



CANDIDATE CONSERVATION AGREEMENT WITH ASSURANCES FOR ARCTIC GRAYLING IN THE CENTENNIAL VALLEY, MONTANA

2023 Annual Report



Montana Fish, Wildlife & Parks



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I. Introduction

A Candidate Conservation Agreement with Assurances (CCAA) is an agreement between the U.S. Fish and Wildlife Service (USFWS) and any non-Federal entity whereby property owners who voluntarily agree to manage their lands or waters to remove threats to species at risk of becoming threatened or endangered receive assurances against additional regulatory requirements should that species be subsequently listed under the Endangered Species Act (ESA). Since 2000 there have been 50 CCAA's approved in 24 different states that have more than 25.2 million acres enrolled by 717 landowners that cover 84 species. CCAA project areas range in size from one-acre aiming to protect the Greater and Lesser Adam Cave Beetles in Kentucky to 7,214,287-acres to protect Lesser Prairie Chicken in Colorado, Kansas, Oklahoma, New Mexico, and Texas (USFWS 2018).

The conservation goal of the Centennial Valley Arctic Grayling CCAA is to secure and enhance Arctic Grayling (*Thymallus arcticus*) populations and habitat in 52 stream miles on non-federal lands in the Centennial Valley. Montana Fish, Wildlife & Parks (FWP) holds a USFWS ESA section 10(a)(1)(A) Enhancement of Survival Permit and issues Certificates of Inclusion to non-Federal property owners within the Project Area who agree to comply with all stipulations of the Program and develop a Site-Specific Conservation Plan (SSP; Figure 1). SSPs are collaboratively developed by each landowner and an interdisciplinary FWP technical team and approved by USFWS. The conservation goal of the Centennial Valley Arctic Grayling CCAA will be met by implementing measures that:

- 1) Improve Streamflows
- 2) Improve and protect the function of riparian habitats
- 3) Identify and reduce or eliminate entrainment threats for Arctic Grayling
- 4) Remove barriers to Arctic Grayling migration

The Centennial Valley Arctic Grayling CCAA is a collaborative effort among private landowners, state and federal agencies, and non-government organizations. These stakeholders have agreed to work together for the common goals of conserving Arctic Grayling, improving Centennial Valley fish populations, addressing private property concerns, and enhancing the overall health of the Centennial Valley watershed.

The 2023 Centennial Valley Arctic Grayling CCAA report summarizes current enrollment, approved SSPs, implemented conservation measures, and completed projects.

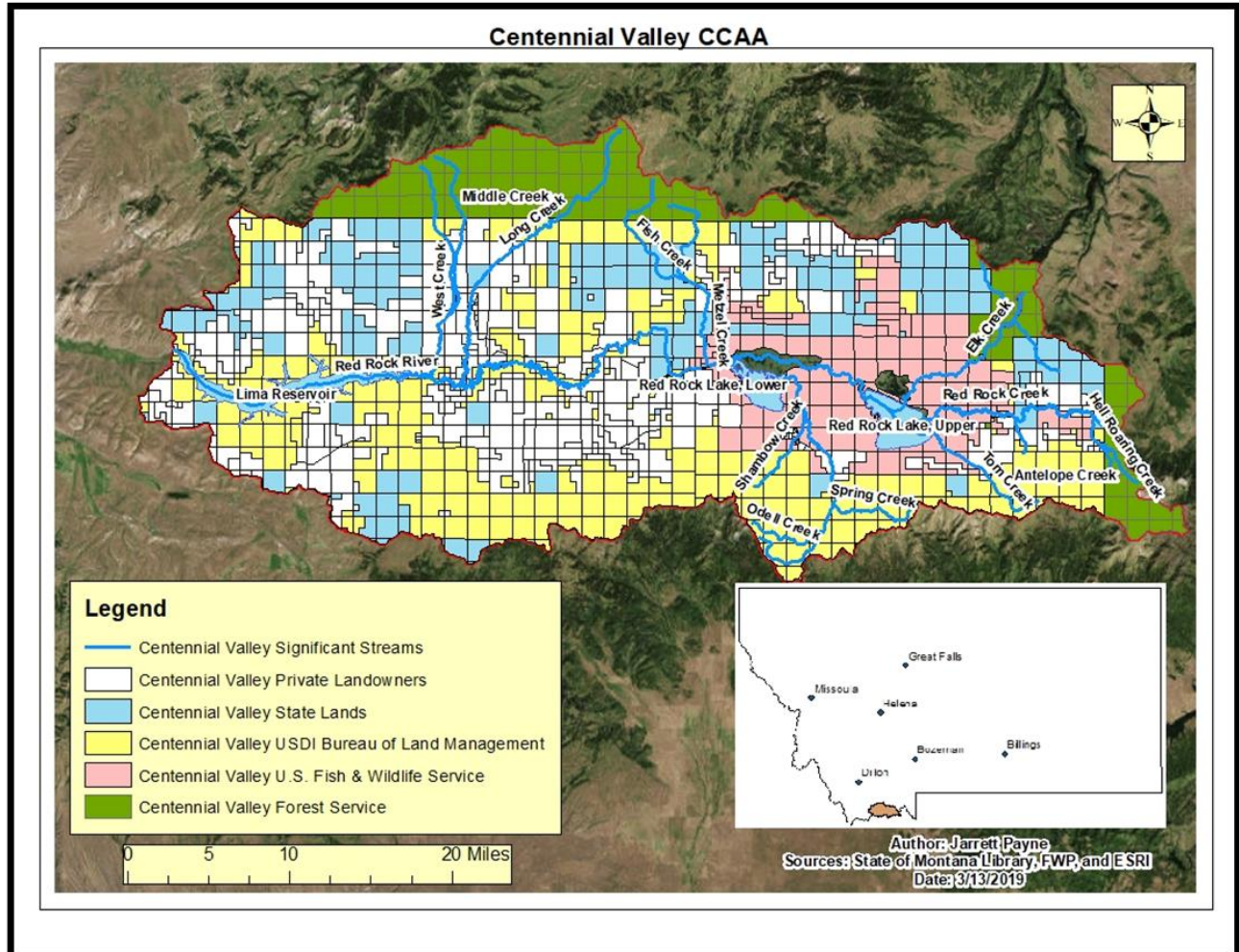


Figure 1. The Centennial Valley Arctic Grayling CCAA Project Area.

II. Legal Status of Montana Arctic Grayling

The present legal status of Arctic grayling was determined by a July 23rd, 2020, ruling where the USFWS announced that the Upper Missouri River Distinct Population Segment (DPS) of the Arctic Grayling did not warrant ESA protection. This decision was determined from the best available science, advances in the Big Hole Arctic Grayling CCAA, and critical conservation work completed by private landowners (Federal Register 2020). For complete legal review prior to 2020 please review the USFWS 2020 listing determination (Federal Register 2020).

On January 30th, 2023, Earthjustice sued the USFWS to list Arctic Grayling under the Endangered Species Act (ESA) due to climate change, poor habitat conditions (e.g., low river flows), and inadequacy of conservation efforts, including the CCAA program. The parties associated and represented by Earthjustice include the Center for Biological Diversity, Western Watersheds Project, and Butte resident Pat Munday.

III. Landowner Enrollment

On September 19th, 2018, the USFWS issued FWP ESA section 10(a) (1) (A) Enhancement of Survival Permit # TE-06690D-0, authorizing the Centennial Valley Arctic Grayling CCAA. This permit allows official enrollment of any non-federal landowner within the Centennial Valley Arctic Grayling CCAA Project Area. Enrolled non-federal landowners are provided incidental take coverage and regulatory assurances if Arctic grayling become listed under the ESA once the non-federal landowner, FWP, and the USFWS countersign a Certificate of Inclusion and the approved SSP for the enrolled property. Currently, there are 6 landowners (Participating Landowners) that have enrolled 20,876.9 acres of private land and 647 acres of DNRC leased land into the Centennial Valley Arctic Grayling CCAA (Figure 2). Enrollment for the Centennial Valley Arctic Grayling CCAA will remain open until 90 days prior to any final listing rule published by the USFWS in the Federal Register.

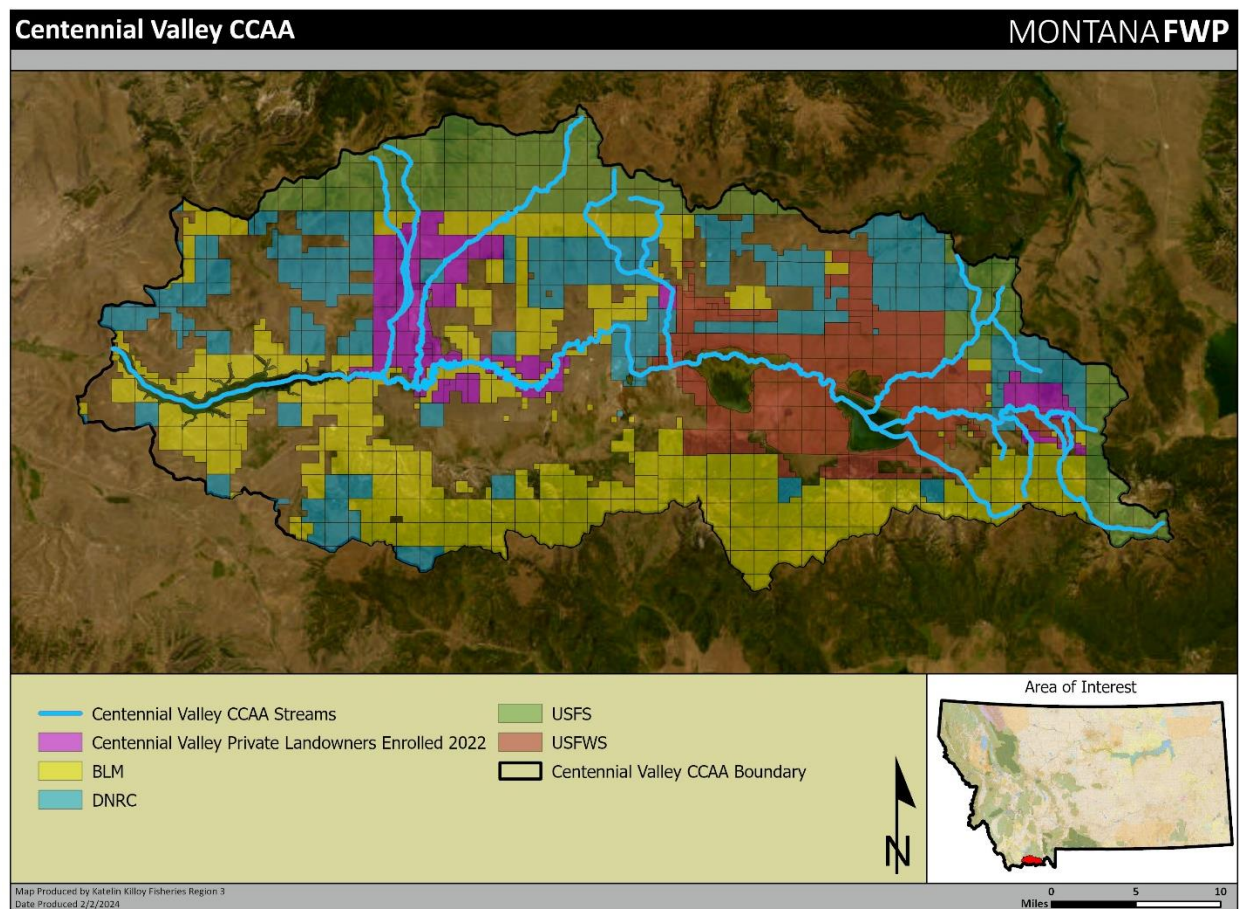


Figure 2. December 31st, 2023, Centennial Valley Arctic Grayling CCAA Program of private land enrolled (six landowners with a total of 20,876.9 private and 647 DNRC leased acres).

IV. Centennial Valley Arctic Grayling CCAA Rapid Assessments and Compliance Monitoring

The Participating Landowners in the Centennial Valley Arctic Grayling CCAA allow the Agencies to complete a “rapid assessment” of the enrolled property within 90 days of enrolling. The rapid assessment focuses on identifying immediate threats to Arctic Grayling and validating water rights compliance. Immediate threats to Arctic Grayling may include structures, mechanical devices or pollutants that pose a threat of immediate mortality. Examples include unscreened pumping from or toxic effluent entering a stream. Additional information may be gathered during rapid assessments that assist with the development of the SSP with the Participating Landowner (Petersen and Lamothe 2006).

A. Surveys for Immediate Threats to Arctic Grayling

Rapid assessment surveys for immediate threats to Arctic Grayling have been conducted on all enrolled properties. No immediate threats to Arctic Grayling were identified during the surveys. Monitoring of enrolled properties for immediate threats continues as SSPs are being developed by the Agencies.

B. Flow and Water Right Compliance Monitoring

FWP completed flow and water right compliance monitoring for all Centennial Valley CCAA streams (FWP and USFWS, 2018). Flow monitoring was completed on Corral Creek, Antelope Creek, Red Rock Creek, Tom Creek, Odell Creek, Metzel Creek, Long Creek, Red Rock River, West Creek, and Middle Creek. FWP checked headgates 19 times throughout the summer of 2023 across these streams to keep flows at or above target levels. FWP completed 72 stream flow measurements to monitor streamflow and maintain rating curves for stream gages. Streamflow gage data collected by FWP can be found at <https://gis.dnrc.mt.gov/apps/StAGE/#> by zooming in on the map to the Centennial Valley and clicking on the black and white square indicating the gage location. Five enrolled landowners have associated water rights that were monitored for irrigation compliance on Corral Creek, Red Rock Creek, Long Creek, Red Rock River, and Middle Creek. All landowners generally followed flow agreements, reducing diversions when requested. Flow and compliance monitoring of all Centennial Valley CCAA streams are summarized in Table 1 and described in more detail in Appendix 1.

V. Site-Specific Plans

SSPs are developed for each Participating Landowner by FWP and the landowner. The SSPs identify conservation measures that will lead to improved streamflow, enhanced riparian and stream channel condition, improved fish passage and reduced levels of entrainment.

A. Completed and Approved

Two SSPs have been completed for the Centennial Valley CCAA program (Table 1). The remaining SSPs will be developed during 2024 and 2025. All SSPs are 10-year agreements between the Participating Landowners, FWP, and the USFWS. Updates on the implementation of these SSPs, including compliance and monitoring results, will be included in future reports.

B. Extension Requests Approved by the USFWS

FWP did not submit approval for extensions to complete SSPs in 2023. Extensions provide additional time to complete SSPs and document past and ongoing conservation actions for Arctic Grayling on the property receiving the extension.

Table 1. Property numbers of enrolled landowners and their associated enrolled acres and enrollment status.

Property Number	Private Land Enrolled (Acres)	State Land Enrolled (Acres)	Enrollment Status	10 Year SSP Update
1	696.21	0	SSP completed	2031
2	2227.7	0	SSP in draft	NA
3	4713.67	0	SSP in draft	NA
4	466.2	0	SSP in draft	NA
5	972.32	0	SSP completed	2032
6	11,801	647	SSP in Draft	NA

VI. Conservation Measures

Through the process of developing SSPs for Participating Landowners, projects that reduce or eliminate entrainment of Arctic Grayling, eliminate barriers to fish passage, maintain adequate streamflow and protect and/or improve riparian and stream habitat quality are identified. Projects and related conservation measures completed in 2023 are reported below.

A. Entrainment Surveys

No grayling entrainment surveys were conducted in 2023 in the Centennial Valley. Previous surveys in 2017, 2018, and 2021 did not document grayling entrainment. Future entrainment surveys will occur as new SSPs are created.

B. Projects to Minimize or Eliminate Entrainment of Arctic Grayling

Currently no grayling entrainment has been observed and is not believed to be a threat on any of the monitored CCAA specific streams.

C. Projects to Enhance Fish Passage

During 2023 one fish passage project was completed. This project installed four sets of step pools to provide fish passage at irrigation diversion structures on one enrolled property (Table 2).

Table 2. Centennial Valley CCAA streamflow and irrigation management projects completed in 2023. Projects include installing step pools to provide fish passage.

2023		
Associated Waterbody	Landowner #	Project Component
West Creek and Middle Creek	6	4 sets of step pools

D. Projects to Enhance Riparian and Stream Channel Habitat

During 2023 no stream restoration projects were completed.

E. Projects to Improve Streamflow and Irrigation Water Management

During 2023 one streamflow project was completed. This project involved six components to improve irrigation efficiency on one enrolled property (Table 3).

Table 3. Centennial Valley CCAA streamflow and irrigation management projects completed in 2023. Projects include installing and maintaining measuring devices and headgates.

2023		
Associated Waterbody	Landowner #	Project Component
West Creek and Middle Creek	6	2 measuring devices were installed, 1 measuring device was reset, 1 headgate was replaced, and 2 pin and plank structures were reset

F. Projects to Expand Arctic Grayling Distribution into Historically Occupied Waters

Beginning in 2017, attempts to create a Centennial Valley grayling genetic reserve were initiated in Handkerchief Lake in the South Fork Flathead River drainage. Initial attempts used the progeny of Red Rock Creek grayling, but numbers thus far have not been sufficient to establish a population with adequate genetic variation of Centennial origin. To supplement these initial stocking efforts, FWP began a spawning project at five mountain lakes containing self-sustaining populations of grayling with Centennial Valley ancestry. In 2022 and 2023, an additional 150,000 grayling were stocked in Handkerchief Lake. These fish were the progeny of 919 grayling spawned at these mountain lakes over two years. This effort will be repeated in 2024. Once the Centennial Valley genetic reserve is established, this source will be available for grayling repopulation efforts in the valley.

VII. Monitoring

A. Population Monitoring

Abundance Estimation:

The estimated number of grayling in the 2023 Red Rock Creek spawning population was 188 fish (95% CI = 47–340), statistically similar to the previous year ($N = 73$, 95% CI = 31–209; Figure 3). The consistently low grayling abundances experienced since 2016 will likely lead to irreversible losses of genetic diversity annually (Kovach et al. 2021). Age distribution of the spawning population in 2023 was similar to the long-term distribution of ages (Figure 11). However, the 2023 grayling age distribution is based on only 47 individuals captured during electrofishing (Figure 4).

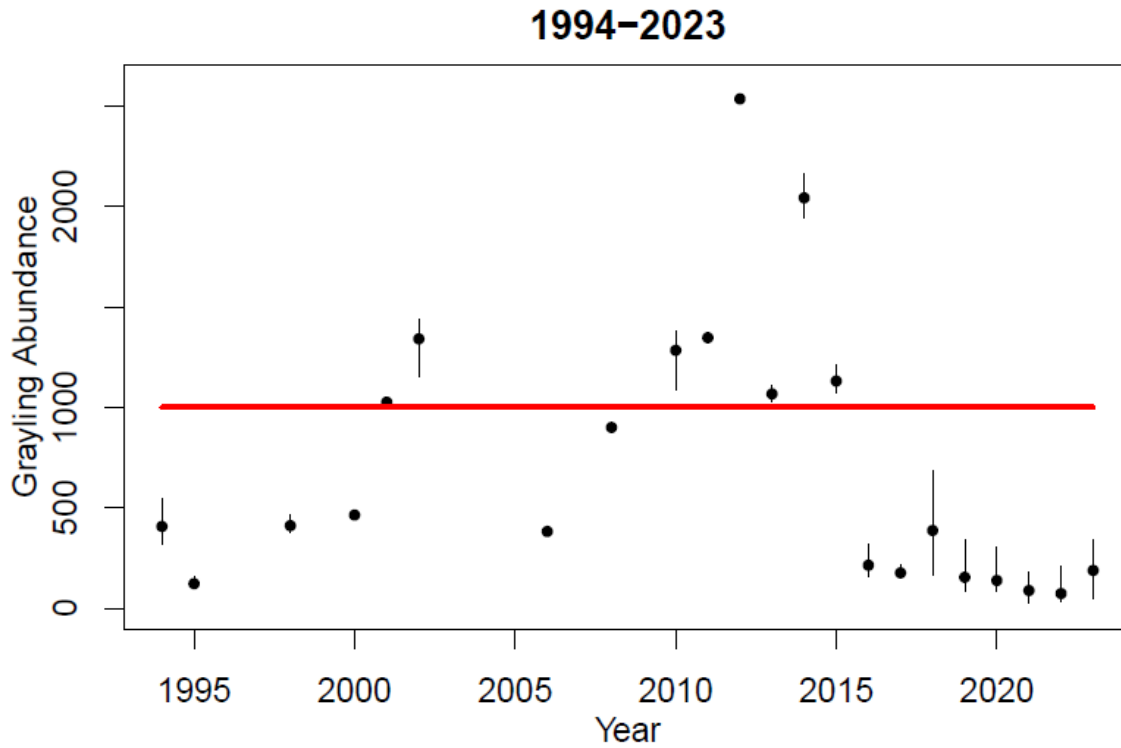


Figure 3. Estimated annual Red Rock Creek Arctic grayling spawning population abundance and 95% confidence intervals (when available), 1994–2023. The red line indicates the current grayling population objective of 1000 fish for Upper Red Rock Lake and tributaries.

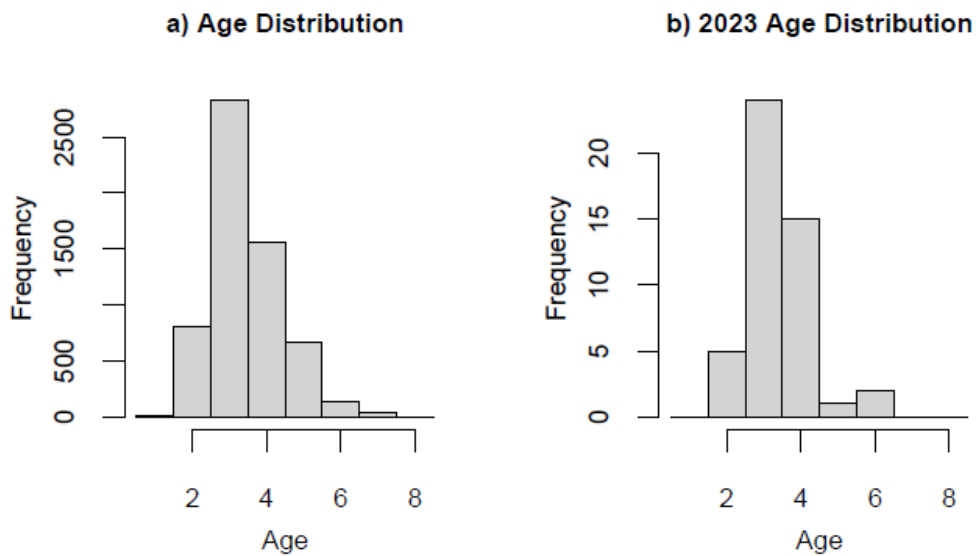


Figure 4. Age distributions of spawning grayling in Red Rock Creek in a) 1950-2022, and b) 2023.

Genetic Monitoring:

Determining trends in population abundance of rare or highly migratory fish species can be difficult. Genetic analysis is an effective alternative or supplemental method to determine the health and long-term persistence of fish populations (Schwartz et al. 2007). Using non-lethal sampling techniques geneticists can analyze the structure of an Arctic Grayling population and determine its long-term viability by estimating genetic diversity in a population (Allelic richness and average expected heterozygosity), effective number of breeding individuals that produced a given cohort (N_b), and ultimately the overall genetic effective population size (N_e). These estimates provide important population information on potential rate of loss of genetic variability and inbreeding depression, population dynamics, and the efficacy of management actions. Moreover, genetic data ensure that conservation efforts maintain the historic diversity found within and among Arctic Grayling populations, and thus, the continued evolutionary legacy of the species [Upper Missouri River Arctic Grayling Conservation Strategy 2022].

Fifty individuals of mixed age were sampled in upper Red Rock Creek and Picnic Creek. We assigned individuals to cohort based on scale aging prior to estimating N_b . We used the samples to update N_b estimates for the 2018 and 2019 cohorts. The updated N_b estimate for the 2018 cohort was 123.0, and the 95% confidence intervals ranged from 34.3 to infinity (Table 4, Figure 5), which emphasizes that this estimate should be interpreted cautiously – the number of samples is small and uncertainty is quite high. The N_b estimate for the 2019 cohort is 60.9, and the 95% confidence intervals ranged from 42.8 to 97.3 (Table 4, Figure 5). Based on the N_b estimates from the 2010 to 2019 cohorts, the N_e of the upper Red Rock Creek population is approximately 137.5.

We used the mixed age sample of fish collected in 2023 to update our time-series of genetic variation (expected heterozygosity and allelic richness) (Figure 6). The 2023 estimates for allelic richness and expected heterozygosity were the lowest on record, consistent with the long-term decline in genetic variation in this population. These results again emphasize that conservation measures are urgently needed to arrest the loss of the genetic legacy of this grayling population.

Table 4. Estimates of the number of effective breeders (N_b) for Arctic grayling from upper Red Rock Creek. N is number of individuals genotyped, LCI and UCI are the lower and upper (respectively) 95% confidence intervals for the N_b estimate from each year.

Year	N	N_b	LCI	UCI
2010	34	273.1	86.1	∞
2011	63	207.1	106.4	544.1
2012	51	406.3	131.0	∞
2013	88	356.7	167.1	1714.4
2014	97	362.0	202.5	1262.1
2015	36	48.0	38.1	63.1
2016	34	43.9	31.8	66.6
2017	28	76.7	43.5	234.7
2018	17	123.0	34.3	∞
2019	40	60.9	42.8	97.3

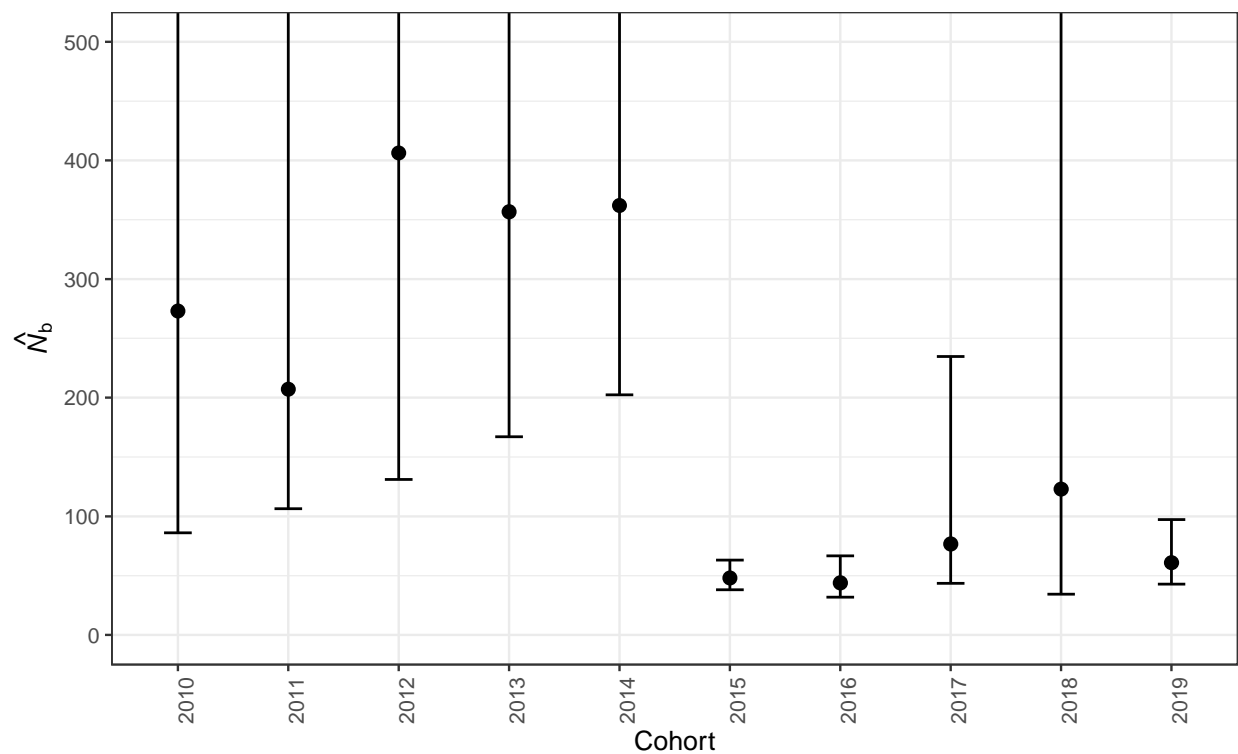


Figure 5. Temporal patterns in the number of effective breeders (N_b) in Arctic grayling from the upper Red Rock Creek. Error bars that surpass the limit of the y-axis can be found in Table 4.

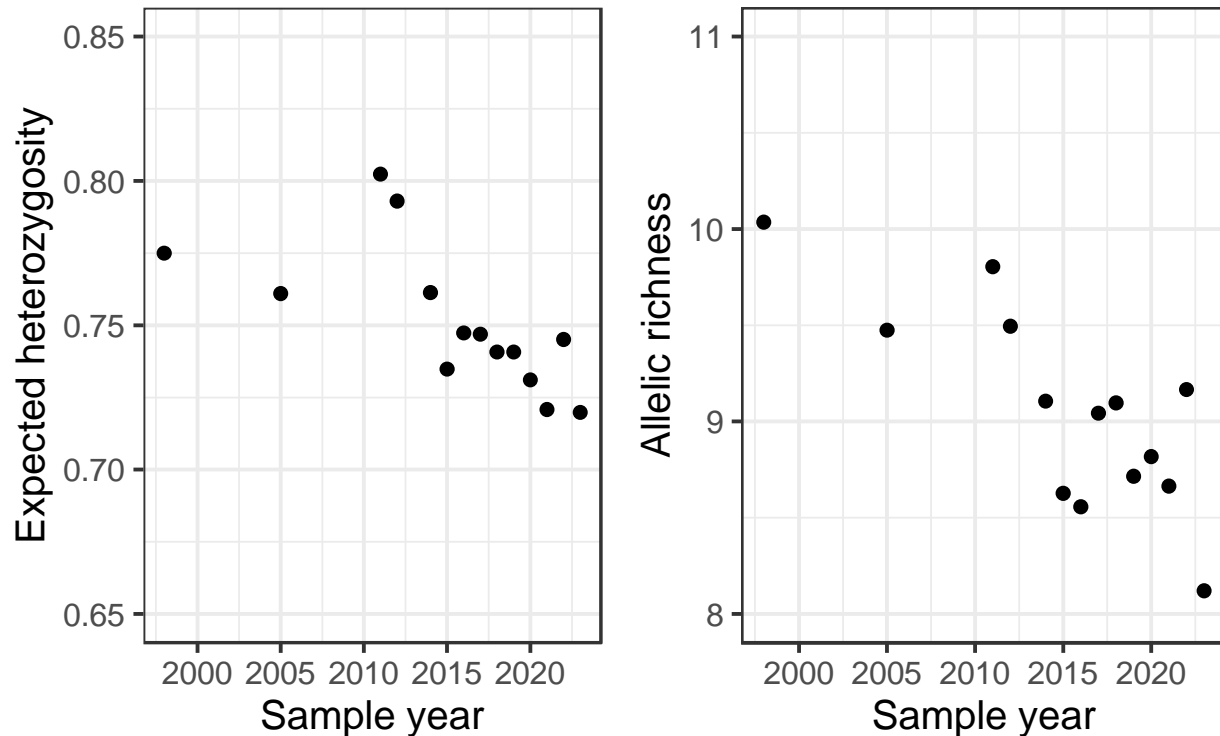


Figure 6. Temporal trends in measures of genetic variation in upper Red Rock Creek.

Centennial Valley Arctic Grayling Adaptive Management Plan:

A workgroup comprised of agencies with land and population management responsibility and authority developed the following objectives to meet the conservation goal for Arctic grayling within the CV:

- 1) Conserve existing Centennial Valley Arctic grayling genetic diversity.
- 2) Establish or maintain Arctic grayling spawning and/or refugia in at least two tributaries up and downstream of Upper Red Rock Lake and connectivity among tributaries.
- 3) Maintain at least 1000 spawning fish in the Upper Red Rock Lake Arctic grayling population.

The Centennial Valley CCAA was developed to improve spawning conditions and migratory access to tributaries on private land and was specifically designed to address Objective 2, which will establish and maintain additional spawning and rearing tributaries for grayling above and below Upper Lake.

To elucidate how to best address Objective 3, FWP and the USFWS implemented an Adaptive Management Plan (AMP) for the Centennial Valley in 2013 to evaluate the hypothetical drivers that govern the grayling population and inform future management actions (Warren and Jaeger 2017). The AMP evaluated the following three hypothesized drivers of the grayling spawning population:

- 1) Quality and quantity of tributary spawning habitat.
- 2) Predation by, and competition with, adult non-native hybrid Yellowstone cutthroat trout.
- 3) Quality and quantity of overwinter habitat in Upper Red Rock Lake.

On an annual basis, a series of management actions (e.g., non-native fish removal, restoration, beaver dam removal) and data collection (e.g., population estimates, Upper Lake dissolved oxygen measurements, spawning habitat availability) are used to inform hypothesis-specific models in the AMP and best identify limiting factors for the population.

Through 2023, AMP modeling indicates overwinter habitat in Upper Red Rock Lake is the primary population driver for Arctic grayling in the Centennial Valley (Warren et al. 2023). The Spawning Habitat model is somewhat well supported and likely describes a secondary population driver. As such, the Centennial Valley CCAA addresses a potential limiting factor by improving quality and quantity of tributary spawning habitat and is expected to ultimately contribute to maintaining genetic diversity.

B. Stream Temperature Monitoring

In 2023, FWP collected stream temperature data from May 18th to October 1st at 6 sites within the Centennial Valley CCAA management section (Figure 7). Thermographs were deployed to collect stream temperature at 60-minute intervals at 1 site on Corral Creek, 1 site on Elk Springs, 4 sites on Long Creek, 1 site on Red Rock Creek, and 1 site on West Creek.

Thermograph data from Corral Creek at the Mouth, Elk Springs, Long Creek 1 at the confluence of Red Rock River, Long Creek 2 at TNC, Long Creek 3 at State, and West Creek at the mouth were downloaded and analyzed. Data on Elk Springs from June 26th-August 1st and data on one logger on Long Creek from July 19th-August 1st has been omitted due loggers being banked over these periods. Additionally, data from one site on Long Creek and the Red Rock Creek site were deemed unusable due to the loggers being banked following high flows. The 2023 data were summarized as mean and maximum seasonal temperature and cumulative hours exceeding 21.1°C (70°F) and 25°C (77°F; Table 5). The thermal stress threshold for salmonid species is considered 21.1°C (70°F; Behkne 1992), and 25°C (77°F) represents the upper incipient lethal temperature for Arctic Grayling (Lohr et al. 1996).

Table 5. Stream temperature monitoring results for 2023.

Monitoring Site (Centennial Valley Arctic Grayling CCAA Management Section)	Mean Seasonal Temperature °C (°F)	Maximum Seasonal Temperature °C (°F)	Cumulative hours exceeding 21.1°C (70°F)	Cumulative hours exceeding 25°C (77°F)
Corral Creek at Mouth	8.86 (47.94)	15.29 (59.51)	0	0
Elk Springs	11.65 (52.96)	21.38 (70.48)	1	0
Long Creek 1 Confluence	15.43 (59.77)	24.58 (76.24)	179	0
Long Creek 2 TNC	14.27 (57.68)	24.15 (75.46)	79	0
Long Creek 3 State	12.76 (54.96)	22.73 (72.91)	36	11
West Creek at Mouth	11.55 (52.79)	18.14 (64.65)	0	0

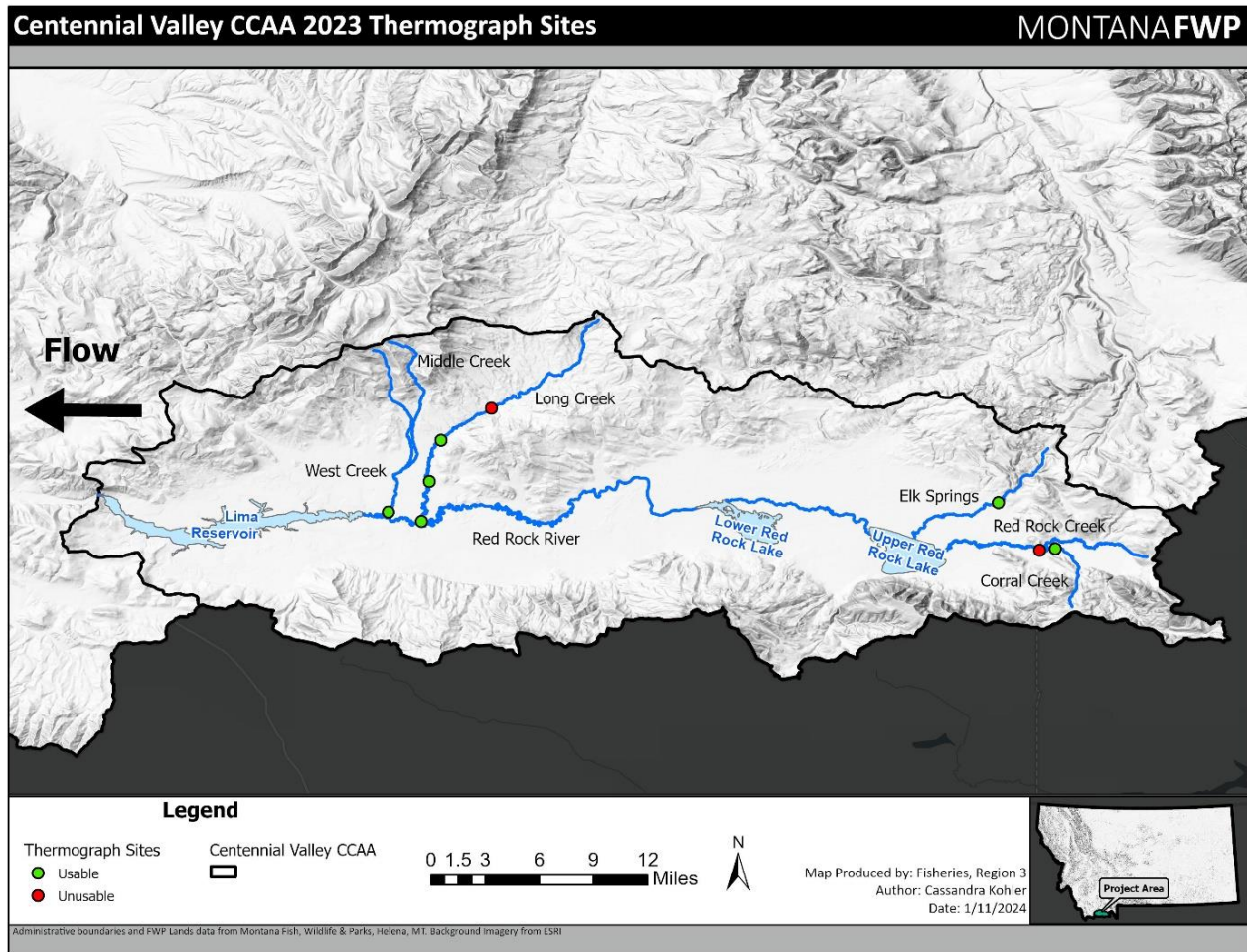


Figure 7. Stream temperature (green/ red circles) monitoring sites in the Centennial Valley Arctic Grayling CCAA Project Area.

C. Compliance Monitoring of Approved Site-Specific Plans

Compliance monitoring for the two enrolled landowners with approved SSPs indicated they were in general compliance with their plan. CCAA staff monitored the amount of water being diverted and enrolled landowners with SSPs in development and they generally followed their interim flow conservation plans in 2023.

VIII. Summary of Estimated Take Associated with the Centennial Valley Arctic Grayling CCAA

In 2020, the USFWS determined that listing the upper Missouri River Basin Distinct Population Segment of Arctic Grayling as threatened or endangered under the Endangered Species Act was not warranted. Due to the current legal status of Arctic Grayling, ESA-defined take (harm,

harass or kill) did not apply to the implementation or monitoring of Centennial Valley Arctic Grayling in 2021.

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APPENDIX 1:

Streamflow targets were developed for the spawning period (mid-April thru late June) and the base flow period (remainder of year) measured below active diversions from the respective streams. For each period a normal and dry condition target was established for both periods except for Red Rock, Tom and Odell Creeks where only a normal base flow target was established, matching the minimum flow requirement of the Red Rock Lakes Compact. The dry targets apply when available streamflow not including diversions drops below the estimated 80th percentile exceedance flow for the stream (trigger flows). This is the flow that would be expected to be met or exceeded in 8 out of 10 years. As streamflow data continues to be collected and a sufficient period of record is established to calculate 80th percentile exceedance values instead of using estimated values from regional regression equations, triggers will be adjusted accordingly.

Targets for both periods were established based on riffle wetted perimeter data for streams where data was available. Where wetted perimeter data was not available, targets from streams with data were translated to those without data using the ratio of the estimated mean annual flow between the streams. The normal spawning target was based on the flow necessary to provide an 0.5 ft. average depth of passage for the most restrictive riffle transect while the dry target is based on the average flow of all riffle transects. The base flow normal target was based on the higher inflection point of the streamflow-wetted perimeter curve above which increases in flow result in very little increase in riffle coverage. The base flow period dry target was based on the lower inflection point of the streamflow-wetted perimeter curve below which decreases in flow result in large losses in riffle coverage. Subsequently the spawning period targets for West and Middle Creeks were adjusted based an additional study of the depth of passage measured in several transects to better refine the needed flow to allow for 0.5 ft. depth of passage. Also, trigger flows were adjusted for Red Rock, Antelope and Tom Creeks based on actual long-term measurement data for Red Rock Creek.

Streamflow measurement typically begins in late April, but due to a lingering snow in the valley, it was delayed until the third week of May in 2023. Table 1 shows the percentage of time that the applicable spawning or base flow target was attained during 2023 based on average daily streamflow. Percentage attainment is given for both the full target as well as 80% of the full target to provide an indicator of the relative extent stream flow was below target. If for example the full attainment percentage is low while the 80% attainment is high, it means that the flow generally was close to the target level most of the time even though it fell short. Low values in both categories indicates streamflow was quite low with respect to the target.

For a given stream if there is a value in both the “Normal” and “Dry” category it means that the trigger flow was initially met during the period but then streamflow fell below the trigger level

causing a shift from a normal to dry target. For example, Long Creek was above the trigger level from the beginning of measurement until latter July when it fell below the trigger level, after which the dry spawning target applied. Once a dry year target is established it remains in effect for the remainder of the period regardless of whether available flow increases above the trigger level.

Table 1 also indicates the number of enrolled and non-enrolled water users along with the number in each category diverting water in 2023. These values provide an indicator of the influence of water users enrolled and not enrolled.

Table 1. Flow and Water Right Compliance Monitoring General Summary for Centennial Valley CCAA 2023.

Stream		Spawning Period Target Attainment		Base Flow Period Target Attainment		CCAA Enrollees				Other Water Users	
		Full	80%	Full	80%	#	# Diverting	# Full Compliance	# Partial Compliance	#	# Diverting
Corral Creek	Normal	100%	100%	100%	100%	1	1	0	1	0	0
	Dry	N/A	N/A	70%	79%						
Antelope Creek	Normal	0%	0%	16%	53%	0	0	NA	NA	1	unknown
	Dry	N/A	N/A	N/A	N/A						
Red Rock Creek	Normal	N/A	N/A	88%	88%	2	1	1	1	0	0
	Dry	87%	100%								
Tom Creek	Normal	0%	42%	82%	82%	0	0	NA	NA	1	0
	Dry	N/A	N/A								
Odell Creek	Normal	100%	100%	88%	95%	0	0	NA	NA	1	unknown
	Dry	N/A	N/A								
Long Creek	Normal	100%	100%	70%	90%	3	2	3	NA	1	1
	Dry	N/A	N/A	62%	73%						
Red Rock River	Normal	97%	100%	100%	100%	1	0	1	NA	0	0
	Dry	N/A	N/A	67%	76%						
Middle Creek	Normal	100%	100%	100%	100%	1	1	1	NA	0	0
	Dry	N/A	N/A	N/A	N/A						
West Creek	Normal	95%	100%	79%	97%	2	1	2	NA	0	0
	Dry	N/A	N/A	N/A	N/A						

If the cell indicates “N/A” or “not applicable” it means that the dry or normal target was not in use during the period. In other words, the target did not shift during the period. For example, during the base flow period, only the dry target was applicable as the inflow was below the trigger level at the beginning of the period. Red Rock, Tom and Odell Creeks do not have dry target values for the baseflow period as indicated by the darkened cells. This is because the Red Rock Lakes Water Compact established minimum flow levels that correspond to the normal base flow targets. A lower dry target would be contrary to the terms of the Compact.

Failure to meet the prescribed target may result from a lack of available flow in the stream as opposed to being caused by diversion of water. Both Tom and Antelope Creek provide an example of this situation as no known diversion occurred during the spawning and base flow

periods, but the targets were not being met. In other cases, such as Long Creek diversion by non-enrolled water users influences target attainment.

Table 1 indicates two circumstances where CCAA enrollees were found to be in partial compliance. In the case of Corral Creek, the partial compliance was due to the diversion of water exceeding the authorized amount. This occurred during a high flow period of quite variable flow. The diversion of water was quickly corrected to comply with the water right limitation. In the case of Red Rock Creek, the partial compliance was due to a lack of measuring devices to enable the enrollee to monitor diversion rates. Measuring devices are scheduled to be installed in 2024.