

The 2017 survey of Chinook Salmon (*Oncorhynchus tshawytscha*) carcasses in Whitehorse,  
Yukon

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## Introduction

Carcass surveys are a useful tool for fisheries management, especially for anadromous fish such as Pacific salmon (*Oncorhynchus spp.*). They are widely used to inform managers on topics such as escapement, run characteristics, and pre-spawn mortality (DeWeber et al. 2017; Rawding et al. 2014; Murdoch et al. 2010). However, outside of spawning grounds and natal streams, carcass surveys have been used sparsely.

The Whitehorse Hydro Plant (WHP), located in Whitehorse, YT, was constructed in 1958. A fish ladder has operated since 1959 and passes an average of 1200 Chinook Salmon (*Oncorhynchus tshawytscha*) per year; however, the proportion of fish that enters the ladder of those approaching it is unknown. Spawning habitat was created along the Robert Service Way (Access Consulting Group 1998) approximately 1.5 km downstream of the WHP, and spawning is known to occur in the mainstem Yukon River below the WHP (Access Consulting Group and Yukon Engineering Services 2002). Carcasses have been found in the Yukon River between the WHP and the Takhini River, though abundance and proportion that have spawned have not been estimated. In 2005, 14 carcasses were found over three surveys conducted in this reach (von Finster 2005). Of these, 13 were female and 5 had either released < 5% of their eggs or had not spawned. The Ta'an Kwäch'än Council conducted carcass surveys in this reach from 2007 to 2012 (Environmental Dynamics Inc. [EDI] 2008a; EDI 2008b; EDI 2009; EDI 2011; EDI 2012; EDI 2013). Eight carcasses were discovered in 2011 but no carcasses were observed in other years; this was attributed to high water conditions in those years. More rigorous survey methods would allow the total number of carcasses and proportion that spawned to be estimated.

To identify carcass deposition zones and better understand carcass detection and retrieval methods, three pilot carcass surveys were conducted in Whitehorse, YT, in August 2017. Participants included the Canadian Wildlife Federation, Carcross/Tagish First Nation, Ta'an Kwäch'än Council and A. von Finster. The goals of the pilot study were to assess carcass distribution and to inform future efforts to develop standardized carcass monitoring protocols.

## Methods

Carcass surveys were undertaken once a week for the last three weeks of August, 2017. All surveys were conducted using a 19-foot outboard propeller aluminum boat and took approximately 2 hours. On August 15<sup>th</sup>, Transect 1 and the Major Deposition Sites were searched; on August 22<sup>nd</sup>, Transects 1 and 2 were searched; and on August 29<sup>th</sup>, Transects 2 and 3 were searched (Figure 1). Transects 1 and 2 were previously identified as deposition areas (A. von Finster, pers. comm.). Transect 3 was identified as having parallel characteristics to Transect 2. Once carcasses were retrieved, their sex, origin, decomposition state, and spawning status were recorded. Carcasses were then deposited on the shore to ensure that they were not recounted.



**Figure 1:** The 2017 carcass survey areas downstream of the Whitehorse Hydro Plant, Whitehorse, YT.

## Results

On August 15<sup>th</sup>, one carcass was detected in the southerly Major Deposition Site but was not recovered it due to lack of proper equipment (a 10-m collapsible gaff). The carcasses recovered on Aug 22<sup>nd</sup> were found in the Major Deposition Sites (undifferentiated in data collection). On August 29<sup>th</sup>, two carcasses were found in the Minor Deposition Site near Rotary Park in downtown Whitehorse. The remaining carcasses were found in the Major Deposition Sites. Additionally, four brood stock carcasses from the Whitehorse Fish Hatchery were found (identifiable because tails were removed). The majority of carcasses recovered were female and of wild origin (69% of identifiable fish). Of the fish for which spawning status could be estimated, 50% appeared to have spawned.

Table 1: Details on carcasses. Fish that appeared to contain >90% of their eggs were considered unspawned. Decomposition state was determined qualitatively, based largely on whether decomposition or scavenging was severe enough to limit estimation of spawning status. An empty box indicates that the data was not recorded because the carcass was unrecoverable due to decay, fast or deep water, or being actively consumed by a scavenger.

Number	Date	Sex	Origin	Degree of Decomposition	Spawn Status
1	Aug 15 <sup>th</sup>	-	-	-	-
2	Aug 22 <sup>nd</sup>	F	Wild	High	Spawned
3	Aug 22 <sup>nd</sup>	F	Wild	Low	Spawned
4	Aug 29 <sup>th</sup>	F	Wild	Low	Spawned
5	Aug 29 <sup>th</sup>	F	Wild	Low	Unspawned
6	Aug 29 <sup>th</sup>	F	Wild	Low	Spawned
7	Aug 29 <sup>th</sup>	F	Hatchery	Low	Unspawned
8	Aug 29 <sup>th</sup>	F	Wild	Low	Spawned
9	Aug 29 <sup>th</sup>	F	Wild	High	-
10	Aug 29 <sup>th</sup>	F	Wild	Low	Unspawned
11	Aug 29 <sup>th</sup>	F	Wild	Low	Unspawned
12	Aug 29 <sup>th</sup>	M	Hatchery	Low	-
13	Aug 29 <sup>th</sup>	-	Wild	High	-
14	Aug 29 <sup>th</sup>	F	Hatchery	Low	Unspawned
15	Aug 29 <sup>th</sup>	F	Wild	Low	Unspawned
16	Aug 29 <sup>th</sup>	-	-	High	-
17	Aug 29 <sup>th</sup>	-	-	High	-
18	Aug 29 <sup>th</sup>	-	-	High	-
19	Aug 29 <sup>th</sup>	F	Hatchery	Low	Spawned
20	Aug 29 <sup>th</sup>	-	-	High	-
21	Aug 29 <sup>th</sup>	-	-	High	-
22	Aug 29 <sup>th</sup>	F	Hatchery	Low	Unspawned
23	Aug 29 <sup>th</sup>	F	Wild	Moderate Decay	-
24	Aug 29 <sup>th</sup>	F	Wild	Lightly Eaten	Spawned

## Discussion

Over three days (6 h total), 24 Chinook Salmon carcasses were recovered, 21 of which were recovered on August 29<sup>th</sup>. This represents approximately 1.5% of the Chinook Salmon that passed the Whitehorse Fish Ladder in 2017 (~1,200). Most of the carcasses were female; however, this is not uncommon in carcass surveys. Females are generally larger than males, and larger carcasses are more likely to settle to the bottom. Size effects are exacerbated in higher flow areas (Zhou 2002). Half of the females appeared to have spawned to some degree, indicating potential spawning in the mainstem Yukon River downstream of the WHP. Spawning has previously been documented in this reach, along with habitat use by fry and smolts (Access Consulting Group and Yukon Engineering Services 2002).

The number of carcasses was notably higher during the third survey. There were fewer staff on the 29<sup>th</sup> than for previous surveys, but more carcasses were observed and recovered. We recommend greater effort during the last week of August and the first week of September in future years.

Conducting carcass surveys in a large river such as the Yukon River is challenging. In small streams, carcasses are most likely to wash up on gravel bars or be deposited in pools (Cederholm et al. 1989). However, in large rivers pools can be deep enough to prevent detection or recovery and high flow over gravel bars prevents deposition. Woody debris is responsible for over 50% of carcass retention in small streams (Cederholm et al. 1989, Cederholm and Peterson 1985), but is rare or absent in the mainstem Yukon River. Most carcasses were found in eddies. In the Yukon River, these areas are often marshy or with shallow uniform gravel substrates (J. Sebes, pers. obs.). Objects such as sticks, trash, and carcasses were deposited in these areas. The Yukon River above the Takhini River is generally very clear, however some eddies were deep and the substrate was difficult to observe on cloudy days or when turbidity was high.

A boat and motor were necessary to conduct surveys in the main stem. Most deposition sites could not have been accessed on foot or by canoe. Travelling upstream by motor allowed for slow and thorough searching; however, several areas were not accessible by the 19' boat with a propeller motor. A smaller, flat-bottom boat with a jet motor would be more suitable for searching shallow riffles in braided channels, which have similar hydraulic conditions to smaller streams and may retain carcasses at a higher rate.

Having defined where and how to recover Chinook Salmon carcasses downstream of the WHP, more frequent and standardized surveys are required to estimate the total number of carcasses. More detailed data should be collected for each carcass, such as length, age, and percentage of egg retention. To ensure consistency, standardized survey methods (e.g., fixed transect locations) should be developed. Future surveys will provide information on mainstem spawning and pre-spawn mortality for Chinook Salmon in Whitehorse, Yukon.

## Acknowledgements

We thank Al von Finster for advice on recovering carcasses around Whitehorse, Yukon. We also thank Carcross/Tagish First Nation and Ta'an Kwäch'än Council, specifically Danny Creswell, Karlie Knight, and Jenna Duncan, for their field support. Funding was provided by the Pacific Salmon Foundation.

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