The State of the Bow River Fishery

Vol:2. Number 1

The Impact of Water Management on the Bow River Fish Population

Introduction:

The Bow River is a world-renowned trout sports fishery that is under pressure from the human population growth in the region, the ever-increasing demand for outdoor recreational pursuits, environmental changes, and degradation of aquatic and riparian habitats. Fishery managers have monitored the Bow River for more than 30 years, and in this time, it has been demonstrated that up until 2003 the fishery was sustainable with proper regulatory constraints. More recently though we have seen dramatic changes to the Bow River with devastating floods, low river flows in the warmest seasons, higher summer temperatures, and now the presence of Whirling Disease [(1).]

A recent University of Calgary research paper [(2)] indicated that Bow River trout populations are in serious trouble. Data analysis showed that the Rainbow Trout population has declined by as much as 50% over a ten-year period from 2003 to 2013. Although the reasons for the decline are unknown, the researchers have suggested that catch-and-release mortality, flood events, whirling disease, and angling pressure may well have contributed to the trout population decline. Because disease and floods are largely uncontrollable from a management perspective, the researchers suggest that stringent tactics such as angler restrictions may be necessary to stop the decline and hopefully enhance the sport fishery.

Alberta Environment & Parks conducted a fish population survey in 2018 to add to the data pool. The survey data was generated from the long-term sample sites downstream of Policeman's Flats [(1)] and at additional sites across the Bow River from Bearspaw Dam to Carseland Dam. The preliminary results [(3)] indicate that rainbow trout, brown trout, and whitefish populations have continued to decline. It also suggests that this decline may well have started as far back as 2003 regardless of flood events and increasing fishing pressure. The data also indicates that the decline is across all age classes. A synopsis of the results will be available in the new year.

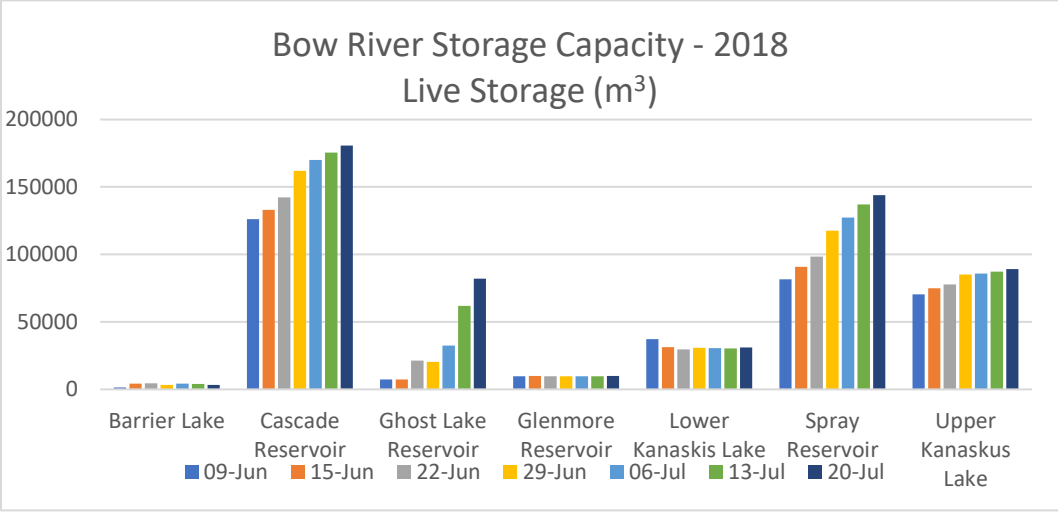
The reasons for the decline are unknown and the complex nature of a managed water supply, natural events, fish habitat, predators, fishing pressure, and the proximity to a large human population add to the many influencers at play. Alberta Environment and Parks have suggested that a Cumulative Effect Modelling initiative for the Bow River is desirable to define the major components contributing to the fish population decline.

It is becoming increasingly evident that the impact of the Bow River water management model may well contribute significantly to the trout population decline. But unfortunately, very little data is available to support or deny this opinion. The following is a review of current water management operational procedures, the available scientific evidence of the impact on the ecology of the river and the fishery. It is hoped that further investigation will take place within government departments to define ways to protect the Bow River ecosystem and its fishery.

Bow River Water Management:

The Bow River fishery needs a constant supply of cold clean water to sustain its future as a world-recognized trout river. The management of water flows is controlled by the Province of Alberta within long-standing agreements with TransAlta who control the hydroelectric dam infrastructure above Calgary, the City of Calgary itself, and the irrigation districts downstream. On a weekly basis, each of these stakeholders meet to establish the water release rates through the upstream storage capacity to meet demands for water and minimum flow legislation. Water will be released or held back within the Bow River Basin storage capacity to meet projected demand. There is a total of 9 reservoirs within the Bow River Basin of which 7 have regulated capacity to store water for year-round operation of TransAlta's power generation plants (Table 1). The largest storage capacity is maintained at Cascade and Spray Reservoirs which account for 60% of the total basin storage. Both Upper Kananaskis and Ghost Reservoirs each account for approximately 15% of the total. Storage levels in each of the reservoirs are at the lowest in the spring and reach their upper limits of capacity by the end of July.

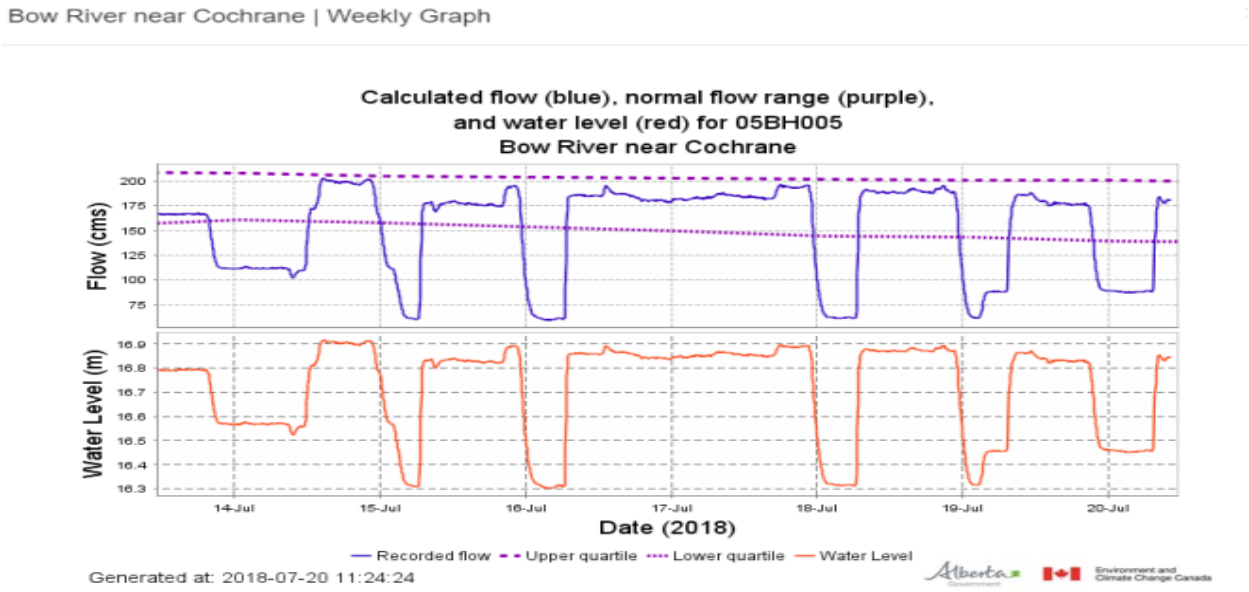
Table 1: Bow River Basin Storage Capacity Upstream of Calgary



Water is subsequently released from each reservoir to meet hydroelectric demand throughout the year. Hydro-electric power generation is the highest at Spray (103 MW) followed by Ghost on the Bow River (54 MW) and Rundle on the Kananaskis River (50 MW). A total of 329 MW of electrical power capacity can be generated within the Bow River Basin, representing 5% of TransAlta's total Alberta generating capacity.

Ghost Reservoir power generation is referred to as "Hydropeaking" that allows TransAlta to turn the generators on when electrical power demand is high and turn off when not needed. This gives rise to extreme changes in inflows below the dam (Figure 1).

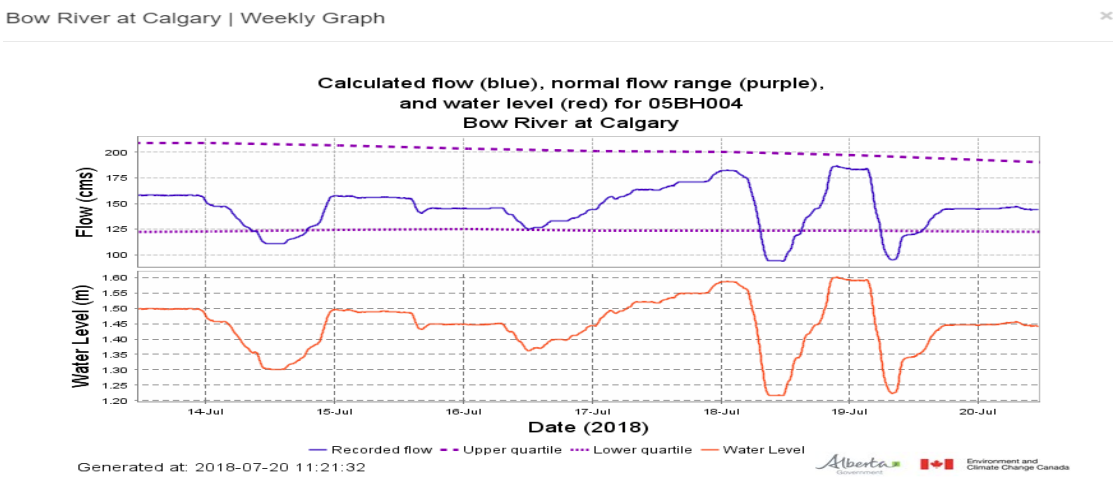
Figure 1: Bow River Flows at Cochrane – Below Ghost Hydroelectric Plant



The rapid changes in river flow below Ghost hydro-electric power plant are contained by Bearspaw Reservoir and which insulates the City of Calgary from the large water flow fluctuations experienced by the Bow River between Ghost and Bearspaw reservoirs.

Historically, consistent Bow River flows gave rise to a very productive trout fishery, but in recent years, floods, droughts, and modification to the Bow River hydro operation protocol [4] have given rise to extreme changes in flow rates. In recent years the Bow River downstream of Bearspaw has experienced as much as a 50% drop or increase in inflows within a very short time (Figure 2). These dramatic fluctuations have a very detrimental effect on the Bow River fishery.

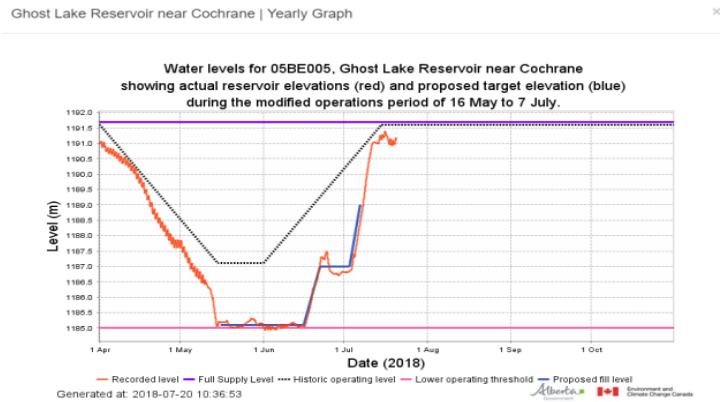
Figure 2: Bow River Flows at Calgary from July 14 to July 20, 2018



Why have we seen these dramatic changes in river flow in recent years?

Due to a modified Bow River water management protocol that empties Ghost Reservoir in May to aid in potential flood relief for the City of Calgary in the event of high flow advisories (Figure 3). Once the city's exposure to this threat is reduced, the reservoir is returned to normal operation capacity by the middle of July. During this time, flood risk protocols are put in place across the upper Bow River watershed to contain water in the basins' reservoirs during times of high rainfall and enhanced snowmelt. Once natural flows recede, the accumulated storage will be released to accommodate further containment of rainfall. Any excess water will flow through the upper Bow River and finally through Calgary. Although river flows will increase significantly after high rainfall in the mountains and foothills, the magnitude of the increase is reduced considerably through and downstream of Calgary.

Figure 3: Ghost Reservoir Water Levels for April – July 2018



Bow River Trout Foundation has documented the modified water management protocol for some time and has expressed our concerns to TransAlta and Alberta Environment & Parks regarding the sudden spikes and drops in water flow through the City of Calgary as illustrated in Figure 2. Unfortunately, there appeared to be a breakdown of the water management operations for the week of July 15, 2018, where the extreme changes in inflow had a severe impact on the recreational fishing downstream of Calgary and may have long-term impacts on the survival of the fishery itself. An immediate correction in the water management protocol was put in place that hopefully will continue to stabilize flows through the summer months (Figure 4).

The Impact of Water Management Practices on the Bow River Basin Ecosystem.

TransAlta's hydroelectric power generation protocol that is referred to as hydropeaking has come under considerable scrutiny in recent years. A large study conducted by a collaboration of researchers from the U.S. Geological Survey, Oregon State University, Utah State University, and Idaho State University [(5)] raises serious questions about the current practice of hydropeaking to meet electricity demand, which has nearly wiped out local populations of some insects that feed local river ecosystems. The researchers' comments illustrate the concerns, "*Insects have evolved to live with occasional extreme floods and droughts, and gradual or seasonal changes in river levels. These large daily rises and peaks in river flows due to hydropower dams are not normal. Prior to the construction of dams, there were almost no major daily changes in river levels. This can interrupt the egg-laying practices of some species, and the impact of this is poorly appreciated. Until now no one really looked at this, and it's a serious problem.*" Hydroelectric power generation has an impact on insects that lay their eggs near the shore of streams, such as a mayfly, stonefly, or caddis fly. Under normal water conditions, the eggs are laid slightly below the water surface and soon hatch. But if the water level drops suddenly, they can be stranded, dry out and die before hatching. This research found a clear correlation between hydropeaking and the number of insect species present and an almost complete absence of certain insects in some parts of rivers where they should have been present. The researchers go on to say, *"The loss of these aquatic insects can have a major impact on fisheries and other aspects of ecosystem health".*

The same scenario applies within the Bow River Basin. Downstream of the Pocaterra dam on the Kananaskis River, University of British Columbia researchers [(6,7)]. assessed morphological change of the river as a result of the hydropeaking flow regime. Pre and post-dam channel conditions were assessed. The hydropeaking signal appears to drive channel change in the upper reaches during high flows and appears to change channel morphology in the more downstream reaches under low flows. The extent of daily changes in physical habitat conditions that organisms in the stream and fish would have to endure was also studied. Changes in habitat between high and low flow dam releases were extreme and happen regularly. This poses challenges to fish under variable flow conditions. An increased fish movement is likely displayed under the Kananaskis River flow management regime, possibly increasing gradation and the survival of fish populations.

Alberta Environment and Parks Review of Benthic Invertebrates and Epilithic Algae at Long-term Monitoring Sites on the Bow River in 2006 [8] reported ongoing changes in water quality across the Bow River Basin, but it also shed light on the impact of hydropeaking on invertebrate concentrations below Ghost dam. The abundance of invertebrates was low at the Cochrane sampling site downstream from the Ghost dam as compared to downstream of Calgary. It was also very noticeable within varieties of mayflies and stoneflies that were much lower than what would have been expected at a relatively clean water site.

Historically the impact of the Ghost dam hydropeaking operations had little impact on the daily variables of flows in and downstream of Calgary, but with the introduction of the modified Bow River, Water Management Protocol in 2014 the Bow River has seen extreme daily variability of flows during the timeline of the modified operation of April to July that would be similar to the impact of hydropeaking at both TransAlta's Pocaterra and Ghost hydroelectric operations. This is at a time of year when both mayflies and stoneflies will be most vulnerable to highly variable flows. There is, therefore, a justification on the part of regulators, fishery managers, and TransAlta, the hydroelectric operator to cushion the impact of current water management protocols for the protection of the Bow River ecosystem, fishery, and the fish population itself.

There is a need for a multi-disciplined research investigation to define what is influencing the decline in the Bow River fish population. Hydrology, habitat enhancement, invertebrate tolerance, and environmental variables need to be considered in the management of the Bow River ecosystem and a very important fishery. Without such a study it will be difficult to define a fishery management policy for the river.

Although the focus of this document is to address the impact of the Bow River water management on the lower Bow River declining trout population, there is a need to recognize that the impact of TransAlta's hydropeaking electric generations has an enormous impact on more than 50 Km of the Kananaskis River and an equal amount of the Bow River between Ghost and Bearspaw reservoirs. There is also the impact of flow diversion from the Ghost River into Lake Minnewanka that also supports power generation. All these water bodies have historically supported native species of Westslope Cutthroat Trout and Bull Trout to some degree. The Kananaskis River was historically one of the best Westslope Cutthroat fisheries in Alberta. Hydropeaking has made the river devoid of this species of critically endangered fish and eliminated the river's sports fishery. With less than 5% of TransAlta total Alberta power generation capacity derived from the Bow River hydro plants, and alternate peak demand power generation needs to be considered. Decommissioning the Bow River Basin's hydropeaking facilities or modifying their operation protocols would not only enhance the river's ecosystem, add to the sustainability of threatened and endangered species of fish, but contribute to the recreational fishery and Alberta's economy.

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