

## Note

### Displacement of migratory Bull Trout (*Salvelinus confluentus*) spawning by a newly constructed beaver (*Castor canadensis*) dam in a west-central Alberta stream

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#### Abstract

Despite broad overlap of the ranges of Bull Trout (*Salvelinus confluentus*) and North American Beaver (*Castor canadensis*), relatively little is published in the peer-reviewed literature on their interaction. Beavers are ecosystem engineers with the potential to transform lotic environments, while Bull Trout are of conservation concern and subject to various protective measures throughout their range. The impact of beaver activity on trout populations is context dependent, and our appreciation of the scope of this impact depends on documentation. We report on the disruption of Bull Trout spawning migration by a newly constructed beaver dam in Fall Creek, a west-central Alberta stream in the North Saskatchewan River drainage system. Large Bull Trout have been documented travelling up to 74 km to spawn in Fall Creek. Since 2007, we have used autumn redd counts to monitor the abundance of spawning Bull Trout in the stream. In 2022, we documented displacement of Bull Trout spawning in Fall Creek by a newly constructed beaver dam. Over 60% of Bull Trout redds were observed in a reach downstream of the dam rarely used by spawning fish. We also observed seven post-spawn Bull Trout, representing over 10% of the spawning run, apparently stranded in a shallow impoundment upstream of the dam. It is unclear whether this displacement will have a long-term impact on the Fall Creek Bull Trout population. However, the seasonal impact on spawning adults is unprecedented in the 15 years we have monitored the population.

Key words: North American Beaver; *Castor canadensis*; Bull Trout; *Salvelinus confluentus*; spawning; redd; migratory; Alberta; impact

Bull Trout (*Salvelinus confluentus*) is a char native to western Canada and the United States Pacific Northwest. The species has declined in abundance and distribution and is subject to various protective measures throughout much of its range (COSEWIC 2012). The Saskatchewan-Nelson Rivers designatable unit (DU) of Bull Trout occurs entirely within Alberta and is listed as Threatened under the Canadian *Species at Risk Act* (Sinnatamby *et al.* 2020; SARA Public Registry 2024). As a member of the family Salmonidae (i.e., trout, salmon, char, grayling, and whitefish), Bull Trout often exhibit a migratory life history and require sediment-free gravel and cobble substrates to reproduce successfully (Beechie *et al.* 2008; COSEWIC 2012).

Beavers (*Castor* spp.) are ecosystem engineers, and their dam building behaviour can transform lotic environments (Johnson-Bice *et al.* 2018; Larsen *et al.* 2021). Appreciation of the role of beavers in the restoration of degraded river habitats is growing, but the use of beaver-related restoration practices for recovery of native salmonids can be controversial (Pilliod *et al.* 2018; Larsen *et al.* 2021; Wolf *et al.* 2024). Beaver dams impound flowing water and can impede fish migration and increase sedimentation, reducing salmonid spawning success (Johnson-Bice *et al.* 2018; Larsen *et al.* 2021). However, these impacts are context specific and vary widely, largely precluding universal statements on the impact of beaver dams on salmonid populations (Collen and Gibson 2000;

Kemp *et al.* 2012; Larsen *et al.* 2021). This complexity fosters uncertainty, which can generate controversy when stakeholder perspectives on the positive and negative aspects of beaver activity differ (Larsen *et al.* 2021).

Despite broad overlap with the range of North American Beaver (*Castor canadensis*), surprisingly little has been published in the peer-reviewed literature on the interaction between Bull Trout and beavers (but see Jakober *et al.* 1998, 2000; DuPont *et al.* 2007; Wolf *et al.* 2024). Here we report on the displacement of spawning Bull Trout by a newly constructed beaver dam in Fall Creek, a west-central Alberta stream in the Saskatchewan-Nelson Rivers DU. Documentation of field observations, such as ours, provides context for assessing the scope of salmonid–beaver interactions generally (Kemp *et al.* 2012; Johnson-Bice *et al.* 2018) and a useful case study for management of Bull Trout specifically.

Fall Creek (coordinates at the mouth: 52.2639°N, 115.5521°W) provides the only known spawning habitat for migratory Bull Trout in the Ram River watershed. The stream is of high conservation value and has been the focus of various conservation measures including a closure to angling and removal of off-highway vehicle stream crossings (reviewed in Judd *et al.* 2023). The stream is a fifth-order tributary (September mean discharge  $\sim 0.37$  m<sup>3</sup>/s) of the Ram River in the foothills of Alberta  $\sim 44$  km southwest of Rocky Mountain House. A waterfall, 7.5 km upstream of the mouth, constitutes a barrier to fish passage, and the headwaters of Fall Creek were historically fishless. Below the falls, Fall Creek has a moderate gradient (1.6%), is dominated by gravel and cobble substrates, and is heavily influenced by groundwater (Rodtka *et al.* 2010), characteristics typical of Bull Trout spawning habitat (COSEWIC 2012). Alberta Conservation Association documented large (i.e., mean fork length  $\sim 58$  cm, 1.8 kg) Bull Trout travelling up to 74 river km from the Ram, North Saskatchewan, and Clearwater rivers to spawn in Fall Creek (Rodtka *et al.* 2010). This population averages 73 Bull Trout annually (Rodtka *et al.* 2010; Judd *et al.* 2023).

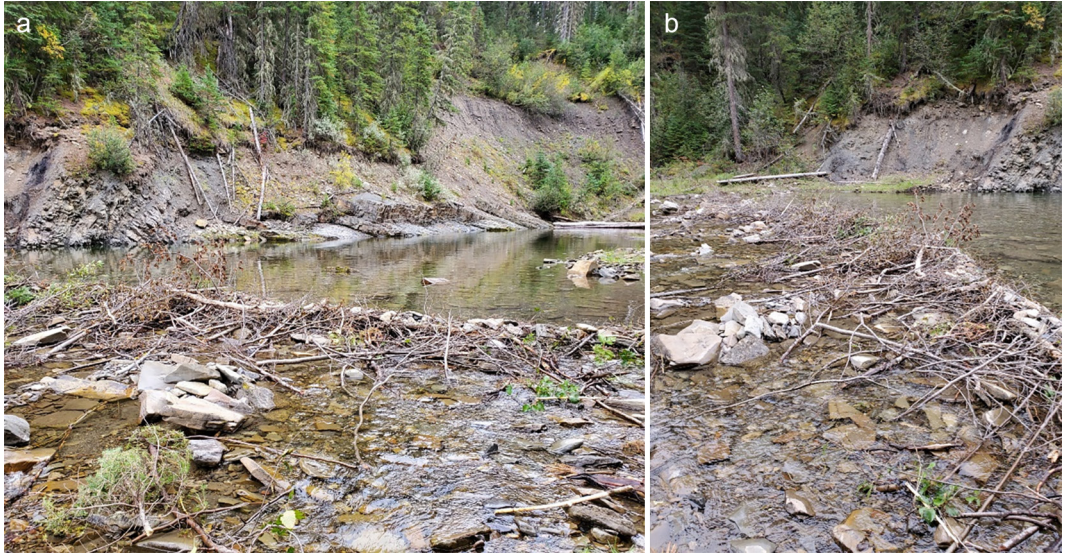
Since 2007, we have used autumn redd counts to monitor the annual abundance of spawning Bull Trout in Fall Creek. Redds are the gravel nests constructed by female salmonids while spawning and can be used as an index of abundance (Beechie *et al.* 2008; Howell and Sankovich 2012; Kaeding and Mogen 2023). Although suitable spawning habitat appears to occur throughout much of the 7.5 km of stream below the barrier falls,  $>95\%$  of Bull Trout redds occur in the upper 3.2 km (“survey reach” hereafter; Rodtka *et al.* 2010; Judd *et al.* 2023). We have observed adult Bull Trout entering Fall Creek as early as April,

but most migrants enter in mid- to late August and redd building begins in early September. Spawning peaks around mid-September and is complete by the first week of October, at which point essentially all migratory Bull Trout have left the stream (Rodtka *et al.* 2010; Judd *et al.* 2023). The timing and location of Bull Trout spawning activity in Fall Creek has remained consistent since we started monitoring the population (Judd *et al.* 2023), which is characteristic of many salmonid populations (Beechie *et al.* 2008). Autumn flows in Fall Creek are usually low and clear, which aids in redd detection.

Although survey methods have varied over the years, in a typical year, we count redds in the survey reach only once in early October. However, from 2018 to 2022 we conducted biweekly surveys to reassess the timing of Bull Trout spawning in the stream first documented over a decade earlier. Our survey season started in early September and ended the first week of October. During surveys, an experienced crew of two walked upstream identifying redds as either definite (i.e., displaying clean substrate, defined pit, and tail spill) or probable (i.e., missing one of the attributes of a definite redd; Bonar *et al.* 1997). Redd locations were marked with a global positioning system waypoint and flagged on a nearby bank. The accumulated count of flagged, definite redds represented our estimate of annual redd abundance in the survey reach. On our last survey of each year (except 2020), we walked all 7.5 km of Fall Creek accessible to migrating Bull Trout to identify any redds downstream from the survey reach. The number and location of any Bull Trout observed was also recorded during every survey.

During our first survey of 2022 on 9 September, we observed a newly constructed beaver dam in the survey reach (Figure 1). This was the first beaver dam we had observed in the stream, although we had noted signs of beaver activity in the survey reach since 2018. The dam was  $\sim 17$  m wide, 0.4 m high, spanned the full width of the stream with no spill over, and was constructed of large gravel, cobble, and deciduous tree branches. The channel downstream of the dam was heavily braided and consistently shallow (i.e.,  $< 0.2$  m). We observed a group of 30 Bull Trout in a 30 m long section of 1 m deep run habitat 185 m downstream of the dam. Although staging of Bull Trout in similar habitat throughout the survey reach in early September is not unusual, the high density of fish we observed in a single run was unprecedented.

During our second survey of 2022 on 16 September, we counted 23 Bull Trout in the same run below the dam at a time when we expected most fish to be at spawning sites upstream of the dam. We also observed redds and actively spawning Bull Trout downstream



**FIGURE 1.** Upstream (a) and profile (b) views of a newly constructed beaver dam in Fall Creek, Alberta, 9 September 2022. Photos: M. Rodtka.

of the dam in an area rarely used by spawning fish since our survey began in 2007. Although spawning was still occurring upstream of the dam, we noted far fewer Bull Trout and redds than usual.

Results of our final survey on 4 October confirmed our suspicion that 2022 was an exceptional year. Most Bull Trout redds occurred downstream of the dam, in areas where there had been essentially no spawning activity in past years (Figure 2). Although we expected almost all migratory fish to have left the stream by October (Roldtka *et al.* 2010), we observed seven large (50–60 cm), Bull Trout in the shallow (<1.5 m) impoundment upstream of the dam, representing >10% of the estimated 2022 spawning run of 63 fish (Judd *et al.* 2023). We also observed a newer, partly completed dam, 100 m downstream from the original. No redds or Bull Trout were observed downstream of the survey reach.

Apparently, the newly constructed beaver dam was displacing Bull Trout spawning downstream and may have impeded downstream migration. The redds we observed upstream of the dam were most likely constructed by early-season migrants that had moved into the reach before the dam became impassible. We are unsure when the dam was completed, but it was first documented on 16 August and was noted as being “fairly fresh” at the time with spill-over and gaps likely capable of passing an adult Bull Trout (M. Banko pers. comm. 10 May 2023), and we have documented adults moving upstream as early as April. Regardless of when, or if, the dam became a full barrier to Bull Trout migration, >60% of the redds

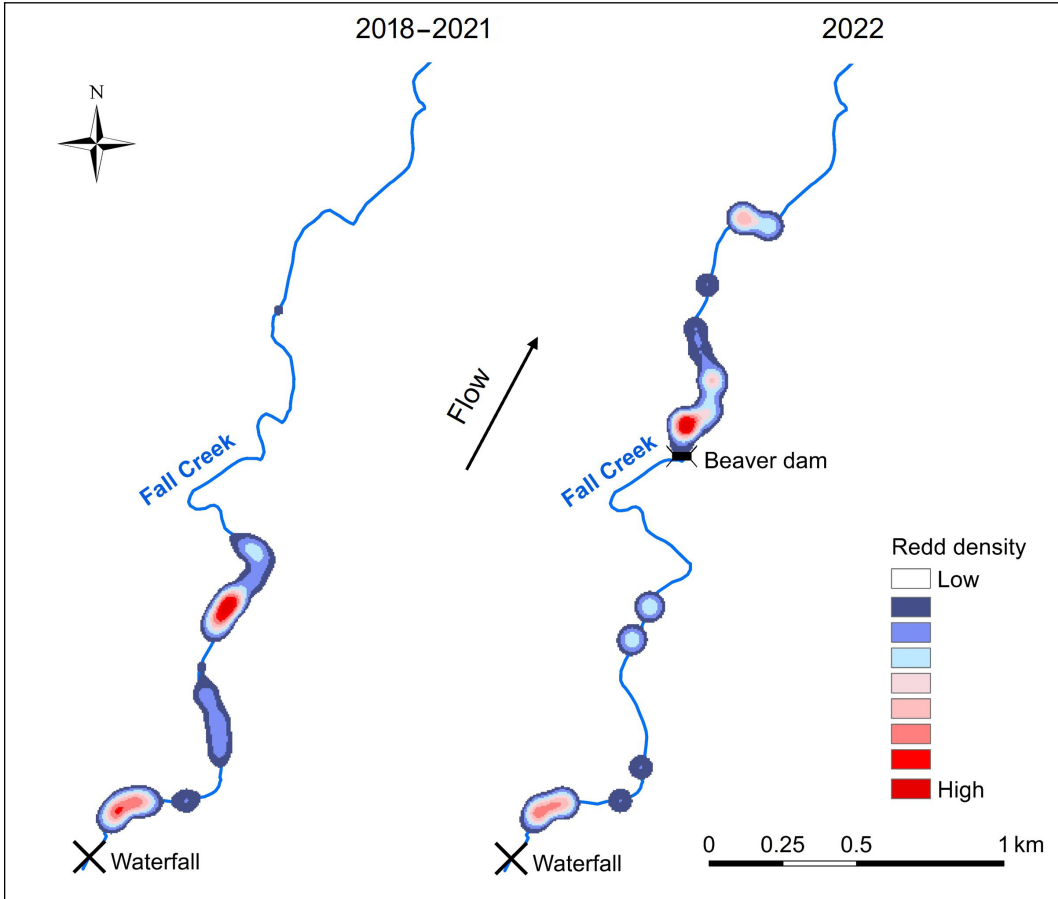
counted in 2022 occurred downstream of the dam in a reach rarely used by spawning Bull Trout. This represents a substantial displacement of Bull Trout spawning which is most plausibly attributed to creation of the beaver dam. It remains to be seen what, if any, long-term impact this disruption has on the Fall Creek Bull Trout population. However, the seasonal impact on spawning adults is unprecedented in the 15 years we have monitored the population.

### Author Contributions

Writing – Original Draft: M.C.R. and C.S.J.; Writing – Reviewing & Editing: M.C.R., C.S.J., and P.K.M.A.; Conceptualization: M.C.R., C.S.J., and P.K.M.A.; Investigation: C.S.J. and M.C.R.; Funding Acquisition: M.C.R. and P.K.M.A.

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**FIGURE 2.** Displacement of Bull Trout (*Salvelinus confluentus*) redds in response to a newly constructed beaver dam in Fall Creek, a tributary to the Ram River in the headwaters of the North Saskatchewan River watershed, Alberta. Redd density was calculated using the kernel density function in ArcGIS 10.6 (ESRI, Redlands, California, USA) in 2022 ( $n = 54$ ) and 2018–2021 ( $64.3 \pm 15.4$ ; mean  $\pm$  SD) redds, respectively.

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