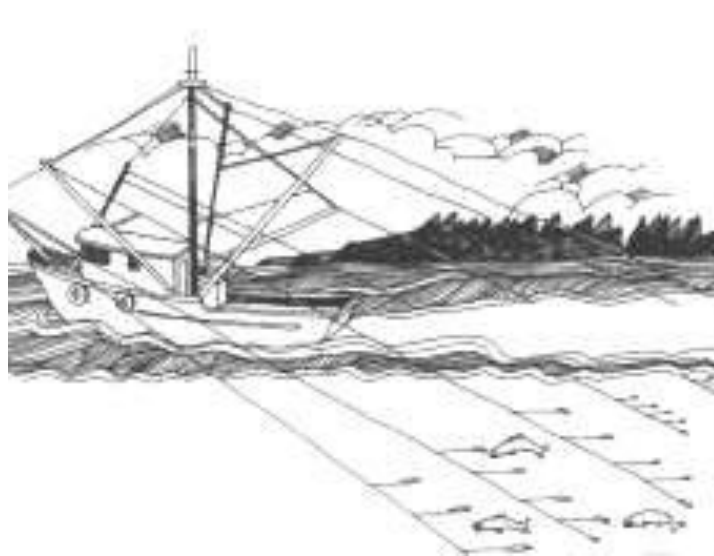


# Chinook Salmon Regional Return

## Odds

By Evan Bowechop



9/10/09

Evan Bowechop

P.O. Box 351

Neah Bay, WA. 98357

## **Abstract**

To the Makah Tribe, Chinook salmon area a very important asset. They are a big part of our culture, and an even bigger part of our economy. Protecting our Chinook salmon fishery is high on our priority list, and one of the reasons this paper was made. In this paper, I hypothesize that Chinook salmon caught in area 4 are more likely to have originated in the Columbia River region, and that Chinook salmon caught in area 4B are more likely to have originated in the Puget Sound region. After collecting data and running a test of odds, this hypothesis was supported. This knowledge could help the Makah Fisheries Management better manage the Chinook salmon fisheries, and reduce our impact on Chinook stocks of concern.

## **Introduction**

The people of the Makah Tribe have historically placed great importance in fishing, making sure that they kept the right to fish when signing their treaty in 1855. That was a very smart move, as in today's world Chinook salmon is not just an important food source, but also one of the most important parts of our economy.

Today our fishermen fish within the limitations of the Makah Usual and Accustomed areas (U&A). The boundaries of the U&A area are the Norwegian Memorial to the south, the Canadian border to the north, Tongue Point to the east, and 40 miles out into the Pacific in the west. Within those boundaries lies fishing areas 4 and 4B. Area 4 is the main ocean trolling area for the Makah Tribe. If we better knew the regional origin of the majority of Chinook caught in area 4 and 4B we could better manage the Chinook fishery and reduce our impact on stocks of concern.

The Chinook that are caught in areas 4 and 4B come from a wide variety of different specific locations, but can be categorized into two broad regions: Puget Sound and the Columbia River. The Chinook that originate in the Puget Sound have lower stocks these days, and are on the ESA list (Yussa, 2009). Chinook from the Columbia River area are also of concern (Lohn, 2008), so minimizing impact on separate stocks of Chinook is important.

Because of the importance of salmon to our culture, we wish to preserve the Chinook salmon as best we can. That means learning all we can about the Chinook: where the fish breed, how many survive to adulthood, etc. In this paper we present research that compares the difference in odds of Chinook caught in area 4 and 4B that originate at hatcheries in the Puget Sound region to the odds of Chinook that originate at hatcheries in the Columbia River region. Knowledge on the answer to this question will help Makah Fisheries Management better manage the fishery of Chinook salmon.

I hypothesize that the majority of Chinook caught in area 4 will have originated in the Columbia River region, and that the majority of Chinook caught in area 4B will have originated in the Puget Sound region, because of the location of the areas. Area 4 is in the Pacific Ocean near the Columbia River region, and so it would be logical that the majority of Chinook caught in area 4 originate in the Columbia River region. Area 4B is within the Strait of Juan de Fuca, so it would make sense that the majority of Chinook caught within area 4B originate in the Puget Sound region (Healey, 1991).

## Methods

### Site Description

The two commercial fishing areas from which Chinook salmon samples were caught and collected were 4 and 4B. The boundaries of fishing area 4 are Cape Alava to the south, Tatoosh Island to the east, and the Canadian border to the north. Fishing area 4B is located in the Strait of Juan de Fuca from Tatoosh Island to the west and east to Sekiu River in the Strait of Juan de Fuca. Both areas are within the Makah Fisheries Usual and Accustomed fishing areas. Area 4 extends west to the Exclusive Economic Zone, and so covers much more ocean than Area 4B. Area 4B stretches north halfway across the Strait of Juan de Fuca to the Canadian Border (Figure 1).

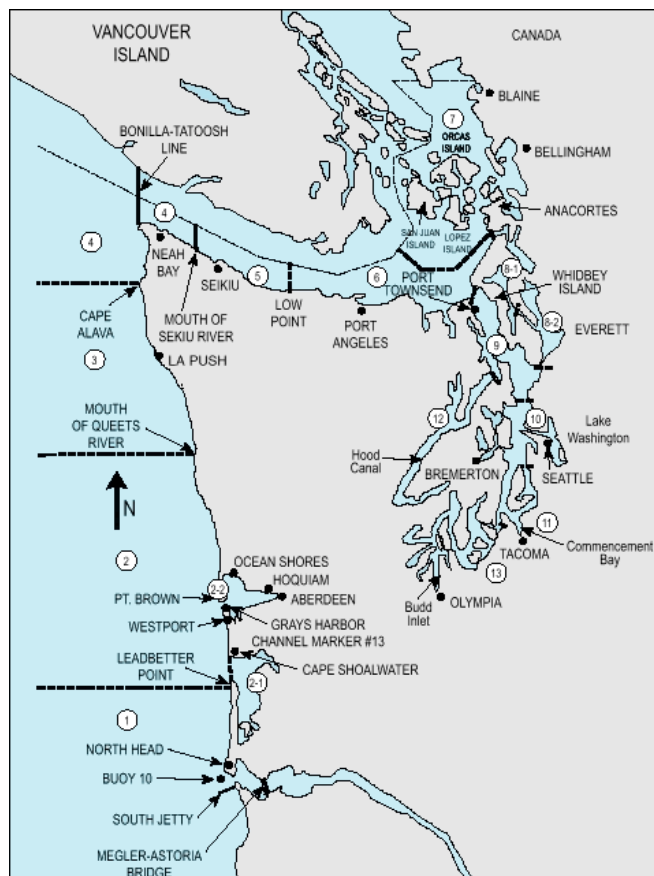


Figure 1: Washington State Fishing Areas

### **Data Collection**

Port samplers from Makah Fisheries Management tested salmon heads caught by troll fishermen for coded-wire tags. The samplers go down either directly to the boats docked in the Makah Marina, the Fishermen's Co-Op, or the High Tide dock. Once there, they use handheld metal-detecting wands to inspect each and every salmon caught for metal in their heads. After a salmon is detected to have metal in its head, the samplers take the fish aside, chop off the head (not including the lower jaw), tie a number tag to the head, and place the head in a bag.

The salmon heads are then brought back to the wet lab at Makah Fisheries Management, and are sliced into smaller pieces so that the wire-encoded tags may be removed. The tags from the heads of these salmon are then read using a microscope, and entered into an online database, the Regional Mark Processing Center ([rmpc.org](http://rmpc.org)). After being entered into the database, the numbers from the coded-wire tags from Chinook caught in area 4 and 4B in 2008 were then retrieved. The Regional Mark Processing Center database was used to determine the hatchery of origin of tagged Chinook.

### **Data Analysis**

After collecting the data from the online database, I analyzed the hypothesis that Chinook caught east of the Tatoosh-Bonilla line in area 4B are more likely to have originated from hatcheries in the Puget Sounds region than fish caught in area 4. I used methods described by Ramsey and Schaffer (2002) to test equality of population odds.

Data compiled in a 2x2 table to compare the odds of where fish originated from (either the Puget Sound or Columbia River region) for fishing areas 4 and 4B.

After the hatchery of origin was determined, I classified each Chinook as having either originated from the Columbia River region, or the Puget Sound region. If the salmon came from a hatchery that was west of the Tatoosh/Bonilla line within the Strait of Juan de Fuca, Puget Sound, or Frasier River, I classified the salmon as being from the Puget Sound region. If the salmon originated from a hatchery south of the Tatoosh/Bonilla line along the Washington or Oregon coast, or within the Columbia, Snake or many other rivers of the area, then I classified the salmon as being from the Columbia River region.

## **Results**

In total, 83 Chinook salmon were sampled from the 2008 summer troll fishery in areas 4 and 4B. Samples were collected May to September of 2008. Eleven samples were collected for area 4B and 72 samples for area 4. Fifty-six Chinook originated from the Columbia River region, and 27 Chinook originated from the Puget Sound region.

The odds of a fish caught in area 4 originating from the Columbia River region compared to originating from the Puget Sound region is 2.4:1. The odds of a fish caught in 4B to originating from the Puget Sound Region compared to the outer coast/Columbia River region is 1.2:1 (Table 1). Based on odds-ratio, Chinook salmon caught in area 4B are 2.9 times more likely to have originated from a hatchery in the Puget Sounds region than a Chinook caught in area 4; Chinook caught in area 4 are 2.9 times more likely to

have originated from a hatchery in the Columbia River region than Chinook caught in area 4B (Test of equality of population odds,  $p = 0.0495$ ).

Table 1: Total number of coded-wire tagged Chinook salmon caught in area 4 and 4B between May and September of 2008 originating from either the Columbia River region or the Puget Sounds region.

Area Caught	Originating from Columbia River region	Originating from Puget Sound region
Area 4	21	51
Area 4B	6	5

## **Discussion**

After observing the results of the origins of Chinook compared to the area in which the Chinook were caught, I have concluded that Chinook caught in area 4 are more likely to originate from the Columbia River region, and that Chinook caught in area 4B are more likely to originate in the Puget Sound region. The test of odds shows that Chinook caught in area 4 are 2.9 times more likely to originate in the Columbia River region than Chinook caught in area 4B. It also shows that Chinook caught in area 4B are 2.9 times more likely to originate in the Puget Sound region than Chinook caught in area 4.

By observing the results in the form of odds, I was able to compare the areas and regions of origin with relative ease. Using odds helped me better understand the likelihood of where a fish from a certain area originated. Using a test of odds supported my hypothesis that a Chinook caught in area 4 is more likely to have originated from the

Columbia River region, and a Chinook caught in area 4B is more likely to have originated from the Puget Sound region.

It is important to understand the odds a Chinook salmon originating in a certain region, because if we know the likely region of origin we can better manage Chinook salmon fisheries. Salmon almost always return to their hatchery of origin, so it can be assumed that a Chinook originating in the Columbia River region, if it survived through adult hood, would someday return to the Columbia River region (Ueda, 1998).

For instance, if the Puget Sound stocks of Chinook were of concern, then the Makah Fisheries management could put a halt to Chinook fishing in area 4B, and instead focus on area 4.

By better managing the Chinook fishery, we can increase the success of future fisheries. The Chinook fishery is important for our culture, and even more so for our economy. Fisheries makes up close to 50% of the tribes economy (buildingonbrownsfield.com, 2009), so if the Chinook fishery collapsed the tribe's economy would suffer. A low Chinook run could mean the tribe suffers financially for it, and a good Chinook run could mean the tribe prospers. Maintaining a successful Chinook fishery is of great importance to the tribe.



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