Silvester Creek: Watershed Condition, Foothills Roads and Native Trout

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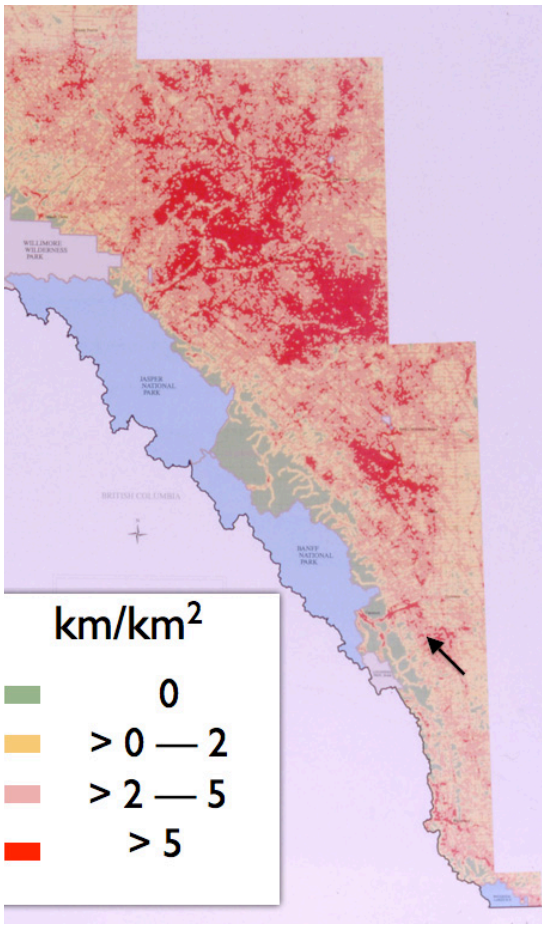
The intensity of land use, measured as the concentration of roads on Alberta's East Slopes, ranks among the highest in western North America. Large parts of the region have road densities of more than 5 km per square km; in some places they exceed 8 km/km2.

The average for the region is 2.7 km/km^2. For perspective, the likelihood of finding Bull Trout in a stream begins declining with any amount of road, from a 60-percent chance in roadless areas to only 10 percent at road densities of 0.8 km/km^2. Trout abundance in general has often been shown to decline with increasing measures of road density.

My colleagues and I have screened the degree of risk to stream channels and fish habitat associated with roads and other development in 99 watersheds on the East Slopes. Nearly one-third are at high risk of stream channel damage from increased peak flows and surface erosion; another two-thirds are at moderate risk. Only three are at low risk. Most of these watersheds once held abundant populations of native trout. Now most of those are at risk or no longer exist.

Roads themselves may impact trout populations in several ways, but a major issue is that they greatly increase fine sediment delivery to streams. Sediment that settles out occludes spaces among cobbles that are used by juvenile trout for shelter, and can suffocate eggs and larvae buried in spawning gravels. Total suspended sediment (TSS) clouds the water, interfering with feeding success and causing physiological stress that, if prolonged, affects overall condition and therefore long-term viability. Recently I have been studying these issues in a foothills stream.



Road development on Alberta's East Slopes as of the mid-1990s. Arrow shows the approximate location of Silvester Creek. Map by M. Sawyer and W. Haskins

Silvester Creek holds a pure population of native Cutthroat Trout, now extremely rare and designated Threatened in Alberta. In the late 1970s the watersheds of this and several neighbouring streams were sacrificed to motorized vehicle recreation. The Silvester watershed is also used for livestock grazing, logging, and is part of a developed gasfield served by an access road and pipeline. There is an extensive designated trail system for off-highway vehicles, including disused and crumbling logging roads, supplemented with a large undesignated (and therefore illegal) network of trails initiated by recreationists themselves.

The roads and trails cover the watershed in a dense, sediment-producing network from the top of the drainage divide to very near the mouth. Their density is 2.5 km/km2 overall, but reaches 4.8 km/km2 in the upper part of the basin. Our assessment scored the watershed as at high risk, primarily due to

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Muddy runoff into Silvester Creek from a pipeline right-of-way heavily used by off-highway vehicles (OHVs). The right-of-way is marked ÒHV Use Prohibited`on the official access map. Photo provided by D. Mayhood

the extent and locations of the road network, but also to some degree owing to the relatively large areas of clearcuts that often encroach on watercourses and have not yet recovered sufficiently from logging.

I studied sediment delivery to this creek in late May through mid-June 2013, while the stream's Cutthroat Trout were spawning. I found more than 40 sediment sources, almost all of them road-related, on this 6.5-km long creek. Frequent use of most trails by off-highway vehicles kept the trail surfaces disturbed and, together with frequent rainfall, produced regular runoff of muddy water into the stream and its many small tributaries. The stream was constantly turbid. I used three different sampling regimes at 4 to 12 sites on the mainstem and tributaries, taking 117 samples to assess the effects of steady rainfall for one day; the effect of an intense thunderstorm; and sediment concentrations over six days that included a three-day period of dry sunny weather, followed by three days of frequent rainfall.

What I found was not surprising, and is probably quite typical for an East Slopes watershed of a similar degree of development subjected to the same kind of use. TSS concentrations were always clearly elevated relative to controls, which were usually near 0 mg/L and never exceeded 1.2 mg/L. Even during rainy weather, TSS was not especially high, commonly ranging from 20-40 mg/L, except shortly after an intense thunderstorm, when concentrations jumped briefly. During dry weather, TSS was as low as 5-7 mg/L at some sites. The highest TSS found was a spike of 179 mg/L, apparently caused by one or more vehicles crossing some distance above the sampling location.

These are definitely elevated concentrations for a creek in this region, but they are not especially high in absolute terms. Much higher TSS, in the thousands of mg/L and sometimes much more, is often measured in similar creeks during instream construction. What is significant for the resident trout population, however, is the duration of exposure to the concentrations I observed. Even the lowest dry-weather TSS loads were sufficient over several days to have near-lethal to lethal effects on the Cutthroat Trout eggs and larvae that were then in the gravel. Considering the survey results as typical of the spring season, I estimated from well established concentration-duration relationships that this population would commonly suffer up to 40-60 percent mortality to eggs and larvae as a result of sediment loading alone, most of it derived from roads. Juveniles of the current population of Cutthroat Trout show 10-15 percent lower condition than those in the same population in 1978, before the watershed was heavily developed. The present population shows evidence of being smaller than in 1978 as well.

These results tend to confirm reports in the literature on the effects of roads on trout, and suggest that road development in Alberta's East Slopes streams is likely a serious limitation on native trout and their habitat. Without significant reductions in road extent, native trout in these drainages are likely to continue to decline.

You can reach Dave Mayhood through fwresearch.ca, where the above research is available for download.