2021 South Fork Nooksack River Chinook Mortality Event
Overview and Conclusions

Prepared by Lummi Natural Resources Department

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Key Points

- The current, preliminary estimate of the total adult Chinook mortality is 2,500
- The identified primary cause of mortality is severely degraded habitat quantity and function that is incapable of supporting an abundance of Chinook salmon even far below the established recovery objective for adult abundance
- Severely degraded habitat exposes both juvenile and adult Chinook to lethal environmental conditions, which results in a cascade of secondary effects and complications
- Water temperature in the South Fork consistently exceeds the established lethal threshold for adult Chinook
- The South Fork is designated 303(d) listed as temperature impaired
- High water temperature causes severe stress, and ultimately resulting in the proliferation of endemic fish pathogen-related diseases, Columnaris
- Summertime South Fork river flows are consistently below the established objective for minimum in-stream flow, or 300 cubic feet per second
- Lummi Nation has brought South Fork Chinook back from the brink of extinction by operating one of the most successful salmon preservation and recovery hatchery programs in the Pacific Northwest
- The habitat is compromised and there is no political or public will to fix the problems and few options exist to prevent this catastrophic event from happening again, which is guaranteed to happen again as the number of returning Chinook continues to increase
- Low river flow in the South Fork when Chinook are holding does not allow passage for nearly all adult fish at approximately river mile 14.2
    - Because few fish can get past a natural barrier, Lummi Nation cannot recruit fish back to the hatchery at an earlier date, and therefore protect them by holding Chinook in the hatchery on cool, shaded water
- Short-term solutions to prevent this from happening again will require years of permitting, not to mention high costs to obtain permits that would otherwise go to in-river habitat structures
    - Federal regulations, particularly FEMA's "no-rise" policy for in-river habitat structures may prevent Lummi Nation and our Fisheries Co-Managers from building any structure that will fully prevent this issue from occurring again

Summary and Overview

In 2021 an unprecedented adult Chinook mortality event occurred in the South Fork Nooksack River. This mortality event coincided with a record number of returning adult Chinook to the South Fork since census estimates have been annually developed.

The preliminary estimate of mortality is 2,500 adult Chinook, but this estimate may increase as the Fisheries Co-Managers finalize evaluation of collected data. Within one day of pre-spawn mortalities being found by Lummi Natural Resources (LNR) fisheries surveyors, a rapid response by LNR, Washington Department of Fish and Wildlife (WDFW) fish health staff, and Washington Department of Ecology (WDOE) staff to identify the cause of mortality occurred.

Findings

Assessments and laboratory analyses concluded that three fish pathogens were present from all fish sampled. In particular, *Flexibacter columnaris*, an endemic and ubiquitous bacterial pathogen that causes the disease Columnaris, notorious for causing pre-spawn mortality in salmonids, was detected. The other confirmed pathogens were *Ichtyophthirus multifiliis* and freshwater diatoms. All three pathogens alone are known to cause mortality in adult Chinook if temperatures increase above acceptable levels.

Laboratory analysis confirmed that no pathogens regulated by the Fisheries Co-Managers, specifically viruses, were present.

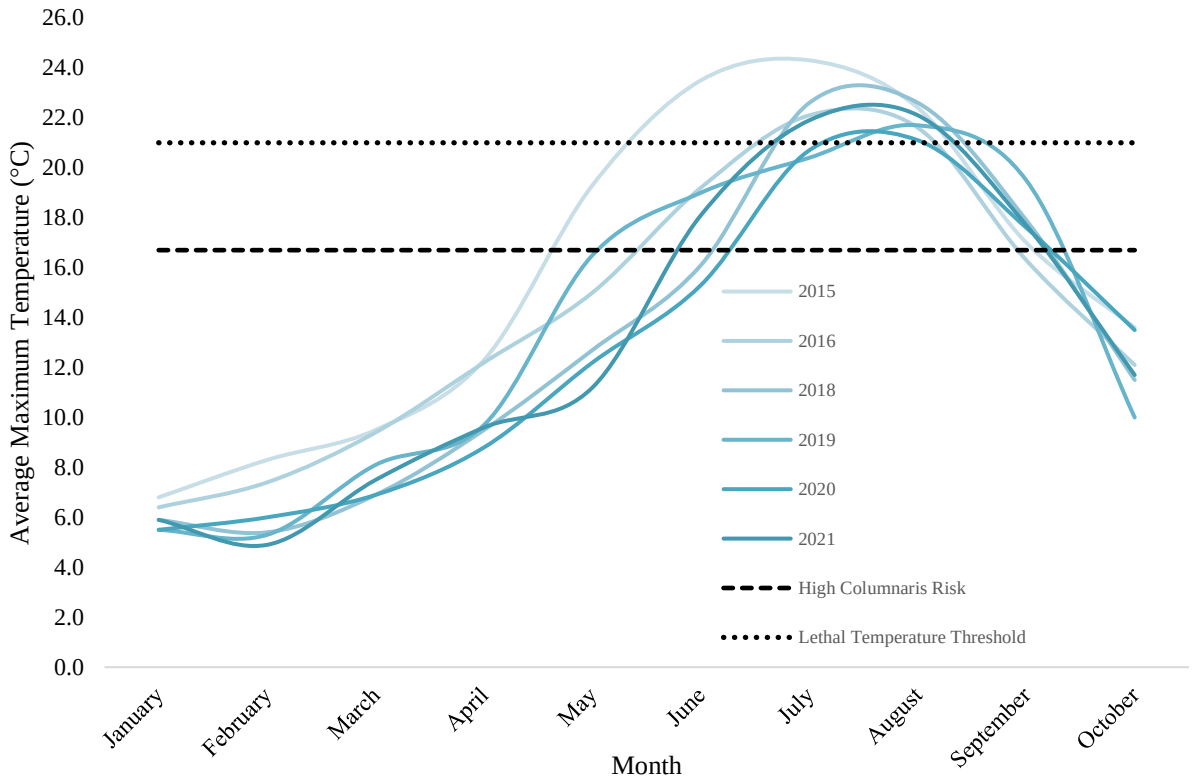
Laboratory analyses of water samples collected by WDOE and LNR found no detection of pesticides or heavy metals at or above sample quantification limits, indicating that pesticides and heavy metals were not a factor or cause of mortality during this event.

Cause of Mortality

Severely degraded habitat quality and function is the identified direct, primary cause of the mortality event. Degraded and impaired habitat conditions directly triggered a cascade of ensuing spread of confirmed pathogens leading to the catastrophic pre-spawn mortality.

The South Fork Nooksack is a 303(d) listed temperature impaired waterbody and summer temperatures consistently exceed the Total Daily Maximum Load (TMDL) for established water quality standards. High water temperature is directly known and implicated as the primary trigger for the infectious etiology of *Columnaris* that caused this mortality event. Several studies have confirmed that water temperature exceeding 16.7°C as the threshold for the proliferation and spread of Columnaris. The US Geological Survey (USGS) river gauge on the South Fork Nooksack immediately below where the majority of mortalities were found has a consistent trend of recorded water temperatures annually exceeding above 16.7°C (Figure 1). In addition, South Fork Nooksack maximum water temperature during summer months consistently exceeds the established threshold lethal to adult salmonids, including Chinook (Figure 1).

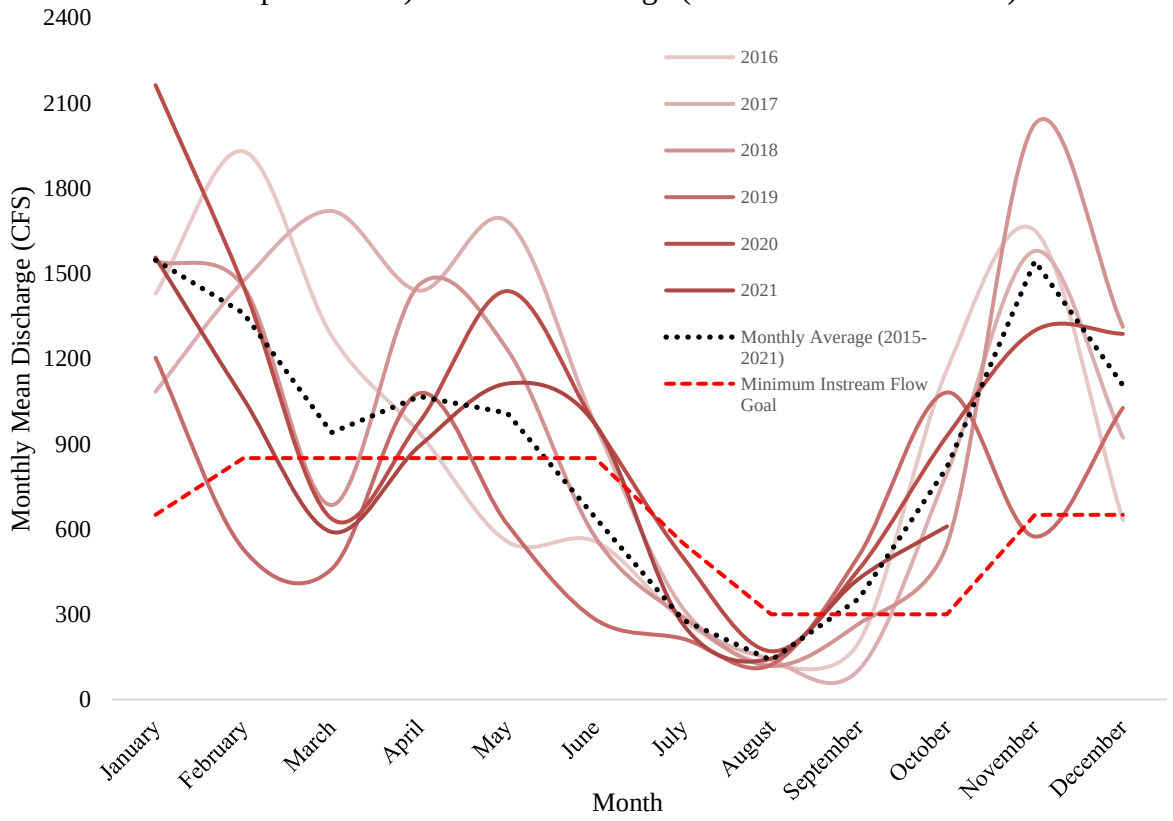
Figure 1. South Fork Nooksack River Daily Maximum Temperature (°C) at the Saxon Gauge (USGS Station 12210000)



Like many river basins throughout the Pacific Northwest, the South Fork Nooksack is severely impacted by an anthropogenically altered flow regime. An extensive history of timber extraction and construction of flood protection structures throughout the South Fork Nooksack sub-basin work in unison to cause a "yo-yo" of river discharge depending on the season. This effect results in consistent, unnaturally high levels of discharge during wet months, and drought conditions during the summer months. Timber extraction at higher elevations reduces the ability for forest soils to retain water, resulting in a "flashy" flow regime. Since flashy systems have a decreased ability to retain water, less water is retained in soils that provide a steady cool water input during summer months. In addition, flashy river systems incise river beds, which in turn results in a significantly decreased capability for large woody debris to accumulate and maintain channel complexity, further exacerbating and compounding an altered flow regime. An altered flow regime has many negative impacts on salmonids, especially in severely degraded systems such as the South Fork Nooksack.

The established minimum instream flow objective for the South Fork Nooksack is as low as 300 cubic feet per second (IIRP 1985). Although regulatory measures are technically in place to achieve the minimum objective, summertime discharge is consistently far below this objective, which results in direct impacts to both adult and juvenile salmonids (Figure 2). Of the salmonid species that occupy the South Fork sub-basin, adult Chinook are especially vulnerable to low flows since they begin entering the South Fork in early July and hold in pools until they begin spawning in early to mid-September.

Figure 2. South Fork Nooksack River Average Monthly Discharge (Cubic Feet per Second) at the Saxon Gauge (USGS Station 12210000)



Implications

The established salmon recovery objective for the South Fork Chinook stock ranges from 9,100 – 13,000 natural-origin (or wild) spawners depending on the assumed level of productivity. It is highly important to acknowledge that habitat conditions within the South Fork Nooksack sub-basin cannot support an adult abundance of even one-third of the minimum recovery objective that were observed in 2021.

Exhaustive efforts must be made by LNR to prevent this tragedy from occurring in the future. In-stream habitat structures designed to supply more water to provide passage to Skookum Creek Hatchery during summer months will be required. Unfortunately, current regulations such as FEMA's "no-rise" policy, other federal permitting constraints and limitations, and State permitting constraints will prevent meaningful actions from being taken in an expedited manner. In addition, LNR will be required to divert large amounts of money towards permit applications and the multiple authorization processes that would otherwise go towards habitat structures.