64.9 |
| 10 | 46.9 | 47.7 | 49.2 | 46.3 | 46.8 | 47.3 | 46.3 | 48.5 | 51.7 | 47.8 | 50.6 | 54.3 | 48.4 | 51.7 | 56.3 | 55.4 | 58.8 | 60.8 |
| 11 | 45.9 | 47.1 | 48.2 | 46.3 | 46.8 | 47.9 | 47.4 | 49.0 | 51.6 | 49.1 | 50.3 | 52.0 | 48.6 | 52.3 | 56.3 | 55.3 | 58.6 | 62.2 |
| 12 | 45.8 | 47.0 | 49.1 | 46.4 | 47.9 | 50.4 | 47.2 | 49.2 | 52.1 | 47.7 | 49.1 | 51.5 | 50.5 | 51.6 | 52.9 | 55.8 | 58.7 | 62.7 |
| 13 | 46.2 | 47.0 | 48.7 | 47.4 | 48.6 | 50.8 | 46.4 | 49.0 | 52.3 | 47.1 | 50.5 | 54.8 | 50.6 | 53.4 | 57.4 | 54.5 | 57.8 | 61.7 |
| 14 | 46.2 | 47.3 | 49.6 | 47.6 | 48.3 | 50.0 | 47.2 | 49.0 | 51.0 | 48.0 | 50.8 | 54.2 | 51.2 | 52.3 | 54.8 | 54.3 | 55.7 | 57.6 |
| 15 | 46.7 | 47.7 | 49.7 | 47.2 | 47.9 | 49.3 | 48.6 | 49.2 | 49.7 | 46.2 | 48.3 | 51.0 | 50.8 | 51.6 | 52.9 | 52.6 | 54.6 | 57.2 |
| 16 | 47.6 | 48.2 | 49.6 | 45.5 | 46.7 | 47.2 | 46.8 | 48.1 | 49.2 | 46.8 | 50.4 | 54.8 | 49.9 | 51.1 | 51.8 | 52.1 | 55.7 | 59.6 |
| 17 | 46.9 | 47.9 | 49.5 | 45.4 | 46.3 | 47.5 | 46.3 | 47.6 | 49.6 | 47.6 | 51.3 | 55.7 | 48.5 | 49.1 | 49.9 | 53.0 | 55.6 | 58.5 |
| 18 | 47.5 | 48.4 | 50.2 | 46.4 | 47.8 | 50.2 | 47.5 | 48.5 | 50.0 | 48.2 | 49.2 | 50.3 | 48.1 | 50.5 | 53.7 | 53.2 | 56.1 | 59.4 |
| 19 | 47.1 | 47.7 | 49.2 | 46.8 | 48.0 | 50.0 | 46.7 | 49.1 | 52.3 | 46.6 | 49.7 | 53.5 | 48.3 | 51.6 | 55.6 | 53.3 | 56.2 | 58.9 |
| 20 | 46.9 | 47.6 | 49.0 | 46.1 | 47.6 | 48.7 | 47.5 | 50.1 | 53.5 | 47.0 | 50.5 | 54.7 | 48.0 | 52.1 | 56.6 | 53.5 | 56.5 | 59.7 |
| 21 | 46.2 | 47.2 | 49.2 | 44.4 | 45.5 | 46.8 | 47.8 | 49.5 | 51.6 | 49.0 | 51.6 | 55.2 | 48.9 | 53.2 | 57.9 | 53.2 | 56.2 | 60.0 |
| 22 | | | | 45.0 | 45.8 | 48.4 | 47.6 | 49.7 | 52.9 | 49.2 | 52.5 | 56.6 | 50.2 | 53.3 | 56.8 | 53.4 | 56.2 | 59.1 |
| 23 | 47.4 | 48.2 | 50.0 | 45.1 | 46.4 | 48.9 | 47.5 | 49.2 | 51.4 | 50.6 | 53.0 | 56.4 | 51.5 | 52.7 | 55.1 | 53.6 | 57.3 | 61.1 |
| 24 | 47.4 | 48.3 | 49.1 | 46.4 | 47.5 | 49.4 | 47.5 | 49.1 | 51.5 | 50.0 | 52.0 | 54.9 | 50.8 | 52.7 | 54.6 | 55.1 | 58.1 | 61.4 |
| 25 | 46.8 | 47.8 | 49.4 | 45.0 | 45.9 | 47.4 | 47.7 | 49.3 | 51.9 | 49.2 | 50.6 | 52.9 | 50.9 | 54.4 | 58.6 | 55.5 | 57.8 | 61.9 |
| 26 | 45.4 | 46.1 | 46.9 | 44.2 | 45.8 | 47.8 | 48.1 | 50.0 | 52.7 | 48.5 | 49.2 | 50.0 | 52.2 | 54.2 | 57.4 | 54.7 | 58.8 | 63.4 |
| 27 | 44.5 | 45.7 | 46.8 | 44.4 | 45.8 | 48.2 | 48.6 | 51.2 | 54.8 | 47.5 | 51.3 | 55.8 | 52.1 | 54.2 | 56.4 | 55.1 | 59.5 | 64.0 |
| 28 | 45.8 | 46.5 | 47.7 | 45.4 | 46.1 | 48.0 | 48.6 | 50.0 | 52.3 | 48.7 | 52.8 | 57.4 | 51.7 | 53.6 | 56.6 | 55.8 | 59.8 | 64.1 |
| 29 | 45.4 | 46.6 | 48.8 | | | | 47.7 | 49.8 | 52.4 | 49.9 | 53.7 | 58.3 | 52.0 | 54.6 | 58.6 | 56.0 | 59.6 | 64.1 |
| 30 | 45.5 | 46.7 | 48.6 | | | | 48.3 | 50.9 | 54.6 | 51.1 | 53.5 | 57.1 | 51.8 | 54.5 | 57.4 | 56.7 | 59.5 | 63.0 |
| 31 | 45.0 | 45.9 | 46.6 | | | | 49.0 | 51.1 | 53.5 | | | | 52.2 | 55.9 | 59.7 | | | |

Appendix 4 continued. Minimum, mean and maximum water temperatures (ºF) from Lewistown area waters in 2015.

**Big Spring Creek - Burleigh FAS (Coordinates = N 47.026990, E 109.377089)**

| | July | | | August | | | September | | | October | | | November | | | December | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** |
| 1 | 55.3 | 58.7 | 62.4 | 53.1 | 56.4 | 60.6 | 51.3 | 54.0 | 58.2 | 50.4 | 51.8 | 53.4 | 50.3 | 51.1 | 52.8 | 46.4 | 47.4 | 49.6 |
| 2 | 55.1 | 58.7 | 62.7 | 53.5 | 56.4 | 60.5 | 52.0 | 54.1 | 57.0 | 51.5 | 52.3 | 53.4 | 49.3 | 50.2 | 51.4 | 47.0 | 48.0 | 49.7 |
| 3 | 55.3 | 58.9 | 63.1 | 53.6 | 56.6 | 60.9 | 52.0 | 54.0 | 57.8 | 49.0 | 50.8 | 52.3 | 48.8 | 49.5 | 50.0 | 46.8 | 48.0 | 49.7 |
| 4 | 55.6 | 59.2 | 63.4 | 53.7 | 54.9 | 56.4 | 52.3 | 53.3 | 55.1 | 48.9 | 49.8 | 51.2 | 48.2 | 49.2 | 50.1 | 47.9 | 48.6 | 49.9 |
| 5 | 54.6 | 55.8 | 57.7 | 52.8 | 54.8 | 56.6 | 51.1 | 52.6 | 53.6 | 49.0 | 51.0 | 54.3 | 47.7 | 48.5 | 49.4 | 47.3 | 48.0 | 49.4 |
| 6 | 54.2 | 56.9 | 60.8 | 52.9 | 55.3 | 59.1 | 50.6 | 52.6 | 56.2 | 49.6 | 51.6 | 55.0 | 47.8 | 48.8 | 50.8 | 47.5 | 48.5 | 49.3 |
| 7 | 53.5 | 56.2 | 59.6 | 52.0 | 55.1 | 59.3 | 50.8 | 52.2 | 54.7 | 50.6 | 52.1 | 54.3 | 47.8 | 49.2 | 51.7 | 48.0 | 48.7 | 49.7 |
| 8 | 52.9 | 56.7 | 61.5 | 52.6 | 54.1 | 56.5 | 50.0 | 52.5 | 55.9 | 51.3 | 52.7 | 55.1 | 48.6 | 49.5 | 51.6 | 48.3 | 48.7 | 49.4 |
| 9 | 53.5 | 57.0 | 60.8 | 53.1 | 55.8 | 60.0 | 51.0 | 53.1 | 56.2 | 51.2 | 52.6 | 55.7 | 48.4 | 49.2 | 50.8 | 47.4 | 48.4 | 49.2 |
| 10 | 54.2 | 56.5 | 59.5 | 53.1 | 56.0 | 60.3 | 51.5 | 53.5 | 56.6 | 51.5 | 53.1 | 56.2 | 48.3 | 48.9 | 49.4 | 47.3 | 47.8 | 48.6 |
| 11 | 55.0 | 56.3 | 58.1 | 53.4 | 56.4 | 60.8 | 51.5 | 53.9 | 57.7 | 50.0 | 51.5 | 53.0 | 47.2 | 48.2 | 50.0 | 47.1 | 48.3 | 49.4 |
| 12 | 54.7 | 56.5 | 59.2 | 53.7 | 55.6 | 57.8 | 51.4 | 53.9 | 58.1 | 49.3 | 51.3 | 54.4 | 47.2 | 48.1 | 49.7 | 46.8 | 47.7 | 49.0 |
| 13 | 53.4 | 56.9 | 60.9 | 53.4 | 56.2 | 60.3 | 51.3 | 53.8 | 57.5 | 49.9 | 51.6 | 54.3 | 47.8 | 49.3 | 50.4 | 47.8 | 48.5 | 49.3 |
| 14 | 54.8 | 57.4 | 60.7 | 53.8 | 56.1 | 60.0 | 51.6 | 53.7 | 56.9 | 50.1 | 51.5 | 54.2 | 49.4 | 49.9 | 50.8 | 45.8 | 47.4 | 48.9 |
| 15 | 54.3 | 56.2 | 58.7 | 53.5 | 55.8 | 59.1 | 52.2 | 53.0 | 54.6 | 49.4 | 50.7 | 53.4 | 48.5 | 49.6 | 51.4 | 46.3 | 47.2 | 48.1 |
| 16 | 53.4 | 55.6 | 59.4 | 52.9 | 54.0 | 56.4 | 50.4 | 51.7 | 52.1 | 48.9 | 50.6 | 53.6 | 47.8 | 48.4 | 49.0 | 46.4 | 47.2 | 48.2 |
| 17 | 52.9 | 55.2 | 58.7 | 52.1 | 53.3 | 54.4 | 49.6 | 51.9 | 55.1 | 49.2 | 51.1 | 54.3 | 47.1 | 48.4 | 50.2 | 45.6 | 46.7 | 48.3 |
| 18 | 53.3 | 55.6 | 59.3 | 51.6 | 52.9 | 55.3 | 50.1 | 52.2 | 55.7 | 50.1 | 51.5 | 53.6 | 46.3 | 47.4 | 48.7 | 46.1 | 47.7 | 48.9 |
| 19 | 52.9 | 55.8 | 59.9 | 51.2 | 54.4 | 58.7 | 50.4 | 52.5 | 56.1 | 50.1 | 51.5 | 53.4 | 47.4 | 47.9 | 48.6 | 47.9 | 48.3 | 49.2 |
| 20 | 53.7 | 56.8 | 60.8 | 52.4 | 54.7 | 57.9 | 50.9 | 52.9 | 56.3 | 49.6 | 51.1 | 51.7 | 46.4 | 47.3 | 47.9 | 46.3 | 47.3 | 48.5 |
| 21 | 54.0 | 56.5 | 59.6 | 52.5 | 54.1 | 57.4 | 51.8 | 53.4 | 56.6 | 49.1 | 50.7 | 53.6 | 46.7 | 47.5 | 49.0 | 47.0 | 47.8 | 48.9 |
| 22 | 53.3 | 55.7 | 58.7 | 50.8 | 52.2 | 54.6 | 51.3 | 53.4 | 56.9 | 49.0 | 50.5 | 53.3 | 47.5 | 48.2 | 49.5 | 47.2 | 47.8 | 48.2 |
| 23 | 54.1 | 55.5 | 58.8 | 49.8 | 53.2 | 57.4 | 51.5 | 53.5 | 57.2 | 48.9 | 50.3 | 52.8 | 47.9 | 48.6 | 50.1 | 46.2 | 47.1 | 48.4 |
| 24 | 52.9 | 55.6 | 58.6 | 51.5 | 54.7 | 58.2 | 51.4 | 53.5 | 56.7 | 48.5 | 50.1 | 52.3 | 46.3 | 47.7 | 48.2 | 46.2 | 47.4 | 48.9 |
| 25 | 53.2 | 55.9 | 59.1 | 52.4 | 55.1 | 58.5 | 51.4 | 53.7 | 57.2 | 49.5 | 50.8 | 52.6 | 45.9 | 46.6 | 47.8 | 45.6 | 46.7 | 47.7 |
| 26 | 53.7 | 56.7 | 60.7 | 53.1 | 55.2 | 58.9 | 51.5 | 53.3 | 56.7 | 49.4 | 50.4 | 51.4 | 45.2 | 46.3 | 48.5 | 45.6 | 46.5 | 48.4 |
| 27 | 52.1 | 54.2 | 55.6 | 52.6 | 54.0 | 56.2 | 51.1 | 52.7 | 55.8 | 48.7 | 49.5 | 50.0 | 45.5 | 46.7 | 49.1 | 45.9 | 47.3 | 49.2 |
| 28 | 52.4 | 54.5 | 57.4 | 51.9 | 54.1 | 57.8 | 50.2 | 52.2 | 55.2 | 47.7 | 49.2 | 51.6 | 46.3 | 47.0 | 49.2 | 46.9 | 47.4 | 48.5 |
| 29 | 52.1 | 55.5 | 59.8 | 52.9 | 54.1 | 56.6 | 50.0 | 52.2 | 55.9 | 48.2 | 49.5 | 51.2 | 46.3 | 47.1 | 49.1 | 46.8 | 47.1 | 48.0 |
| 30 | 52.8 | 56.1 | 60.3 | 52.9 | 54.3 | 58.1 | 50.1 | 52.3 | 55.9 | 48.9 | 50.0 | 51.5 | 46.5 | 47.3 | 49.2 | 46.6 | 47.1 | 48.0 |
| 31 | 53.3 | 56.4 | 60.6 | 51.6 | 53.6 | 56.6 | | | | 49.9 | 50.8 | 51.8 | | | | 46.2 | 47.1 | 48.5 |

Appendix 4 continued. Minimum, mean and maximum water temperatures (ºF) from Lewistown area waters in 2015.

**Big Spring Creek - Hruska FAS (Coordinates = N 47.1130, E -109.5096)**

| | January | | | February | | | March | | | April | | | May | | | June | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** |
| 1 | 38.6 | 41.0 | 43.4 | 35.9 | 38.7 | 42.6 | 36.9 | 40.7 | 44.3 | 45.9 | 47.9 | 51.4 | 49.2 | 54.0 | 57.9 | 55.9 | 59.8 | 63.2 |
| 2 | 38.6 | 40.8 | 42.5 | 40.8 | 42.5 | 43.8 | 38.2 | 40.5 | 42.4 | 42.5 | 45.4 | 48.3 | 50.5 | 54.4 | 57.9 | 56.2 | 58.6 | 61.4 |
| 3 | 35.1 | 37.0 | 40.2 | 38.5 | 40.6 | 43.5 | 35.3 | 38.1 | 40.4 | 42.5 | 46.2 | 49.3 | 50.7 | 55.2 | 59.8 | 53.6 | 57.7 | 61.4 |
| 4 | 34.7 | 35.6 | 36.4 | 36.6 | 39.6 | 42.8 | 34.5 | 39.1 | 43.3 | 43.5 | 47.2 | 49.9 | 49.9 | 54.9 | 59.0 | 55.5 | 58.7 | 61.7 |
| 5 | 35.5 | 37.4 | 39.5 | 41.6 | 43.5 | 45.1 | 38.1 | 42.3 | 46.1 | 43.8 | 45.4 | 47.6 | 50.6 | 54.7 | 58.5 | 55.7 | 59.2 | 62.3 |
| 6 | 35.6 | 37.2 | 38.4 | 43.0 | 44.3 | 46.8 | 40.7 | 44.2 | 47.6 | 42.7 | 44.2 | 46.8 | 51.0 | 53.4 | 55.2 | 56.3 | 60.5 | 64.4 |
| 7 | 36.5 | 38.9 | 42.0 | 42.6 | 43.1 | 44.0 | 41.6 | 44.1 | 46.0 | 40.9 | 46.7 | 51.9 | 48.1 | 50.8 | 53.2 | 56.8 | 61.4 | 65.4 |
| 8 | 34.7 | 38.4 | 42.2 | 41.7 | 43.2 | 45.2 | 42.4 | 45.4 | 49.0 | 44.6 | 49.0 | 53.2 | 48.5 | 50.0 | 51.9 | 57.6 | 62.7 | 67.2 |
| 9 | 32.7 | 35.2 | 38.5 | 41.0 | 42.6 | 44.1 | 41.7 | 45.7 | 49.4 | 44.8 | 49.5 | 54.0 | 45.8 | 50.4 | 54.2 | 59.1 | 63.4 | 67.2 |
| 10 | 38.5 | 40.3 | 42.0 | 42.1 | 42.8 | 43.9 | 42.1 | 46.3 | 49.9 | 45.0 | 50.1 | 54.5 | 45.9 | 51.2 | 56.1 | 59.7 | 61.9 | 64.5 |
| 11 | 38.8 | 40.4 | 41.6 | 41.4 | 42.2 | 43.9 | 43.7 | 46.8 | 49.0 | 47.3 | 49.3 | 51.1 | 46.8 | 52.8 | 57.6 | 56.8 | 61.3 | 65.8 |
| 12 | 36.2 | 38.3 | 39.9 | 41.1 | 43.9 | 46.7 | 44.8 | 48.1 | 51.4 | 44.9 | 47.3 | 50.0 | 49.7 | 52.0 | 54.2 | 57.8 | 61.6 | 65.1 |
| 13 | 36.9 | 38.9 | 40.8 | 43.4 | 45.8 | 48.5 | 43.3 | 47.5 | 51.1 | 42.8 | 48.9 | 54.3 | 50.0 | 54.6 | 59.7 | 56.1 | 60.4 | 64.5 |
| 14 | 37.1 | 39.5 | 41.7 | 43.7 | 45.2 | 46.7 | 44.5 | 47.1 | 49.1 | 46.9 | 50.5 | 54.4 | 51.4 | 54.0 | 57.2 | 55.8 | 57.9 | 60.6 |
| 15 | 38.8 | 40.9 | 43.0 | 43.2 | 44.3 | 45.5 | 46.5 | 47.7 | 48.5 | 41.6 | 45.8 | 48.9 | 50.4 | 51.6 | 53.1 | 53.4 | 56.0 | 58.1 |
| 16 | 40.6 | 42.4 | 44.4 | 40.5 | 42.2 | 43.8 | 44.2 | 46.3 | 48.0 | 43.3 | 49.2 | 54.8 | 49.7 | 51.0 | 52.0 | 53.1 | 57.9 | 62.3 |
| 17 | 39.7 | 41.7 | 43.5 | 39.4 | 41.2 | 43.3 | 42.4 | 44.5 | 46.3 | 45.6 | 51.4 | 56.5 | 47.3 | 48.3 | 49.6 | 54.6 | 57.8 | 60.9 |
| 18 | 42.1 | 43.6 | 45.4 | 41.1 | 43.5 | 46.3 | 44.9 | 46.4 | 48.1 | 46.1 | 48.6 | 52.2 | 46.5 | 49.6 | 52.8 | 55.3 | 58.9 | 62.8 |
| 19 | 41.0 | 42.5 | 43.6 | 42.0 | 44.5 | 46.8 | 43.2 | 47.3 | 51.2 | 43.7 | 48.3 | 52.9 | 48.0 | 52.1 | 56.6 | 55.9 | 59.0 | 62.1 |
| 20 | 41.0 | 42.1 | 43.1 | 42.6 | 44.0 | 45.4 | 45.3 | 49.3 | 52.9 | 44.0 | 49.8 | 54.6 | 48.1 | 53.1 | 57.7 | 55.1 | 59.0 | 62.7 |
| 21 | 38.7 | 40.4 | 41.9 | 37.8 | 40.0 | 42.6 | 45.8 | 48.3 | 50.5 | 47.0 | 52.0 | 57.1 | 49.2 | 54.8 | 59.9 | 55.3 | 58.6 | 61.2 |
| 22 | | | | 34.9 | 38.1 | 41.1 | 45.0 | 48.7 | 52.1 | 48.1 | 53.4 | 58.5 | 51.1 | 55.1 | 58.0 | 54.7 | 58.7 | 62.6 |
| 23 | 41.0 | 43.3 | 45.1 | 35.4 | 39.7 | 44.2 | 44.2 | 47.2 | 49.0 | 50.6 | 54.8 | 58.8 | 52.7 | 53.8 | 55.2 | 55.0 | 60.4 | 65.7 |
| 24 | 43.5 | 44.3 | 45.5 | 41.9 | 44.0 | 46.4 | 45.2 | 47.5 | 50.6 | 49.6 | 52.8 | 55.7 | 51.1 | 53.4 | 56.3 | 58.0 | 62.0 | 65.7 |
| 25 | 42.1 | 44.3 | 46.4 | 39.4 | 41.1 | 44.3 | 44.3 | 47.4 | 50.1 | 48.3 | 50.7 | 53.3 | 51.3 | 56.5 | 61.6 | 58.3 | 61.6 | 65.3 |
| 26 | 41.0 | 42.2 | 44.9 | 37.4 | 39.3 | 42.2 | 46.3 | 49.1 | 51.5 | 47.1 | 48.0 | 50.0 | 53.8 | 56.4 | 59.6 | 57.2 | 62.9 | 68.2 |
| 27 | 41.1 | 42.3 | 43.6 | 34.3 | 38.0 | 41.0 | 46.4 | 51.0 | 55.5 | 44.8 | 50.7 | 56.4 | 52.9 | 56.3 | 59.5 | 58.4 | 64.4 | 69.7 |
| 28 | 41.2 | 42.4 | 43.5 | 37.5 | 39.6 | 42.2 | 46.9 | 48.9 | 51.6 | 47.8 | 53.9 | 59.3 | 53.2 | 55.3 | 57.7 | 60.2 | 65.4 | 70.2 |
| 29 | 39.6 | 41.8 | 43.5 | | | | 44.7 | 48.2 | 51.3 | 49.9 | 55.7 | 60.7 | 52.4 | 56.2 | 60.2 | 59.9 | 64.9 | 69.8 |
| 30 | 39.5 | 41.7 | 43.5 | | | | 46.1 | 50.8 | 55.2 | 51.8 | 55.8 | 59.3 | 53.1 | 56.3 | 58.7 | 60.9 | 65.2 | 69.3 |
| 31 | 37.9 | 39.9 | 41.8 | | | | 47.1 | 50.6 | 53.1 | | | | 52.9 | 58.0 | 63.0 | | | |

Appendix 4 continued. Minimum, mean and maximum water temperatures (ºF) from Lewistown area waters in 2015.

**Big Spring Creek – Hruska FAS (Coordinates = N 47.1130, E -109.5096)**

| | July | | | August | | | September | | | October | | | November | | | December | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** | **Min** | **Mean** | **Max** |
| 1 | 58.8 | 64.0 | 68.9 | 57.0 | 60.7 | 63.7 | 53.6 | 57.0 | 59.6 | 49.7 | 51.9 | 53.9 | 48.9 | 50.1 | 51.7 | 37.7 | 40.0 | 41.9 |
| 2 | 58.7 | 63.6 | 68.1 | 57.4 | 60.9 | 63.6 | 54.6 | 57.2 | 58.7 | 51.3 | 52.6 | 53.4 | 46.3 | 48.0 | 49.5 | 39.3 | 41.7 | 43.7 |
| 3 | 59.0 | 64.3 | 69.1 | 58.3 | 61.2 | 63.6 | 54.2 | 56.9 | 59.1 | 47.7 | 50.6 | 53.4 | 45.7 | 46.8 | 48.0 | 40.2 | 42.2 | 44.0 |
| 4 | 59.4 | 64.9 | 69.9 | 58.3 | 59.4 | 62.6 | 54.1 | 55.5 | 57.5 | 46.1 | 47.4 | 48.8 | 45.1 | 45.7 | 46.8 | 43.4 | 44.3 | 45.7 |
| 5 | 56.2 | 59.1 | 65.1 | 56.1 | 57.6 | 58.7 | 53.2 | 54.2 | 55.3 | 45.8 | 49.5 | 52.8 | 42.8 | 44.0 | 45.0 | 41.5 | 42.8 | 43.9 |
| 6 | 55.3 | 60.0 | 65.3 | 56.3 | 58.6 | 60.8 | 50.8 | 53.3 | 55.4 | 47.0 | 50.9 | 54.1 | 42.9 | 44.4 | 45.7 | 41.6 | 43.1 | 44.5 |
| 7 | 55.7 | 59.3 | 62.6 | 55.3 | 58.4 | 61.1 | 51.3 | 53.3 | 54.9 | 49.3 | 52.3 | 54.1 | 42.5 | 45.2 | 47.6 | 43.0 | 44.3 | 45.7 |
| 8 | 54.3 | 60.4 | 66.3 | 55.9 | 57.3 | 59.7 | 49.8 | 53.0 | 55.6 | 51.3 | 53.9 | 56.8 | 44.4 | 46.3 | 48.4 | 44.8 | 45.6 | 46.3 |
| 9 | 56.2 | 61.5 | 66.4 | 55.8 | 58.8 | 62.3 | 52.1 | 54.7 | 56.9 | 50.7 | 53.7 | 56.6 | 44.1 | 45.7 | 46.8 | 43.5 | 45.3 | 46.3 |
| 10 | 56.7 | 60.4 | 63.8 | 56.9 | 60.1 | 62.7 | 52.8 | 55.7 | 58.4 | 51.4 | 54.7 | 57.8 | 44.6 | 45.2 | 46.6 | 41.6 | 42.5 | 43.5 |
| 11 | 57.6 | 59.7 | 62.8 | 57.2 | 60.9 | 64.0 | 53.3 | 56.5 | 59.1 | 49.2 | 51.8 | 54.9 | 42.2 | 43.6 | 44.6 | 42.7 | 43.7 | 45.2 |
| 12 | 57.2 | 60.5 | 63.8 | 57.9 | 60.1 | 62.5 | 53.0 | 56.6 | 59.5 | 46.5 | 50.1 | 53.1 | 41.2 | 42.8 | 44.2 | 40.4 | 42.0 | 43.0 |
| 13 | 55.9 | 61.3 | 66.5 | 57.2 | 60.6 | 63.6 | 52.9 | 56.5 | 59.1 | 48.0 | 51.2 | 53.3 | 42.4 | 44.5 | 46.4 | 41.9 | 43.3 | 44.9 |
| 14 | 58.1 | 62.5 | 66.3 | 58.0 | 61.0 | 63.5 | 53.3 | 56.1 | 57.8 | 48.9 | 51.5 | 53.8 | 45.7 | 46.8 | 47.8 | 39.4 | 42.5 | 44.9 |
| 15 | 57.3 | 60.0 | 62.3 | 58.3 | 60.6 | 62.3 | 53.8 | 55.1 | 57.0 | 46.6 | 49.4 | 51.8 | 44.8 | 46.7 | 48.1 | 39.3 | 40.7 | 42.5 |
| 16 | 55.5 | 59.3 | 62.8 | 55.8 | 57.8 | 60.1 | 50.6 | 52.6 | 54.7 | 45.4 | 48.7 | 50.9 | 43.3 | 44.3 | 46.6 | 38.5 | 40.0 | 41.6 |
| 17 | 54.2 | 58.1 | 62.4 | 54.6 | 55.7 | 57.2 | 48.5 | 51.8 | 54.5 | 46.2 | 49.8 | 52.8 | 41.7 | 43.6 | 45.2 | 37.9 | 38.9 | 40.2 |
| 18 | 54.9 | 59.1 | 64.1 | 52.8 | 54.3 | 56.2 | 49.7 | 52.6 | 54.9 | 48.2 | 50.8 | 52.6 | 40.8 | 42.2 | 44.9 | 38.0 | 40.2 | 43.2 |
| 19 | 54.6 | 59.5 | 62.7 | 52.3 | 56.1 | 59.7 | 49.7 | 53.2 | 55.7 | 48.3 | 50.8 | 52.6 | 40.5 | 42.3 | 44.2 | 42.8 | 43.6 | 44.4 |
| 20 | 56.3 | 61.7 | 66.7 | 55.2 | 57.6 | 59.4 | 50.8 | 54.1 | 56.9 | 48.2 | 50.7 | 52.6 | 39.6 | 41.6 | 42.8 | 40.3 | 41.7 | 44.0 |
| 21 | 57.3 | 61.5 | 65.0 | 55.0 | 56.9 | 58.7 | 52.2 | 55.4 | 58.3 | 45.8 | 49.0 | 51.7 | 38.5 | 40.8 | 43.1 | 39.3 | 40.8 | 43.0 |
| 22 | 55.7 | 59.7 | 63.3 | 52.9 | 54.4 | 56.9 | 51.9 | 55.3 | 58.0 | 45.9 | 48.9 | 51.1 | 40.6 | 43.1 | 45.3 | 41.9 | 42.6 | 43.0 |
| 23 | 56.6 | 59.0 | 62.4 | 50.8 | 54.1 | 57.2 | 52.2 | 55.8 | 58.5 | 45.3 | 48.4 | 50.3 | 43.5 | 44.8 | 45.9 | 39.4 | 40.6 | 41.9 |
| 24 | 54.7 | 59.5 | 63.1 | 53.3 | 56.5 | 59.2 | 52.3 | 55.8 | 58.3 | 44.5 | 47.6 | 49.5 | 39.7 | 42.8 | 44.9 | 38.9 | 40.3 | 41.9 |
| 25 | 55.3 | 60.0 | 63.6 | 55.1 | 57.7 | 59.8 | 52.7 | 56.3 | 58.6 | 47.3 | 49.4 | 51.1 | 37.6 | 38.9 | 40.2 | 37.6 | 39.2 | 40.8 |
| 26 | 56.5 | 61.2 | 65.4 | 56.2 | 58.7 | 60.6 | 52.6 | 55.3 | 57.2 | 47.3 | 48.5 | 49.5 | 35.1 | 37.1 | 38.9 | 35.7 | 37.3 | 38.7 |
| 27 | 54.1 | 57.6 | 61.9 | 55.9 | 57.6 | 60.0 | 51.9 | 54.6 | 56.8 | 45.2 | 46.8 | 48.0 | 35.1 | 37.7 | 39.9 | 36.7 | 38.8 | 41.2 |
| 28 | 53.5 | 55.6 | 58.2 | 54.2 | 57.2 | 59.5 | 49.6 | 52.8 | 55.2 | 43.3 | 45.8 | 48.1 | 36.9 | 39.0 | 41.0 | 39.7 | 40.7 | 41.4 |
| 29 | 54.0 | 58.1 | 61.8 | 55.8 | 57.5 | 58.6 | 48.9 | 52.7 | 55.6 | 43.7 | 46.1 | 48.1 | 37.0 | 39.2 | 41.0 | 39.4 | 40.1 | 41.0 |
| 30 | 55.6 | 59.7 | 63.3 | 55.6 | 57.8 | 60.1 | 48.9 | 52.8 | 55.6 | 45.4 | 47.1 | 48.3 | 37.6 | 39.7 | 41.7 | 39.0 | 40.0 | 41.0 |
| 31 | 56.6 | 60.5 | 63.9 | 54.1 | 56.8 | 58.8 | | | | 47.1 | 48.7 | 50.3 | 48.9 | 50.1 | 51.7 | 39.4 | 40.1 | 41.2 |