TRIP REPORT

State of Alaska
Department of Fish and Game

Field Dates:	May 2 - 17, 2022
Location:	**Fort Knox Mine – Water Supply Reservoir (WSR) and Wetlands**
Objectives:	1) Spring Arctic grayling sampling in WSR and wetlands complex
	2) Water temperature monitoring in Pond F outlet and North Creek
Participants:	Chad Bear, Justin Burrows, Olivia Edwards, Chelsea Clawson, Kieren Vasquez and Haley Sorensen
Weather:	Sunny, rain, wind, snow, hail, air temperature between -2°C and 10°C
Access:	State truck to Fish Creek

On April 14, 2022, Chad Bear and Justin Burrows traveled to the Fort Knox Mine for the annual late winter Water Supply Reservoir (WSR) water quality sampling event (see ADF&G Trip report: *04-14-22; Bear; Fort Knox WSR Winter Water Quality Sampling*). After sampling the WSR, two HOBO water temperature probes were placed in the wetlands complex, one in Fish Creek at the Pond F outlet and one in North Fork Fish Creek (Figure 1). The majority of Fish Creek was ice covered. Ice appeared soft and thin but very little exposed flowing water was visible. The water temperature of Fish Creek at Pond F was 0.84°C. North Fork Fish Creek had mostly open water throughout the drainage but also sections with overflow and glaciated ice in the creek bed. North Fork Fish Creek was 2.69°C taken in open water near its confluence with Fish Creek. Conditions were determined to be appropriate to begin fyke netting Arctic grayling on May 2. This sampling start date was three days later than in 2021.

During 2021 and spring of 2022 improvements and widening were made to Centerline Road and the Gil Haul Road causeway across the WSR (Figure 2). Fork Knox broke ground on the Gil Expansion project in the fall of 2021 and began hauling ore eight miles to the Fort Knox mill. Centerline Road travels down Fish Creek valley with Fish Creek on the south side and North Fork Fish Creek on the north side. Three Fish Creek culverts were extended to accommodate the wider road for haul trucks.

The winter of 2022 had heavy snowfall and precipitation that resulted in runoff from the new road surface entering both Fish Creek and North Fork Fish Creek at several locations. The runoff was high in total suspended sediments, and it visually increased the turbidity in Fish Creek (Figure 3) and North Fork Fish Creek. Fort Knox staff were working on the storm water prevention measures while we were on site and improved the diversion of this spring melt water away from the creek. Water clarity visually improved as the spring melt water diminished, and new sediment control measures became effective.

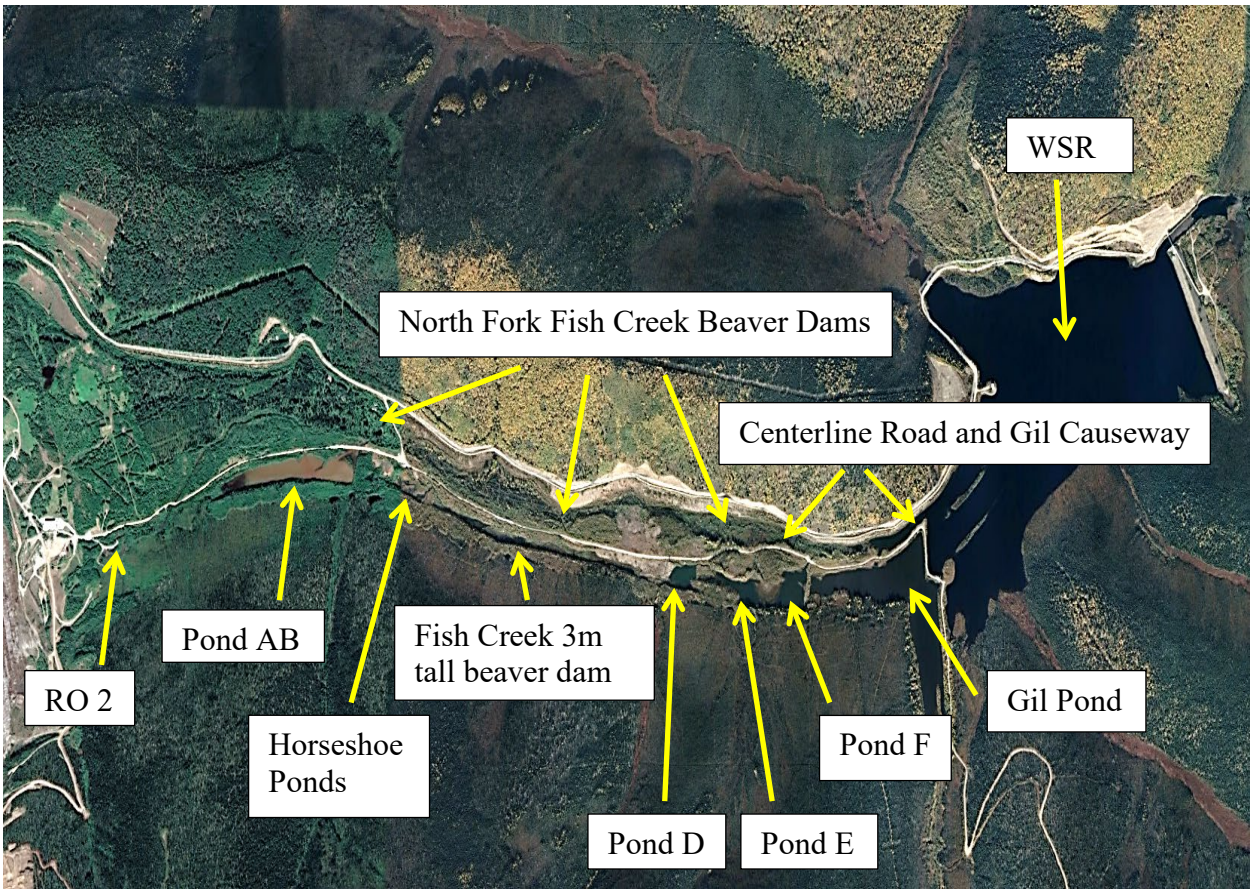

Figure 1. Fish Creek wetland features including 2022 beaver dam locations.

Figure 2. Centerline Road widened and improved during 2021 and 2022.

Figure 3. Fish Creek during spring runoff and beaver dam blocking Pond D outlet, May 11, 2022.

In winter 2021/2022, aufeis in Fish Creek was minimal. North Fork Fish Creek had substantial aufeis and formed glaciers of frozen overflow two to three feet deep throughout the drainage. A channel with open water was flowing on April 14, 2022, from the discharged warm RO water from Outfall 002. Beaver dams throughout the lower wetlands complex and Pond D and F outlets had been rebuilt during fall of 2021 or spring of 2022 (Figures 1 and 3). Fort Knox staff were successful in removing several resident beavers from Fish Creek during the summer of 2021 to maintain fish passage, but the remaining beavers reestablished many of the dams. Arctic grayling had access to the Fish Creek wetland complex (Ponds D, E, and F) during most of the summer of 2021, but access was limited by a 3-meter-tall beaver dam in the channel connecting Pond D and the Horseshoe Ponds (Figure 4). No Arctic grayling were observed upstream of this dam during the two weeks of sampling in spring 2022. In North Fork Fish Creek, a series of six or more smaller beaver dams were creating partial obstructions to fish and creating ponds between Pond AB and its confluence with Fish Creek (Figure 5).

Figure 4. A beaver dam (about 3 m high) located in the channel below Horseshoe Ponds.

Figure 5. Beaver dams in North Fork Fish Creek limiting fish movement.

Fyke nets were set in Fish Creek at the Pond F outlet (Figure 6) and North Fork Fish Creek (Figure 7) on May 2. Both fyke nets were fished in the same locations without being moved for the duration of the sample period. Beginning on May 3, the fyke nets were checked daily except on May 14 and 15 until they were removed on May 17. A third fyke net was placed in Pond AB on May 9 to determine the presence of fish residing in the upper wetlands (Figure 8). Capture efficiency declined in the North Fork Fish Creek fyke net on May 7 when a new channel thawed around the fyke, which allowed fish to avoid capture. Capture efficiency was also reduced in both nets by numerous holes chewed by muskrats, beaver or other aquatic mammals residing in the wetlands (Figure 9).

Figure 6. Fish Creek Pond F fyke net and open water, May 2, 2022.

Figure 7. North Fork Fish Creek fyke net and open water, May 9, 2022.

Figure 8. Pond AB fyke net, May 9, 2022.

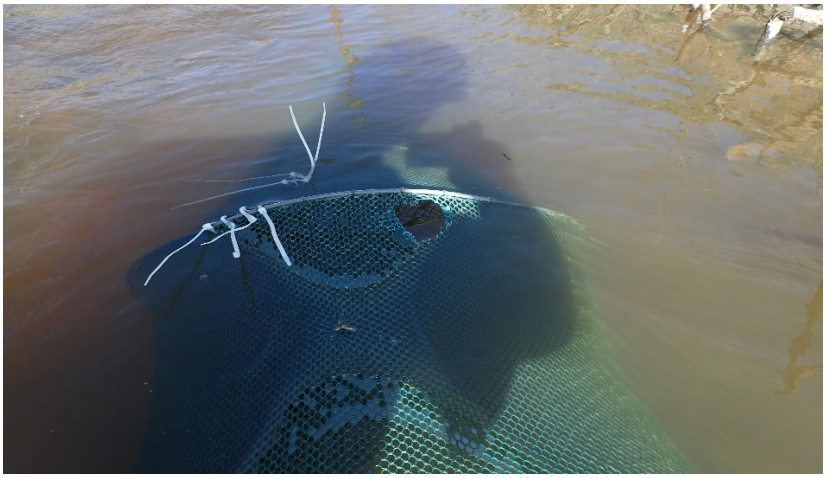

Figure 9. Holes chewed in fyke nets from aquatic mammals reducing capture efficiency multiple times during sampling.

The 2022 Fish Creek daily peak water temperature taken at the Pond F outlet was similar when compared to previous years during similar timing (Figure 10). Fish Creek water temperature was 1.83°C on April 22 from natural spring melt water entering the drainage. The Fish Creek daily peak water temperature and timing were like 2021 and 2020 but dissimilar to 2019 when all discharged RO water was diverted into Fish Creek. North Fork Fish Creek water temperature data collection began on April 22 and was warmer at 4.79°C compared to Fish Creek temperature of 1.83°C (Figure 11). The warmer water temperature resulted from the up to 3,000 gpm discharge of RO water from Outfall 002. The large volume of warm water dilutes the influx of cold spring melt water thereby keeping North Fork Fish Creek warmer than Fish Creek (Figure 11). Fyke netting started on May 2 as water temperatures were suitable for Arctic grayling movement.

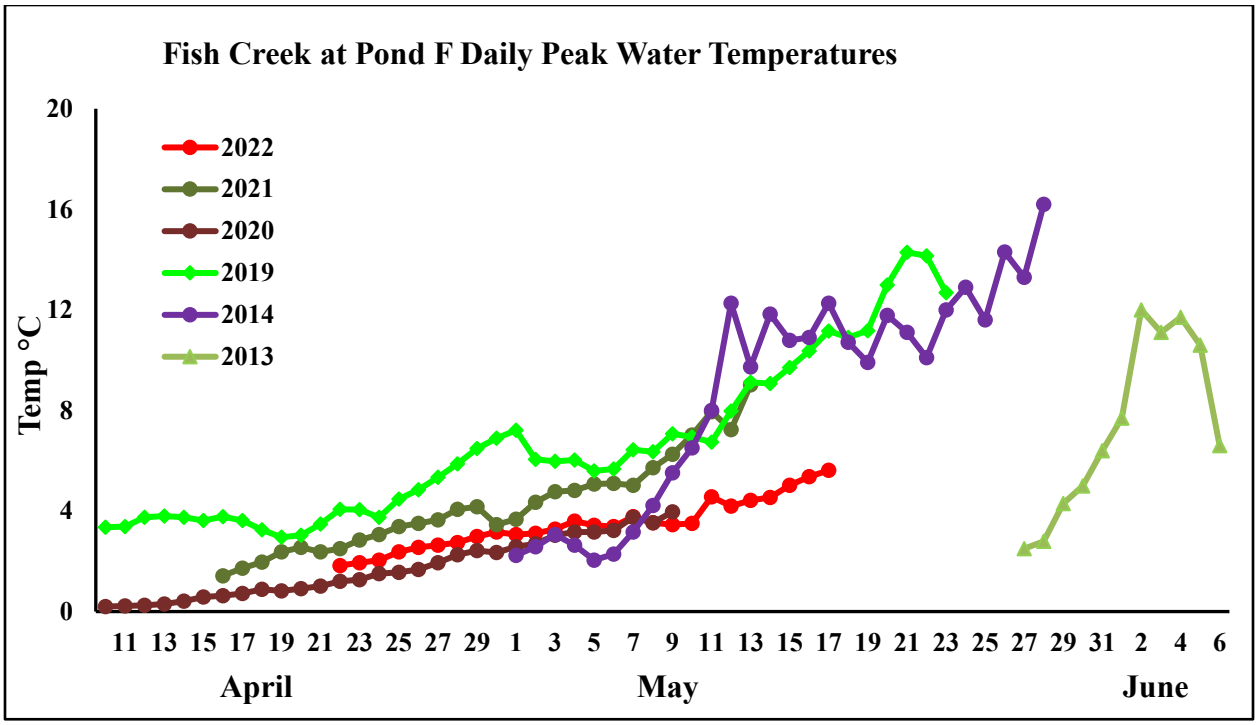

Figure 10. Fish Creek at Pond F daily water temperature maximums; select years for reference.

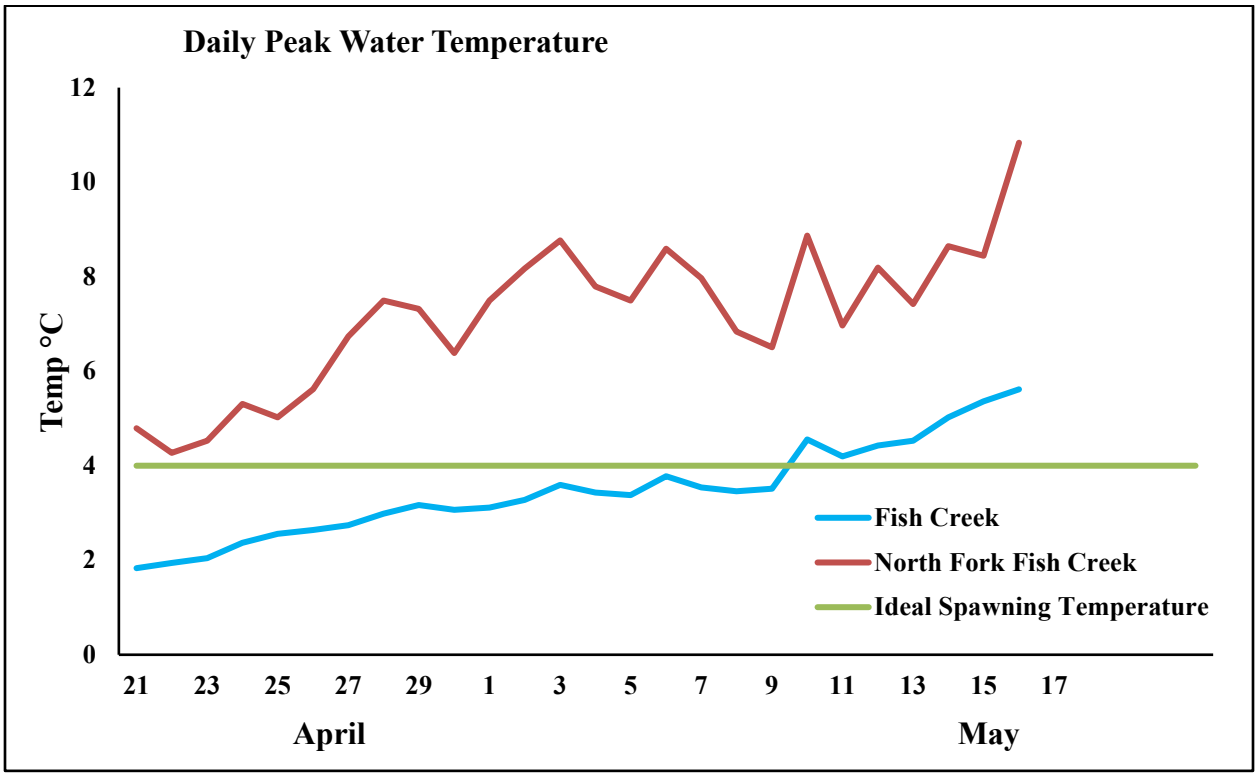

Figure 11. Fish Creek and North Fork Fish Creek daily peak water temperature 2022.

From May 3 to May 17, all fish caught in fyke nets were handled with the majority being Arctic grayling. Burbot also were captured. The Arctic grayling catch per unit of effort (CPUE) in Fish Creek varied during the first few days of sampling and peaked at 1.90 fish/hour on May 13 (Figure 12). The North Fork Fish Creek fyke net CPUE varied greatly during sampling as catches were affected by numerous holes in the fyke net created by aquatic mammals. Days without holes from aquatic mammals had substantially higher numbers of fish. North Fork Fish Creek CPUE reached a high of 5.75 fish/hour on May 6 and catch rates declined in part due to a previously frozen channel that thawed around the fyke net allowing fish an alternate route. Water temperatures were warmer in North Fork Fish Creek, 7.49°C on May 2 compared to 3.12°C in Fish Creek. The fyke nets were pulled on May 17 as water temperature increased past the ideal spawning temperature of 4°C in Fish Creek.

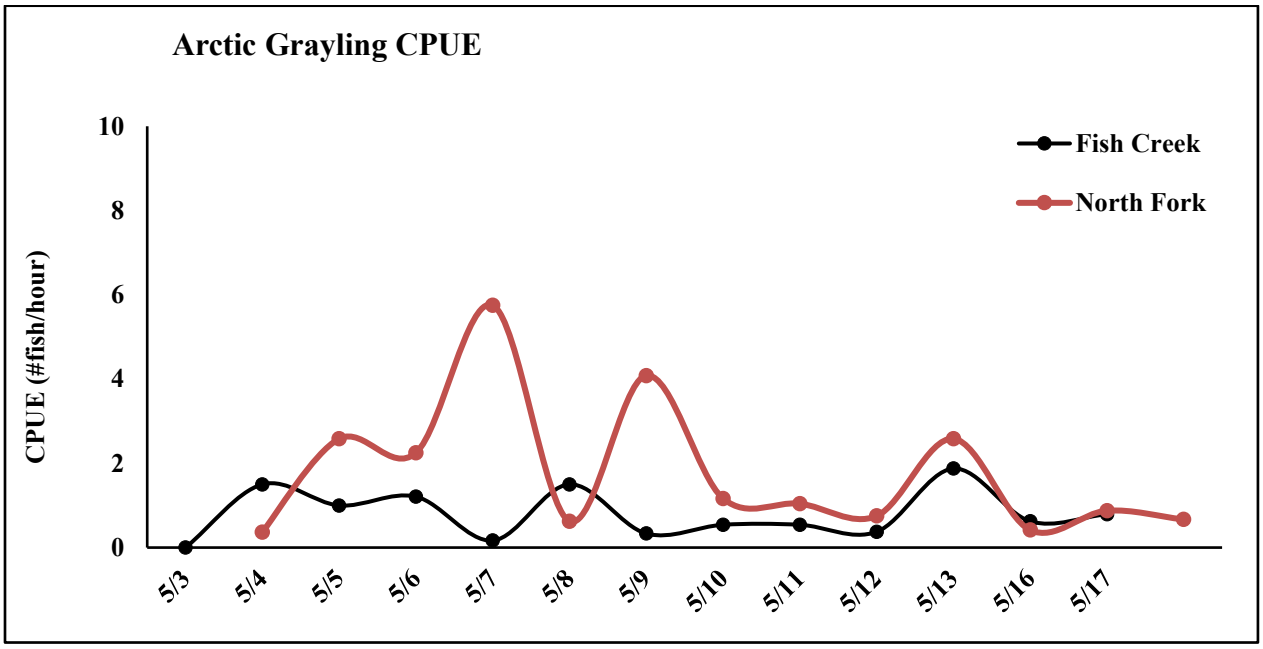

Figure 12. Catch per unit of effort (CPUE) in #fish/hr at the Pond F and North Fork Fish Creek fyke nets in the wetlands complex, 2022.

Female Arctic grayling were categorized as not ripe, ripe, or spent, based on their spawning condition (Figure 13). On the first day of fish capture (May 3), 75% of the female Arctic grayling were categorized as not ripe. The number of not ripe females decreased throughout the sampling period to 10% on May 17. On May 3, 16% of the female Arctic graying were classified as ripe. The number of ripe females increased to 79% on May 10 and remained high until sampling concluded. No fish were classified as spent during the first eight days of sampling and 15% of females were spent on May 17.

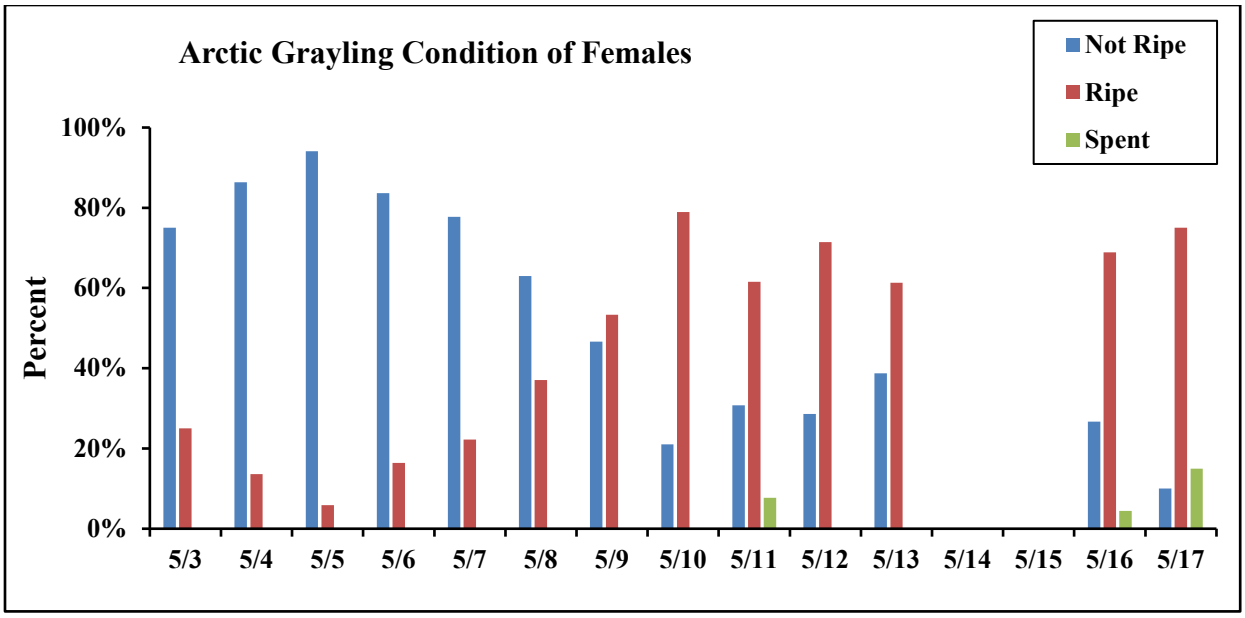

Figure 13. Spawning condition of Arctic grayling females categorized as: not ripe, ripe or spent, 2022.

The spring 2021 population abundance estimate for Arctic grayling ≥200 mm was 3,090 fish with a 95% CI of 2,763 to 3,417 fish (Figure 14). The population has declined since 2017 but remains above the post mining goal of 800 – 1,600 fish ≥200 mm. This Arctic grayling population is anticipated to increase in the future with the substantial number of age-2 and age-3 Arctic grayling captured during the spring 2022 sampling event.

The 2021 population abundance estimate of Arctic grayling in the WSR was calculated using spring 2021 as the mark event and spring 2022 as the recapture event. During the spring of 2022 509 Arctic grayling ≥240 mm were captured, of those 182 were recaptures from the spring 2021 tagging event. For the 2021 population estimate, Arctic grayling population length frequency distributions from 2021 and 2022 were compared to eliminate those fish handled in 2022 that would have been too small (<200 mm) to mark in spring 2021, 370 fish met this criterion and were not included in the population estimate.

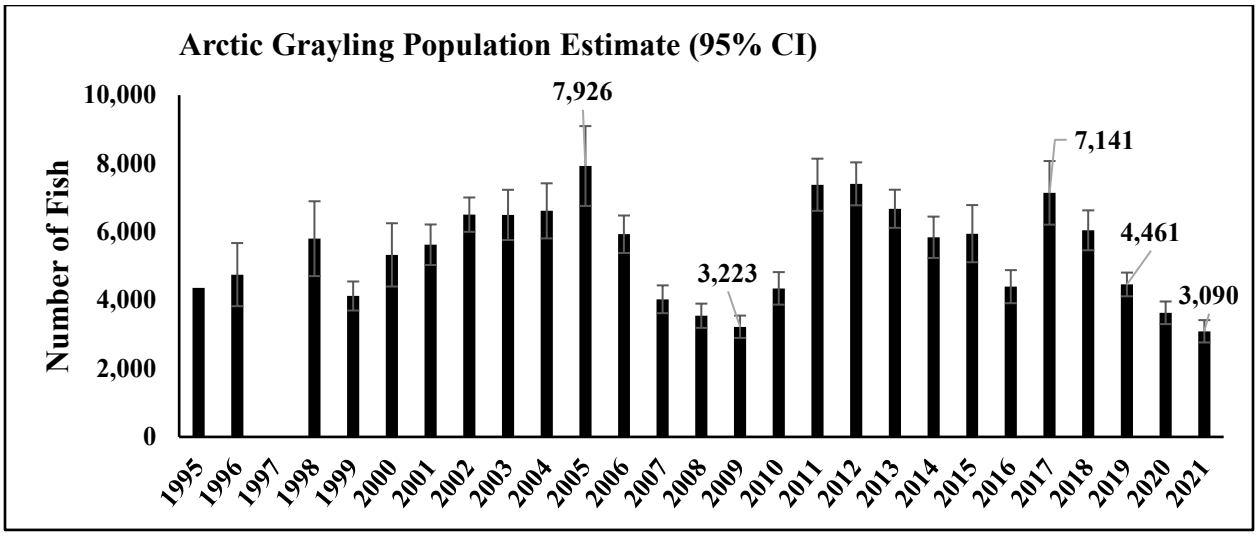

Figure 14. Estimates of the Arctic grayling population in the wetlands and WSR with 95% confidence intervals, 1998 – 2021.

Recruitment (defined as those fish ≥200 mm that would have been too small to mark in the previous year) is variable among the sampling years. Recruitment was high in 2017, declined from 2018 to 2021, and then increased in 2022 (Figure 15). Substantial recruitment was observed in the spring of 2004, 2010, 2014, 2017 and 2022. A substantial recruitment event was defined as >300 fish encountered during a recapture sampling event that were not available for tagging based on size during the marking event (typically fish between 200 and 240 mm). In 2022 there was 370 Arctic grayling captured between 200 and 240 mm that met the recruitment criteria and were not included in the population estimate.

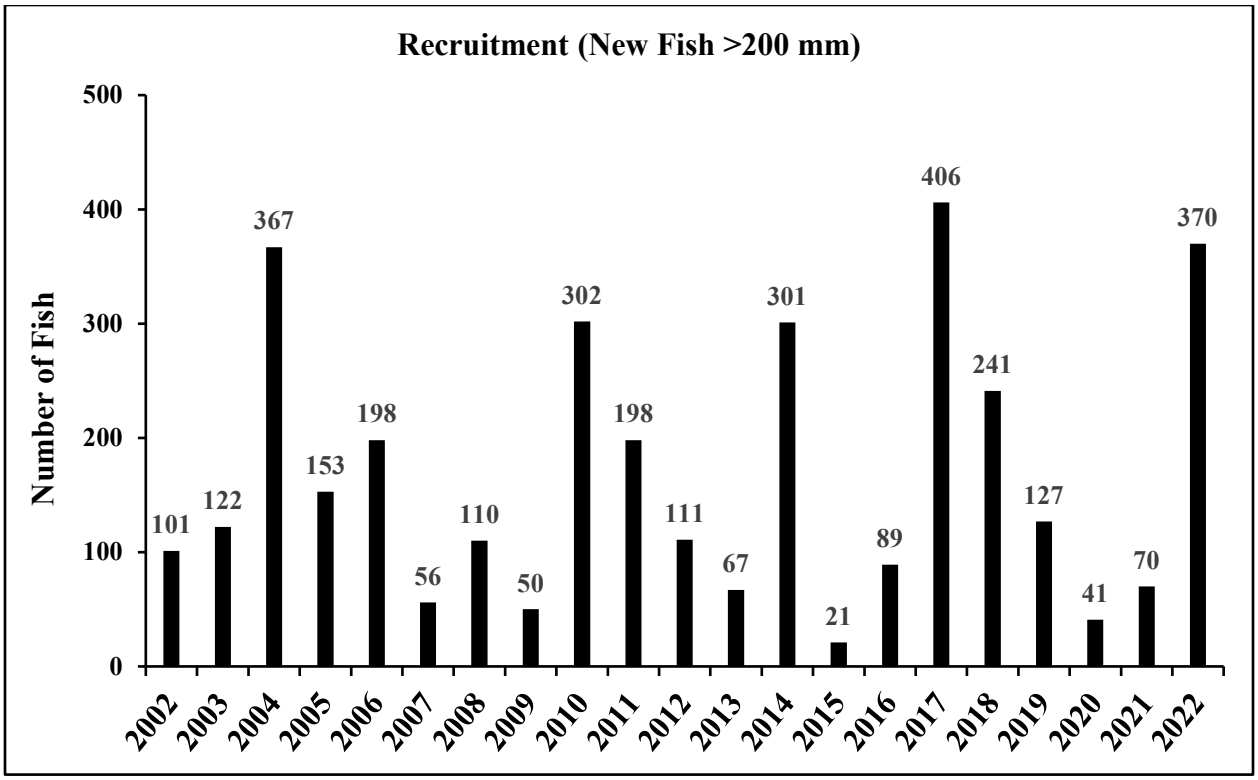

Figure 15. Number of new fish ≥ 200 mm that entered the population but would have been too small to mark in the previous year (upper limit of size based on growth of marked fish – generally about 235 mm).

Average growth of Arctic grayling prior to the development of the WSR ranged from 3 to 17 mm per year (Figure 16). Average growth in each size class has increased since the construction of the WSR in 1994. The highest annual average growth in most size classes occurred in 2014, and the lowest occurred in 2015.

The 2022 length frequency distribution of Arctic grayling caught in the wetlands complex is presented in Figure 17. Data from 1995 are included for comparison to the length of Arctic grayling before the construction of the WSR. The 1995 data set was obtained before construction of the freshwater dam and reflects the stunted condition of the population at that time. During the 2022 sampling, 781 grayling were captured between 130 and 240 mm, this was an increase over the 488 fish captured in that same size range in 2021. The current population appears to have fewer large grayling ≥300 mm but a more even distribution of fish in all size ranges (Figure 17).

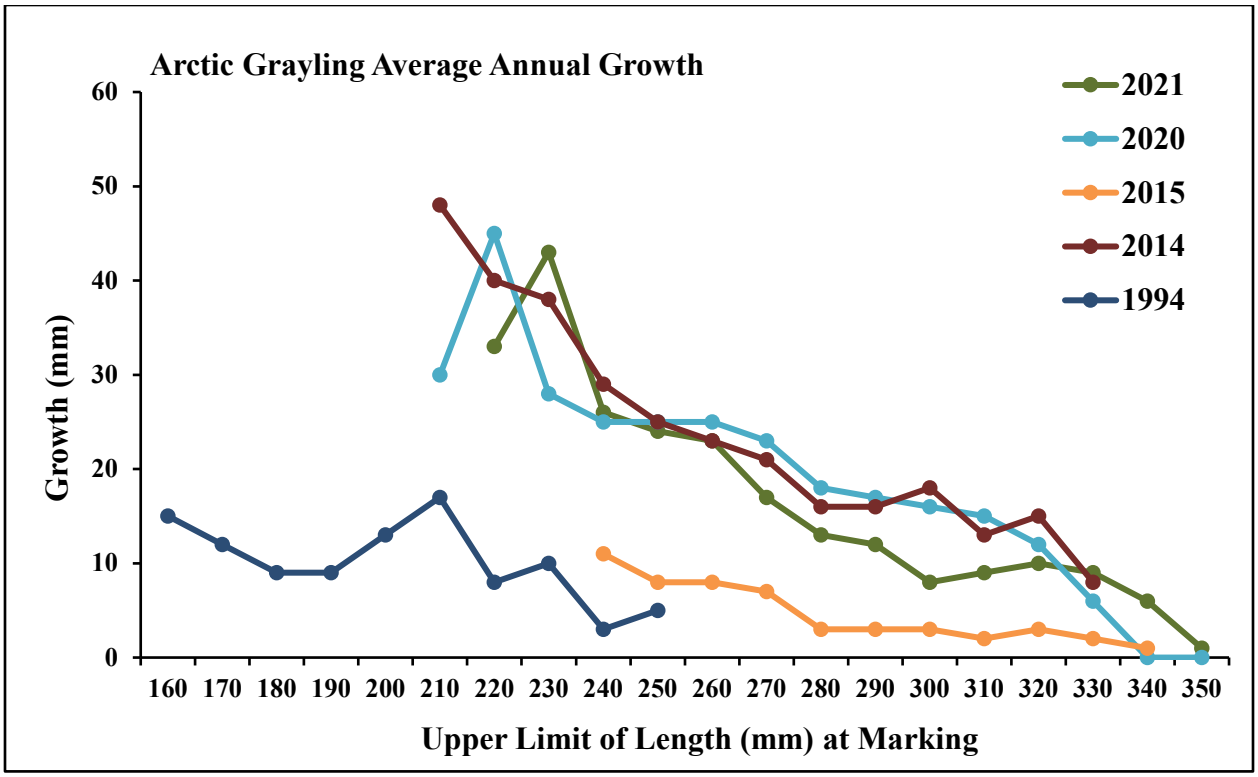

Figure 16. Average annual growth of Arctic grayling by size group in the WSR in selected years including baseline (before WSR) in 1994.

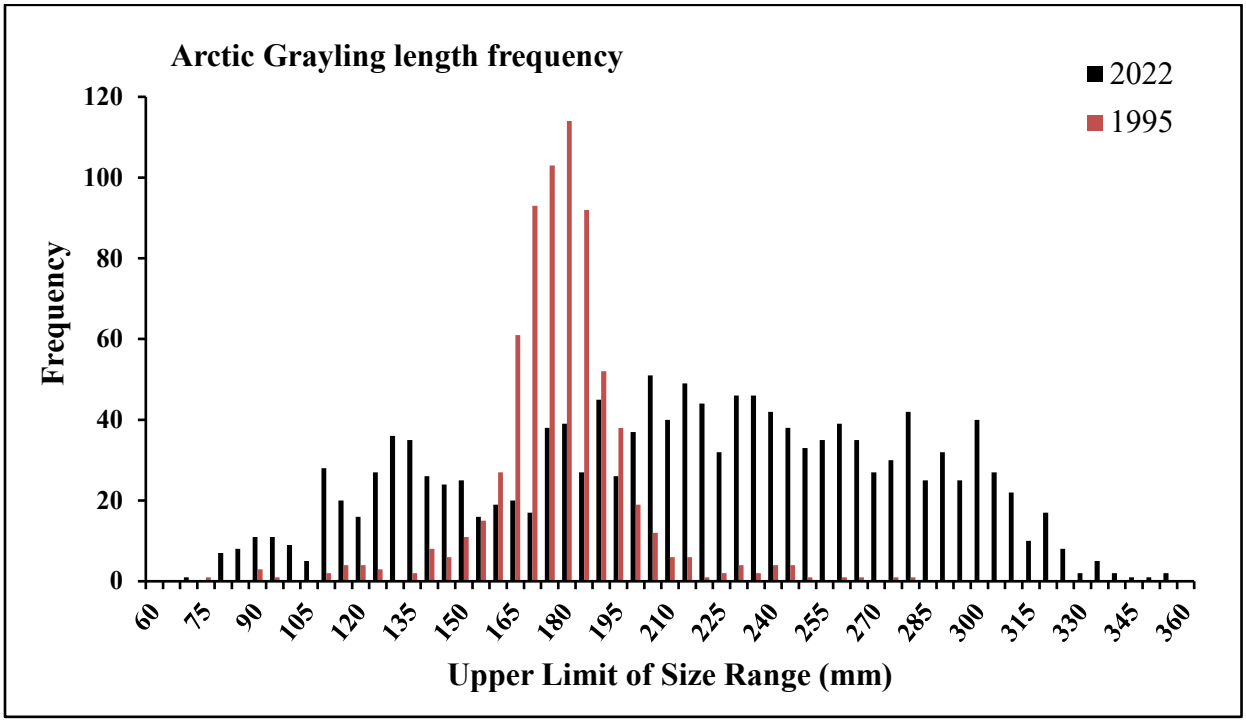

Figure 17. Length frequency distribution of Arctic grayling captured in spring 2022 and 1995.

The uppermost waterbody in the wetlands system located immediately downstream of the tailings dam is referred to as Pond AB. It is located below Outfall 002 in the North Fork Fish Creek channel (Figure 1). A lake set fyke net was placed in Pond AB near the inlet culvert on May 9 to determine if Arctic grayling were present in the upper wetlands (Figure 8). The fyke was fished in this location until it was removed on May 17 with no muskrat of beaver holes during the sampling period. This fyke net captured 165 Arctic grayling between 115 and 240 mm with an average size of 173 mm. The 2022 length frequency distribution of Arctic grayling caught in Pond AB is presented in Figure 19. Eighteen Arctic grayling were ≥200 mm and tagged with a unique identification numbered Floy tag. No grayling were captured in Pond AB in 2022 that had been handled and tagged in in the two fyke nets located in the lower Fish Creek wetlands during past years sampling events. The population of Arctic grayling in Pond AB may be isolated from the lower wetlands by the beaver dams and vertical obstructions in Fish Creek and North Fork Fish Creek. High water events may allow juvenile Arctic grayling to move through the obstructions but no adult Arctic grayling >240 mm were captured during the 2022 sampling.

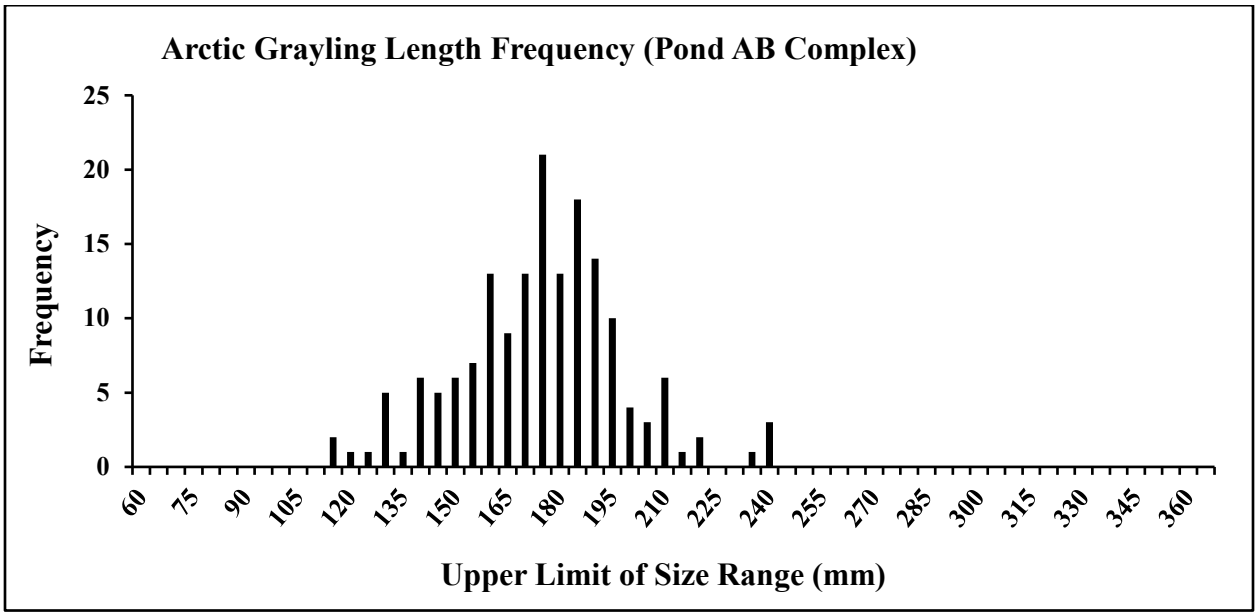

Figure 18. Arctic grayling (n=165) length frequency captured in Pond AB, 2022.

Fish Creek Wetlands Burbot

During the spring 2022 fyke netting 35 burbot were captured in Fish Creek and North Fork Fish Creek. Five of these were ≥300 mm and tagged with a unique numbered floy tag. Thirty were <300 mm and were measured and released without being tagged (Figures 20 and 21). Most (32 of the 35) burbot were captured in the North Fork Fish Creek fyke net. One burbot was recaptured that had been previously tagged during past years' Fish Creek or WSR burbot sampling. These burbot will be included in the population estimate and reported in the 2023 ADF&G Technical Report after fall 2022 hoop trap sampling is conducted in the WSR.

Figure 19. Juvenile burbot captured in Fish Creek wetlands, May 2022.

Figure 20. Juvenile burbot captured in Fish Creek wetlands, May 2022.