Rocky Mountain Cutthroat Trout (*Oncorhynchus virginalis*) Conservation Status Rank Summary

March 7, 2024

For details on assessment and ranking methodology, see: *Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species*

Rarity and Trends

Rank Factor	Date Assessed	Value	Score	Data Source	Comments
Rarity					
Range Extent	2024-02-20	Y: 24030.8 km²	3.930	MTNHP Range Maps	None
Area of Occupancy			-		Factor not used in ranking.
Number of Occurrences			-		Factor not used in ranking.
Population Size			-		Factor not used in ranking.
# of Occurrences in Good Condition			-		Factor not used in ranking.
% of Area Occupied in Good Condition			-		Factor not used in ranking.
Environmental Specificity			-		Factor not used in ranking.
Rarity is calculated by averaging weighted factor scores: **((3.93 × 1)) / 1 = 3.93**					
Trends					
Short-term Trend	2024-02-20	[-29.0, 21.0%]	[-0.070, 0.070]	FWP Survey Data	FWP Survey Data 2024; Data from FWP Survey data (2013-2023). I calculated the geometric mean of annual population rates for all sections that had conducted long-term monitoring (electrofishing) surveys in consecutive years at any point from 2013-2023 in the native range of YCT (n=11). From those data I calculated the mean population trend for Montana (seen here as estimated trend) and the standard errors (95% confidence intervals). HOWEVER, I did not have data on effort for these surveys, so these are based solely on count data and therefore should be used with caution (perhaps not used at all).
Long-term Trend	2024-02-20		-0.220	May et al. 2007; Gresswell 2011; Endicott et al. 2016	May et al. 2007; Gresswell 2011; Endicott et al. 2016: All of these sources mention declines in historical abundance, but only provide numbers in relation to the decline in distribution between their current and historical range. So it makes sense that there has been a decline in abundance as well, but I couldn't find any studies

					that provided a population trend for this. May et al. 2007 at least provides some abundance metrics, but only for the populations assessed as 'current' when the report was published. Over 50% of populations have some level of hybridization with other trout species
Trends score is calculated by summing weighted short and long-term trend scores: **(([-0.07, 0.07] × 2) + (-0.22 × 1)) = [-0.36, -0.08]**					

Threats

Rank Factor	Date Assessed	Value	Score	Data Source	Comments
Threats					
Overall Threat Impact		Very high	0.000		None
Intrinsic Vulnerability			-		Factor not used in ranking.
Threat score is calculated from Overall Threat Impact when available or Intrinsic Vulnerability if not: **(0.00) = 0.00**					

Individual Threats Data

Threat Category	Date Assessed	Impact Score	Scope	Severity	Immediacy	Comments
Biological Resource Use	2024-02-20	Medium	Large	Moderate	High	Hostetler et al. 2021; Cline et al. 2022: As drought and hoot owl restrictions (from warming stream temperatures) become more common (e.g., Hostetler et al. 2021), fishing pressure for cutthroat trout in drought resistant areas (e.g., higher elevation headwaters) may increase (Cline et al. 2022) with the potential for increased catch-and-release stress/mortality. I estimated this as affecting 50% of the population to encompass the tributaries on public land that this could affect, but am unsure what the actual fishing pressure is like throughout their native range, so this could be higher or lower.
Invasive & Other Problematic Species, Genes & Diseases	2024-02-20	High	Large	Extreme	High	Al-Chokhachy et al. 2018; Al-Chokhachy et al. 2021; unpublished data in Heinle dissertation; Heim et al. 2020: In Al-Chokhachy et al. (2018) they found that 70% of YCT throughout their range are either hybridized or sympatric with non-native species. While this number is for the entire YCT range, not just in Montana, large portions of YCT's range in Montana are threatened by non-native species (e.g., brown trout, rainbow trout, brook trout, smallmouth bass), so this number may be accurate for Montana as well. In Al-Chokhachy et al.. (2021), they found that the negative influence of non-native species on YCT occurrence was most prominent at cold temperatures (10ºC). Additionally, Al-Chokhachy et al. (2021) found in their Idaho/Wyoming study area that brook

						trout abundance regularly exceeded YCT abundance, a pattern that is common in many Montana streams. At Duck Creek (tributary of the Yellowstone River), we've found that YCT seasonal survival across all age classes is significantly lower in the presence of non-native brown trout (unpublished data, Heinle dissertation). Al-Chokhachy and Sepulveda (2019) also found growth in length and mass was lower for YCT sympatric with brown trout than in allopathy in the same system. Heim et al. (2020) found that abiotic factors don't mediate hybridization between rainbow trout and YCT (only distance to the source population of rainbow trout/hybrids), therefore hybridization represents an ongoing threat to YCT. Smallmouth bass encroachment in the Yellowstone River (Voss et al. 2022) may also act as an additional predation threat to YCT. Predation from non-native lake trout is also an issue in Yellowstone Lake, but likely has less of an influence on YCT within Montana.; Vincent 2002; McMahon et al. 2010; Carim et al. 2015; Glassic et al. (2024); Glassic et al. (2024) found that for Yellowstone cutthroat trout populations in Yellowstone Lake, disease, low lake levels, and non-native lake trout all affected population dynamics of YCT. Whirling disease is likely going to continue to be exacerbated by increasingly frequent drought conditions (McMahon et al. 2010), although YCT may be less susceptible than rainbow trout (Vincent 2002 via Carim et al. 2015). I estimated that 50% of cutthroat trout could be affected by whirling disease, as it is likely a relative threat wherever the disease is present. However, this number should be updated if there is any resource on the distribution of whirling disease throughout Montana, as I know it has been present in the Yellowstone River and likely exists in some tributaries, but I am not sure how widespread it actually is. (The more than 10 years classification is referring to the timeline of increasing drought/low flow conditions)
Climate Change & Severe Weather	2024-02-20	High	Pervasive	Serious	High	VerWey 2018; Hostetler et al. 2021; Glassic et al. 2024; unpublished data from Heinle dissertation: Low flow and drought conditions in summer months are likely to become more common throughout the Greater Yellowstone Area (Hostetler et al. 2021). Lower flow can negatively

						affect cutthroat trout growth (unpublished data on YCT, Heinle) and abundance (coastal cutthroat trout – VerWey 2018; YCT–Glassic et al. 2024) as well as negatively affect non-native salmonids like brown trout (Tim Cline brown trout meta-analysis, unpublished?). In a field experiment, we found that YCT in allopathy displayed no difference in growth (but lower body condition) due to drought conditions when in allopathy, but slower growth in the presence of brown trout. However, our long term mark-recapture work in Duck Creek, has shown that growth generally slows under lower flow conditions, but this response is somewhat dependent on the overall density of fish. Therefore, YCT may exhibit some resilience to increasingly frequent drought conditions, but less so in areas where there are already experiencing other threats (e.g., non-native species)
Threat Tally: 0 - Very High, 2 - High, 1 - Medium, 0 - Low Overall Threat Impact* = Very high						

*See Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species for calculation of Overall Threat Impact based on the number and impact of individual threats.

Conservation Status Rank Calculation

Raw score

Rarity: (3.93 × 70%) + Threats: (0.00 × 30%) + Trends: ([-0.36, -0.08]) = [2.39, 2.67]

Calculated Rank: S2S3

Accepted Rank	S2
Date Approved	Date Unknown
Approval Authority	Legacy Assessment: MTNHP Staff
Rank Justification	Species is facing threats from hybridization with other trout species as well as changing habitat.

Supplementary Information

Montana Natural Heritage Program. 2021. Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species. 18 p.
https://mtnhp.mt.gov/docs/Montana_State_Rank_Criteria_20211201.pdf

Montana Field Guide Species Account:
https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AFCHA02170

Predicted Suitable Habitat Model:
https://mtnhp.mt.gov/resources/models/?elcode=AFCHA02170

Information Needs

Information needs are assessed by considering the availability of factors used to assess species status as well as the quality of these assessments. Current information availability and quality to inform Conservation Status Rank for this species are highlighted.

Rank Factor	Assessment Category	Value	Criteria
General Status	Status Quality	Adequate	Calculated rank has low uncertainty and is represented by a single rank (e.g. S3); accepted rank may be adjusted to a range rank (e.g. S2S3)
		Poor	Rank assessed as SU or calculated rank has notable uncertainty and corresponds to a range rank with 2 or more values (e.g. S2?, S1S3, or S4S5)
Rarity	Range Quality	Adequate	Range polygon adequately represents area of probable occupancy and does not include substantial unoccupied areas; range may be adequately defined and still include areas of unsuitable habitat (e.g. mountain ranges for plains species)
		Marginal	Range polygon defined, but may include or exclude notable areas where the species may or may not occur on the landscape
		Poor	Range polygon not defined
	Habitat Quality	Adequate	Species-habitat relationship is well-defined (e.g. relevant literature or robust habitat model available)
		Marginal	Understanding of species-habitat relationship is adequate among some but not all habitats (e.g. literature covers similar habitats outside of Montana or habitat model performance is only somewhat adequate)
		Poor	Species-habitat relationship is not well understood
Threats	Threat Quality	Adequate	Threat Impact is a single value (including "Unthreatened")
		Marginal	Threat Impact assessed at more than one value (e.g. "High - Medium")
		Poor	Threat Impact is Unknown but Intrinsic Vulnerability is assessed
		Unknown	Threat Impact is Unknown and Intrinsic Vulnerability is not assessed
Trends	Recency	Current	Short-term Trend assessment date less than 10 years old
		Out of Date but Adequate	Short-term Trend assessment date is more than 10 years old or Unknown, but species is Unthreatened
		Out of Date	Short-term Trend assessment date more than 10 years old
		Not Available	Short-term Trend data are not available
	Trend Quality	Sufficient	Short-term Trend assessed at a single value or multiple values with a minimum trend greater than -10% (stable or increasing)
		Unknown but Sufficient	Short-term Trend is Unknown, but species is Unthreatened
		Poor	Short-term Trend is less than -10% (in decline) with two or more values selected
		Unknown	Short-term Trend is Unknown

Summary of Information Availability

All information are available, but trend is uncertain

Summary of Information Needs

Further exploration of trend is necessary to provide additional certainty in rank score

Additional Threat Details

The table below contains the complete threats assessment for this species. While the Conservation Status Rank Calculation is based on cumulative, broadly categorized (Level 1) threats data, threats are assessed and tracked for more specifically categorized (Level 2) threats when available.

Threat Category	Date Assessed	Assessed By	Data Source	Scope	Severity	Imme-diacy	Comments
Biological Resource Use - 5.4 - Fishing & Harvesting Aquatic Resources	2024-02-20	Kacie Heinle	Hostetler et al. 2021; Cline et al. 2022	Large	Moderate	High	Hostetler et al. 2021; Cline et al. 2022: As drought and hoot owl restrictions (from warming stream temperatures) become more common (e.g., Hostetler et al. 2021), fishing pressure for cutthroat trout in drought resistant areas (e.g., higher elevation headwaters) may increase (Cline et al. 2022) with the potential for increased catch-and-release stress/mortality. I estimated this as affecting 50% of the population to encompass the tributaries on public land that this could affect, but am unsure what the actual fishing pressure is like throughout their native range, so this could be higher or lower.
Invasive & Other Problematic Species, Genes & Diseases - 8.1 - Invasive Non-Native/Alien Species/Diseases	2024-02-20	Kadie Heinle	Al-Chokhachy et al. 2018; Al-Chokhachy et al. 2021	Large	Extreme	High	Al-Chokhachy et al. 2018; Al-Chokhachy et al. 2021; unpublished data in Heinle dissertation; Heim et al. 2020: In Al-Chokhachy et al. (2018) they found that 70% of YCT throughout their range are either hybridized or sympatric with non-native species. While this number is for the entire YCT range, not just in Montana, large portions of YCT's range in Montana are threatened by non-native species (e.g., brown trout, rainbow trout, brook trout, smallmouth bass), so this number may be accurate for Montana as well. In Al-Chokhachy et al.. (2021), they found that the negative influence of non-native species on YCT occurrence was most prominent at cold temperatures (10ºC). Additionally, Al-Chokhachy et al. (2021) found in their Idaho/Wyoming study area that brook trout abundance regularly exceeded YCT abundance, a pattern that is common in many Montana streams. At Duck Creek (tributary of the Yellowstone River), we've found that YCT seasonal survival across all age classes is significantly lower in the presence of non-native brown trout (unpublished data, Heinle dissertation). Al-Chokhachy and Sepulveda (2019) also found growth in length and mass was lower for YCT sympatric with brown trout than in allopathy in the same system. Heim et al. (2020) found that abiotic factors don't mediate hybridization between rainbow trout and YCT (only distance to the source population of rainbow trout/hybrids), therefore

							hybridization represents an ongoing threat to YCT. Smallmouth bass encroachment in the Yellowstone River (Voss et al. 2022) may also act as an additional predation threat to YCT. Predation from non-native lake trout is also an issue in Yellowstone Lake, but likely has less of an influence on YCT within Montana.; Vincent 2002; McMahon et al. 2010; Carim et al. 2015; Glassic et al. (2024); Glassic et al. (2024) found that for Yellowstone cutthroat trout populations in Yellowstone Lake, disease, low lake levels, and non-native lake trout all affected population dynamics of YCT. Whirling disease is likely going to continue to be exacerbated by increasingly frequent drought conditions (McMahon et al. 2010), although YCT may be less susceptible than rainbow trout (Vincent 2002 via Carim et al. 2015). I estimated that 50% of cutthroat trout could be affected by whirling disease, as it is likely a relative threat wherever the disease is present. However, this number should be updated if there is any resource on the distribution of whirling disease throughout Montana, as I know it has been present in the Yellowstone River and likely exists in some tributaries, but I am not sure how widespread it actually is. (The more than 10 years classification is referring to the timeline of increasing drought/low flow conditions)
Climate Change & Severe Weather - 11.1 - Habitat Shifting & Alteration	2024-02-20	Kadie Heinle	Al-Chokhachy et al. 2018; Al-Chokhachy et al. 2021	Large	Unknown	Low	Al-Chokhachy et al. 2018; Al-Chokhachy et al. 2021; Hostetler et al. 2021; unpublished data in Heinle dissertation: In Al-Chokhachy et al. (2018), they found that 44% of YCT throughout their native range occupy habitat "with low climatic resilience". Within Montana, most streams are comprised by 51-75% of habitat that is predicted to exceed 12ºC (Figure 3a in Al-Chokhachy et al. 2018), so the proportion of the population within Montana that may be affected by warming stream temperatures could be larger. However, in Al-Chokhachy et al. (2021), they found that large YCT grew more in length under warmer stream temperatures, and probability of occurrence either remained high across a variety of stream temperatures (in allopathy), or even increased under warmer stream temperatures (in sympatry with non-native species). At Duck Creek (a tributary of the Yellowstone River), we have found that growth and survival of YCT (both in allopathy and sympatry with brown trout) tends to decline with increasing stream temperatures, but relative body condition is higher under warmer conditions (unpublished data from 2013-2023, Heinle dissertation). The timeline answer is

							in reference to the 'ongoing' negative effects that YCT currently experience from warm temperatures, but the more than 10 years classification is in reference to how aspects of their habitat will change into the future (e.g. Hostetler et al. 2021).
Climate Change & Severe Weather - 11.2 - Droughts	2024-02-20	Kadie Heinle	VerWey 2018; Hostetler et al. 2021; Glassic et al. 2024	Pervasive	Serious	High	VerWey 2018; Hostetler et al. 2021; Glassic et al. 2024; unpublished data from Heinle dissertation: Low flow and drought conditions in summer months are likely to become more common throughout the Greater Yellowstone Area (Hostetler et al. 2021). Lower flow can negatively affect cutthroat trout growth (unpublished data on YCT, Heinle) and abundance (coastal cutthroat trout – VerWey 2018; YCT–Glassic et al. 2024) as well as negatively affect non-native salmonids like brown trout (Tim Cline brown trout meta-analysis, unpublished?). In a field experiment, we found that YCT in allopathy displayed no difference in growth (but lower body condition) due to drought conditions when in allopathy, but slower growth in the presence of brown trout. However, our long term mark-recapture work in Duck Creek, has shown that growth generally slows under lower flow conditions, but this response is somewhat dependent on the overall density of fish. Therefore, YCT may exhibit some resilience to increasingly frequent drought conditions, but less so in areas where there are already experiencing other threats (e.g., non-native species)