# Draft Technical Memo

**Date:** 11/19/2018

**From:** Casey Baldwin (Colville Confederated Tribes)

**To:** UCUT Fish Committee and Kevin Malone

**Subject:** Sockeye Salmon spawner abundance potential estimates in the Sanpoil River

**Introduction:**

The goal of this technical memo is to provide a range of estimates for Sockeye Salmon spawner abundance potential in the Sanpoil River and to document the data sources and assumptions used to generate the estimates. This information is needed to contribute to the habitat assessment for Phase 1 investigations of fish passage and reintroduction upstream of Chief Joseph and Grand Coulee dams.

The effort focused on the Sanpoil River because it is the largest tributary upstream of Grand Coulee Dam (but downstream of other dams) with Sockeye spawning potential in the United States, and because data are available to estimate the quantity specific habitat units (i.e., glides, pool tailouts, and small cobble/gravel riffles) that are anticipated to support Sockeye spawning, as they do in other areas where Sockeye have not been extirpated. It is reasonable to assume that Sockeye would also utilize spawning habitat in many other small tributaries to Lake Roosevelt and that they would/could access lakes and tributaries in Canada such as Christina Lake and Norns Creek. However, the scope of this assessment is only the Sanpoil River.

It is important to note that the spawner capacity estimates provided in this memo have not been modeled through a life cycle model and therefore do not include density dependence or mortality affects across multiple life stages. The estimates are simply how many Sockeye could spawn in the Sanpoil if they spawn at a range of densities and utilize a portion of each habitat unit.

The Colville Tribes Fish and Wildlife Department conducted surveys of habitat in the Sanpoil River and estimated the quantity of each habitat unit (Wolvert and Nine 2009). The survey included 28 reaches across the lower 48 miles of the Sanpoil River with transects in each reach and data expansions for unsurveyed areas. Total habitat area was 340,663 $m^2$ with potential spawning habitat unit types comprised of 46.5% glides, 25.7% small cobble gravel riffles and 1.8% pool tailouts. The remaining 26% of the habitat was within habitat unit types considered not suitable for spawning.

Habitat suitability can vary within potential spawning habitat units due to sediment, hyporheic flow, adjacent cover, depth, velocity and other factors. To account for this uncertainty, we evaluated a range of habitat utilization by using an adjustment factor of 25%, 50% and 75%.

We used two approaches to estimate the range of spawner density within the various habitat types. First, in southern British Columbia the Okanogan Nation Alliance and Department of Fisheries and Oceans have extensive data sets on sockeye spawner density (females/$m^2$) in the Okanogan River. Hyatt and Rankin (1999) used a range of 0.56-2.0 females/$m^2$ and a mean of 1.48 which was taken from a combination of published and unpublished data. Recent data from extensive monitoring efforts that includes some high escapement years has confirmed that good habitat in the Okanogan River has about 1.4 females/$m^2$ (K. Hyatt, personal communication). Therefore we doubled Hyatt the estimate of

females/$m^2$ to account for males with a 1:1 sex ratio. We then created a matrix to capture a range of possible outcomes depending on the level of habitat utilization and fish density within each habitat unit (Table 1). The abundance estimates for Sockeye spawners ranges from 70,585 to 756,272 (Table 1).

The second approach to evaluating how Sockeye may utilize the available habitat was to use the area per redd. The USBR (2007) conducted a literature review and found a variety of sources with estimates of redd size from 1.5-6.9 $m^2$. For the Sanpoil, we chose to use 1.75-3.7 $m^2$/redd to capture some of the variability around redd sizes. We did not use the highest value (6.9 $m^2$) because it was reported as a low density estimate and the point of our effort is to answer the question of how much habitat exists for potential spawners. Six of the seven studies evaluated by the USBR (2007) reported sockeye redd size close to 1.75 $m^2$, providing some confidence in that estimate. When the habitat utilization multipliers were applied to the potential redd size estimates the range of Sockeye abundance estimates was 34,000-216,000 (Table 2).

**Conclusions and Considerations:**

There are many combinations of possible habitat utilization and spawner densities that could have been selected from our approach. In certain areas fish may use more or less than 25-75% of the available habitat. We selected 25-75% habitat utilization to represent a reasonable middle-ground of expectations for how much of the habitat may be utilized. Additionally, we expect that Sockeye will spawn in high density in a portion of the highest quality habitat and lower density in less favorable habitat. We did not to try to make a series of assumptions to get the estimate to a single number, but instead prefer to report the range and provide the matrix in case reviewers or managers need to use the information for a specific purpose. Considering what is known about the Sanpoil River and how Sockeye behave in other systems, it is clear there is enough habitat to support tens of thousands to hundreds of thousands of spawning Sockeye Salmon. That should be sufficient detail for the purpose of the habitat assessment for the Phase 1 investigations for fish passage and reintroduction. Other approaches and additional analyses, such as life-cycle modeling, will be used to further refine expectations for returns given specific reintroduction strategies.

## *References:*


Hyatt, K.D. and D.P. Rankin. 1999. A Habitat Based Evaluation of Okanagan Sockeye Salmon Escapement Objectives. Department of Fisheries and Oceans, Canada. ISSN 1480-4883. Nanaimo, British Columbia.

USBR (United States Bureau of Reclamation). 2007. Assessment of Sockeye Salmon Production Potential in the Cle Elum River Basin, Storage Dam Fish Passage Study, Yakima Project, Washington, Technical Series No. PN-YDFP-008, Bureau of Reclamation, Boise, Idaho, March 2007.

Wolvert and Nine. 2009. Chief Joseph Kokanee Enhancement Project, 2009 Annual Progress Report (Technical), Mainstem Sanpoil Habitat Surveys. BPA Project Number 9501100. Confederated Tribes of the Colville Reservation, Nespelem, Washington.

Table 1. Matrix of potential Sockeye Salmon spawners in the Sanpoil River, WA using estimates of habitat type, habitat utilization and spawner density.

| Habitat Unit | Habitat unit % | Habitat Utilization Multiplier | Adjusted area (m2) | Abundance if density (fish/m2) = 1.12 | 2.96 | 4.0 |
|---|---|---|---|---|---|---|
| Pool tailout | 1.8% | 25% | 1,533 | 1,717 | 4,538 | 6,132 |
| | | 50% | 3,066 | 3,434 | 9,075 | 12,264 |
| | | 75% | 4,599 | 5,151 | 13,613 | 18,396 |
| | | | | | | |
| Small cobble/ gravel riffle | 25.7% | 25% | 21,888 | 24,514 | 64,787 | 87,550 |
| | | 50% | 43,775 | 49,028 | 129,575 | 175,101 |
| | | 75% | 65,663 | 73,542 | 194,362 | 262,651 |
| | | | | | | |
| Glide | 46.5% | 25% | 39,602 | 44,354 | 117,222 | 158,408 |
| | | 50% | 79,204 | 88,709 | 234,444 | 316,817 |
| | | 75% | 118,806 | 133,063 | 351,666 | 475,225 |
| | | | | | | |
| Sum of 25% | | | 63,023 | 70,585 | 186,547 | 252,091 |
| Sum of 50% | | | 126,045 | 141,171 | 373,094 | 504,181 |
| Sum of 75 % | | | 189,068 | 211,756 | 559,641 | 756,272 |

Table 2. Matrix of potential Sockeye Salmon spawners in the Sanpoil River, WA using estimates of habitat type, habitat utilization and redd size.

| Habitat Unit | Habitat unit % | Habitat Utilization Multiplier | Adjusted area (m2) | Abundance if area (m2) per redd = 3.7 | 1.75 |
|---|---|---|---|---|---|
| Pool tailout | 1.8% | 25% | 1,533 | 829 | 1,752 |
| | | 50% | 3,066 | 1,657 | 3,504 |
| | | 75% | 4,599 | 2,486 | 5,256 |
| | | | | | |
| Small cobble/ gravel riffle | 25.7% | 25% | 21,888 | 11,831 | 25,014 |
| | | 50% | 43,775 | 23,662 | 50,029 |
| | | 75% | 65,663 | 35,493 | 75,043 |
| | | | | | |
| Glide | 46.5% | 25% | 39,602 | 21,407 | 45,260 |
| | | 50% | 79,204 | 42,813 | 90,519 |
| | | 75% | 118,806 | 64,220 | 135,779 |
| | | | | | |
| Sum of 25% | | | 63,023 | 34,066 | 72,026 |
| Sum of 50% | | | 126,045 | 68,133 | 144,052 |
| Sum of 75 % | | | 189,068 | 102,199 | 216,078 |