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Overwintering Eagle Demographics on the Nooksack River

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Abstract:

This paper provides a look into the demographics of overwintering eagles on the Nooksack River and their ties to salmon. Viewing overwintering eagles on the Nooksack River has become somewhat of a tradition for locals wanting to catch sight of these American icons in their natural habitat and consuming another PNW favorite; salmon. However, climate change and ever increasing ecological pressures have begun to alter the eagle-salmon food web dynamic in ways that are just starting to be explored. During the winter, eagles rely on the supply of salmon carcasses that wash onto the river banks and gravel bars after they spawn. This makes the Nooksack River an ideal location with its annual salmon runs. For my research, I investigated the demographics of eagles on a portion of the Nooksack River in Deming, WA. Between November and January I collected weekly observational data walking an approximate two mile stretch from the Deming Homestead Eagle Park to the Welcome Bridge. I recorded the number of eagles, where they were located, if they were juvenile or adult, general behavior, and weather and river height. From my findings I discovered a relationship between eagle numbers and river height which I hypothesize correlates to salmon carcass availability on gravel bars. I also found that in regards to habitat selection, more eagles were found on deciduous trees and juveniles and adult eagles were found in the same types of habitats. Juveniles and Adults did differ in their groupings with juveniles found in more groups and adults in more pairs. Although the West side of the river had pedestrian access, the eagles did not appear to be on one side of the river over the other (East vs West). I also obtained escapement reports from Kendall Creek Hatchery and found potential correlations between return increases and eagle increases. Salmon are in decline due to various environmental stressors but there are gaps in research on what happens to the species reliant on their spawning returns. Observational research such as mine can inform scientists and

policy makers on the trophic level effects of salmon availability changes, specifically in the overwinter eagle populations.

1. Introduction:

1.1 Salmon

Salmon are anadromous which means that they migrate from the ocean to freshwater streams to spawn. They attempt to swim as far upstream as they can to find an ideal nest site in the river substrate, called a redd, which is an energetically taxing journey that leads them to die after spawning (or attempting to). This leaves their carcasses at the whim of the river flow which leads them to wash up on the banks and gravel bars. This annual event enriches the river and its riparian zones through the incorporation of nutrients into the ecosystem either from scavenging or decay. One of the species that is enriched from the spawning events are eagles that migrate to rivers like the Nooksack to take advantage of the high value carrion.

Figure 1.1.1 An alive chum salmon in a side channel and an unidentified salmon carcass on a bank in the Nooksack River.

1.2 Eagle Scavenging

Eagles migrate during the winter to the Nooksack and Skagit rivers from British Columbia, Alaska, and the Yukon (Grace, 2003) to feed on salmon carcasses. Although the Nooksack has a

smaller abundance compared to the Skagit, it still attracts 100s of eagles migrating for the chinook, chum, and coho salmon runs. Eagles rely on the carcasses washing up on gravel bars and banks to access them for feeding. This suggests that eagles are most likely to feed when river levels rise to wash the carcasses onto gravel bars or when a flow event decreases exposing the carcasses.

1.3 Purpose:

Environmental stressors such as climate change are creating earlier salmon runs and changes in flooding events (Duvall, 2022) that are putting the eagles' primary winter food source at risk of depletion. Chum salmon and eagle abundances appear to be correlated (Hung et al., 1992) which suggests that declining salmon populations will lead to a decline in eagle abundances or an adaptation to find other sources of food. There are several studies done on the Skagit River but there is little known about the eagles on the Nooksack River. This is why I chose to do an observational study on eagles on the Nooksack to get an idea of what their behaviors and abundances looked like.

2. Methods:

2.1 Study Area

Figure 2.1.1 Google Earth image showing the stretch of the Nooksack River between the Deming Homestead Eagle Park and the Welcome Bridge where the study took place.

I walked an approximate two mile stretch along the West bank from the Deming Homestead Eagle Park to the Welcome bridge. I was using binoculars so the map is based on what I could visualize from what I observed as my visual boundaries of the site.

2.2 Data Collection

This was an observational based study using binoculars. Every eagle sighting I recorded if it was an adult or juvenile, if it was perched whether the tree was deciduous or conifer, if the location was on a gravel bar, where it was relative to the river either West, East, or middle, and the grouping as individual, pair, or group. I also wrote down general observations and weather conditions. I would later use the USGS Deming river height gauge to access river heights for the days I surveyed.

Figure 2.2.1 Example of an adult eagle and a juvenile eagle perching in a deciduous tree. Juveniles do not develop a full white head until around 5 years of age.

Figure 2.2.2 Arrows pointing out the locations of a group of eagles on a gravel bar and deciduous tree on the East bank.

3. Results and Discussion:

3.1 Salmon Runs

Salmon spawning runs alternate with some overlap between the types of salmon (figure 3.1.1) . The Nooksack salmon runs that eagles would be concerned about are the chinook, chum, and coho runs. Data obtained from the Kenall Creek fish hatchery weekly escapement (number of hatchery adults returning to spawn) reports on the North fork of the Nooksack is presented in figure 3.1.2. You can see the alternating spawning periods which is beneficial to scavengers like eagles since it gives them a longer period of time of carcass availability.

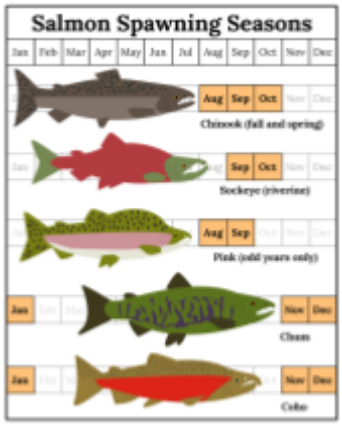

Figure 3.1.1 NOAA diagram depicting the timelines of salmon runs based on salmon species

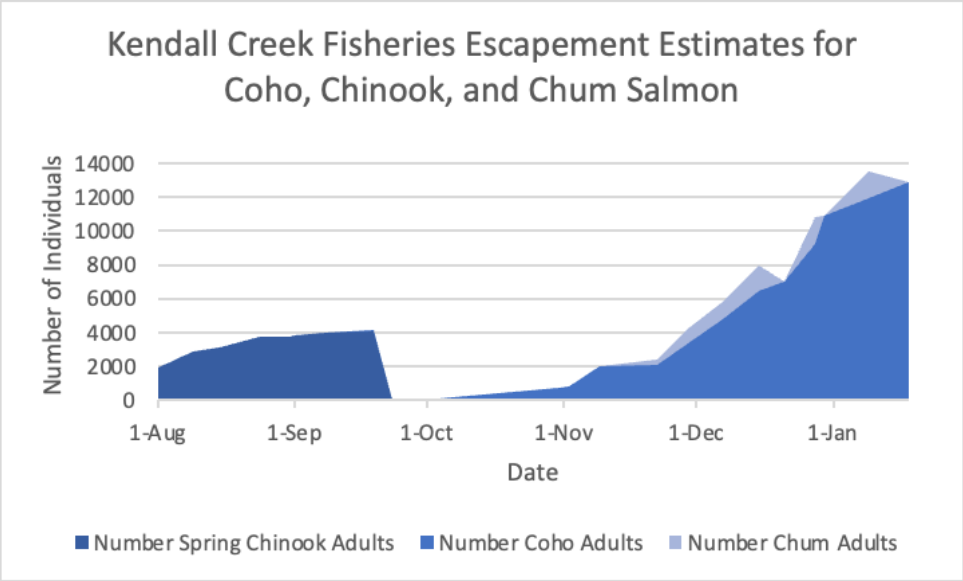

Figure 3.1.2 Kendall Creek fish hatchery escapement weekly report numbers of coho, chinook, and chum salmon.

3.2 Eagle Numbers

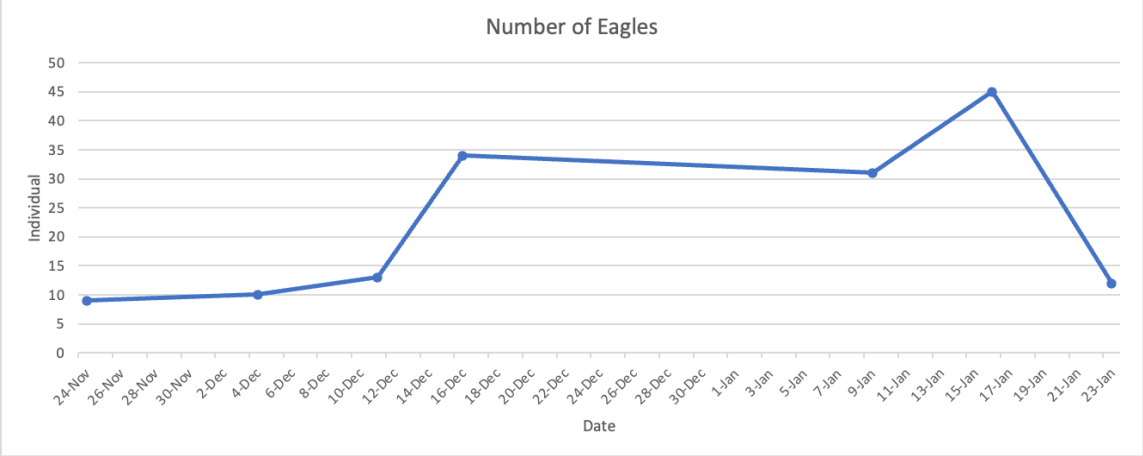

Figure 3.2.1: This is the total number of eagles counted on each survey date. There is a general trend of increase until the end survey where there is a drop in numbers. The largest count day had 45 eagles recorded on January 16th and the smallest day there were 9 counted on November 24th. The average number of eagles per day was 22 with a total of 154 recorded from 7 surveys.

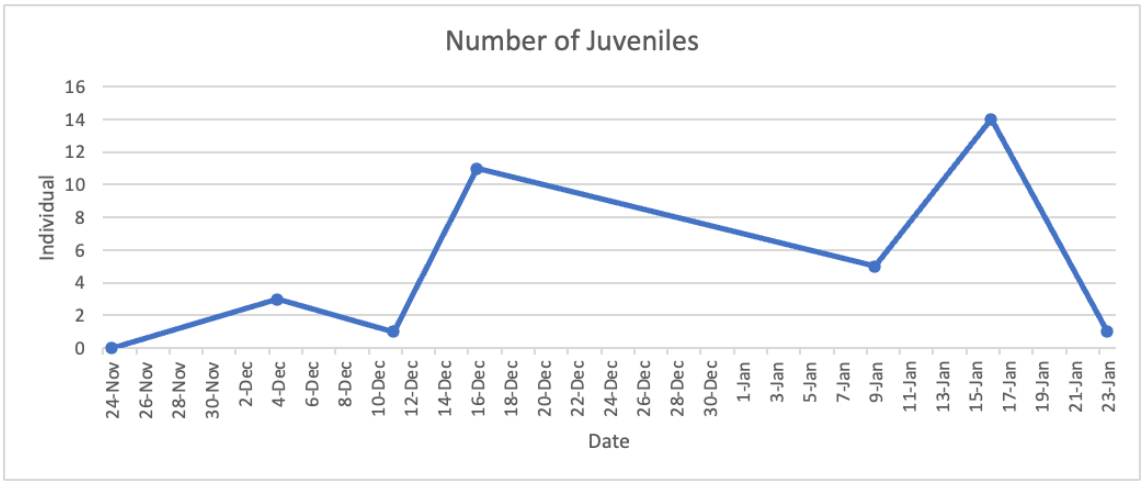

Figure 3.2.2: This graph represents the total number of juveniles recorded on each outing. There is a lot of variability with some increase overall and a similar trend shown to the total number of eagles. The most juveniles seen was on January 16th with 14 total and the smallest amount seen was 0 on November 24th. The average amount of juveniles seen was 5 per day with a total of 35 in 7 surveys.

3.3 River Height

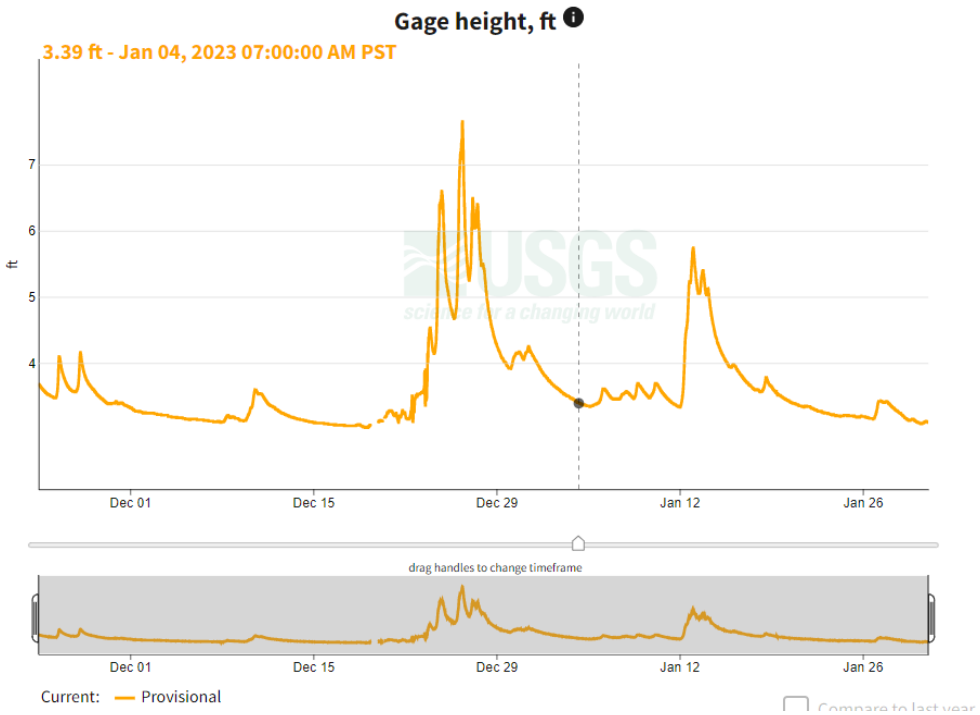

Figure 3.3.1: This is a graph taken from the USGS river height gauge data of the Nooksack River at the Deming location during the time frame of the surveys. The peaks represent high flow/flooding events.

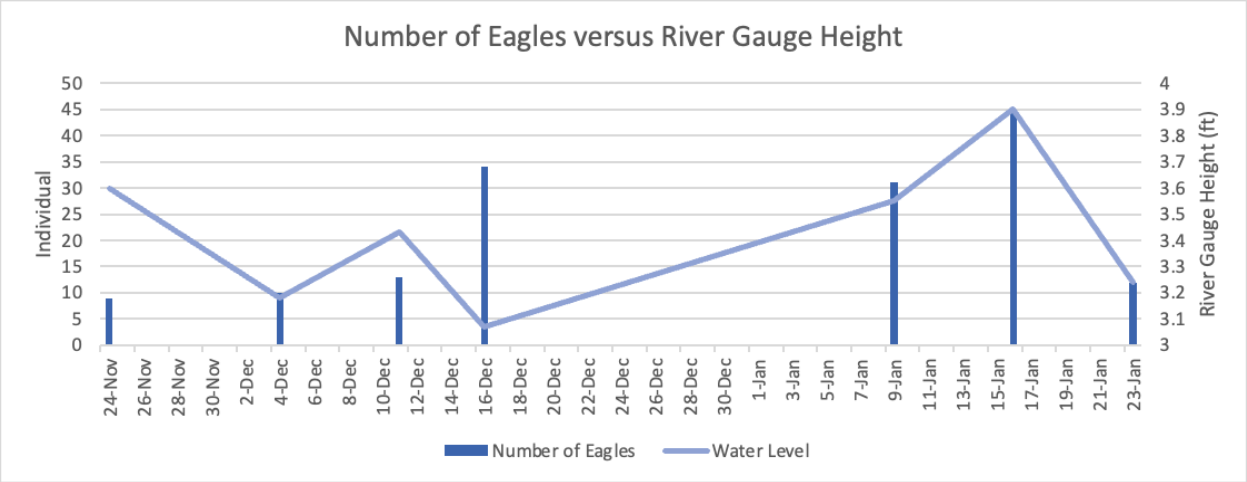

Figure 3.3.2: This graph shows the total number of eagles against the river heights on the days of the surveys. The river height follows a similar pattern as the number of eagles and the highest flow matches with the peak number of eagles.

The river height can influence eagle presence by either flooding the carcasses off of the gravel bars or washing them onto them for scavenging availability (Brown et al., 1998). The first peak in eagles could be due to the increase in river height a few days later that could have washed the carcasses onto gravel bars and when it receded it exposed them. The next two peaks in eagle numbers coincide with an increase in river height that could indicate salmon carcasses being washed onto gravel bars but then the drop in numbers after the peak in river height could either be because they were flooded out or the eagles consumed whatever was available.

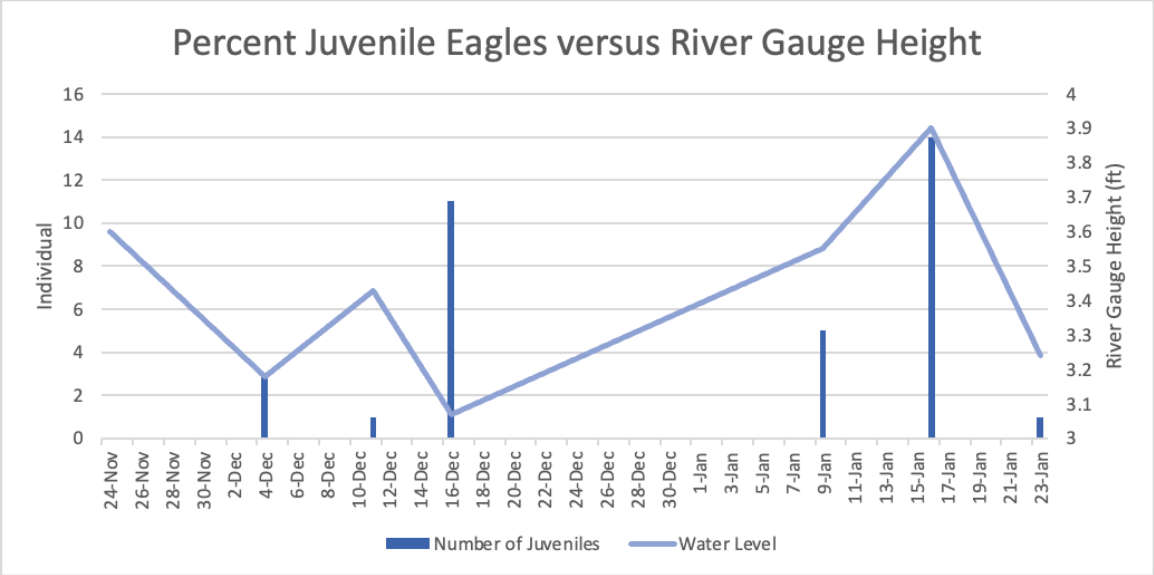

Figure 3.3.3: This graph shows the river gauge height against the percent of juvenile eagles out of the total number of eagles recorded per survey. There is a very similar pattern to the total number of eagles and the river height peaks are also coinciding.

3.4 Habitat and Grouping

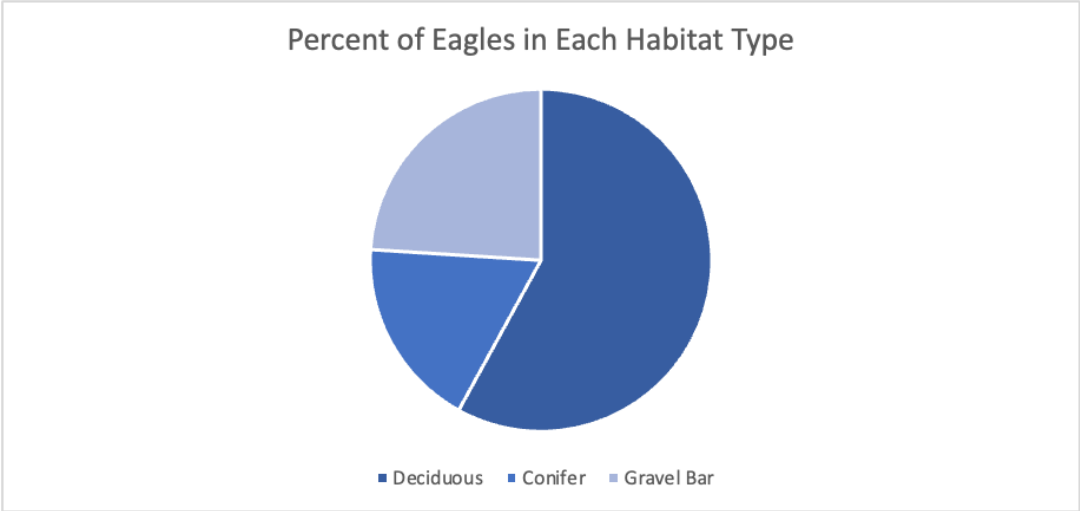

Figure 3.4.1: This pie chart represents the percent of eagles recorded in each habitat type which includes deciduous tree, conifer tree, and gravel bar. 58% were found in deciduous trees, 18% in

conifers, and 24% on gravel bars. 76% were sighted perched in a tree while 24% found on the ground. Deciduous trees were the dominant habitat type chosen.

The larger percent found in deciduous perches would fit with potentially increased ability to scope out salmon carcasses since it gives an open view (Stalmaster and Newman, 1979), but they most likely prefer to perch as close to the bank as they can regardless of tree type for optimal scavenging opportunity. It is important to note that I observed that the majority of the trees on the banks were deciduous.

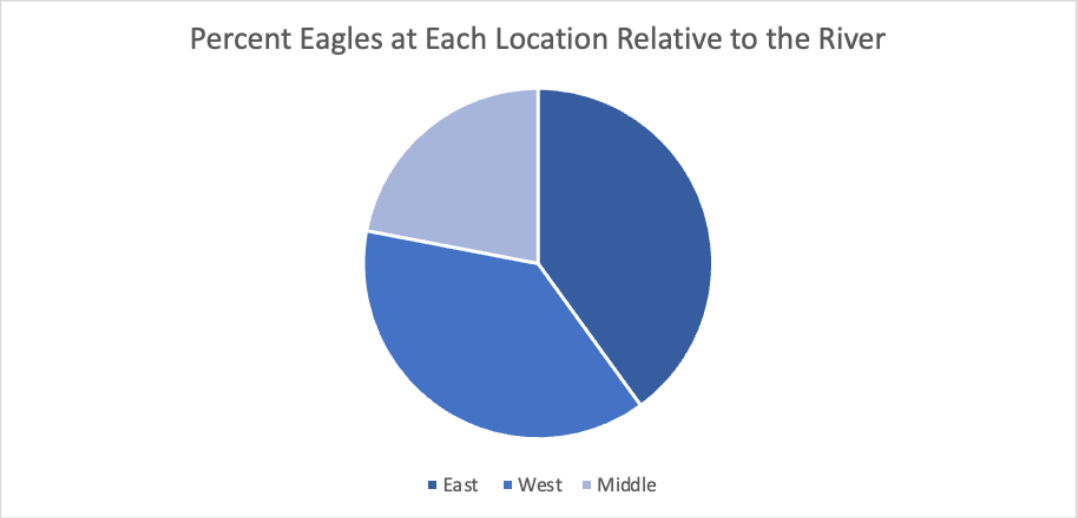

Figure 3.4.2: This is a pie chart representing the percent of eagles found at each location relative to the river including East, West, and middle (on a gravel bar). There were 40% sighted on the East side and 38% were found on the West with 22% in the middle. There is a pretty even divide between East and West.

This was surprising because I had expected eagles to potentially be found more on the East side since that was the opposite side to where I was and where pedestrian access, private property, and the roads are. They might be desensitized to human activity since I did observe some, including people with dogs, but it could also be that there just wasn't a large enough disturbance for them to make a choice either way.

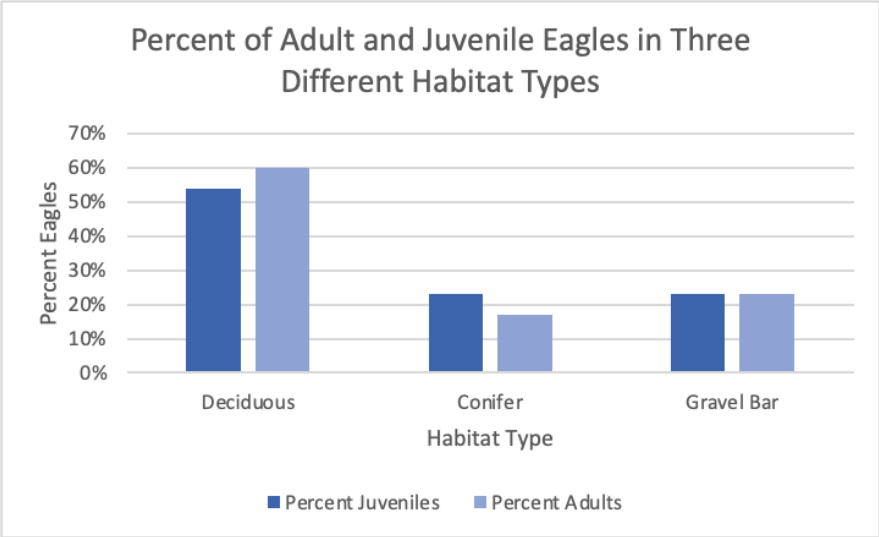

Figure 3.4.3: This bar chart shows the percent of juvenile versus adult eagles choosing each habitat type. The bars are fairly matched with each other. They were even at 23% each choosing gravel bars, juveniles with 23% chose conifers 6% more than adults, and adults with 50% chose deciduous 6% more than juveniles.

This isn't too surprising since eagle habitat preference wouldn't necessarily change with age if it is just for perching and foraging.

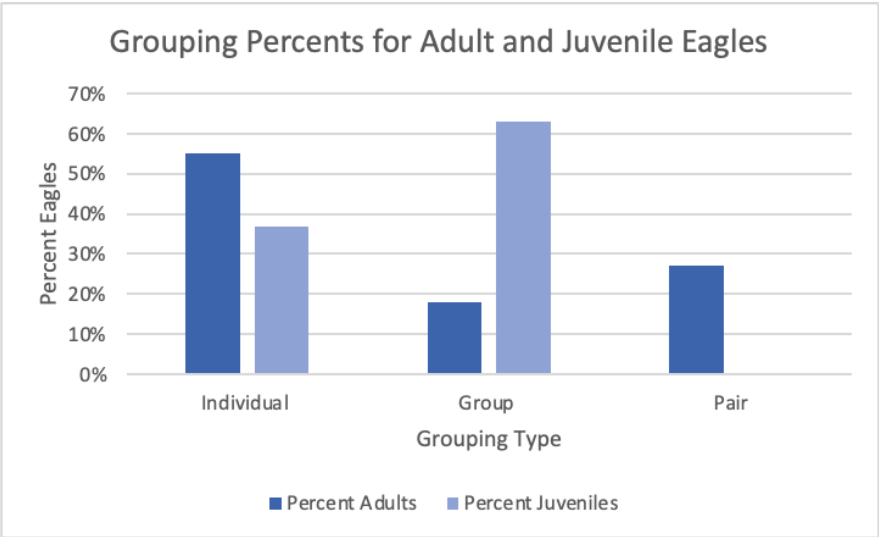

Figure 3.4.4: This bar graph shows the grouping percent differences between juveniles and adults. There is a larger difference in choices compared to habitat selection. Only adults were found in pairs at 27%. Juveniles with 63% were found in groups 45% more than adults and adults with 55% were found as individuals 18% more than juveniles.

These findings are coherent with what I would expect to find based on known eagle behavior. Juvenile eagles are known to be found in groups more often than adults because they can not out compete adults as individuals and are still learning the ropes of navigating salmon runs (Stalmaster and Gessaman,1984). Adults reach maturity at about 5 years and therefore are able to pair up, which they typically do monogamously.

3.5 Salmon and Eagle Numbers

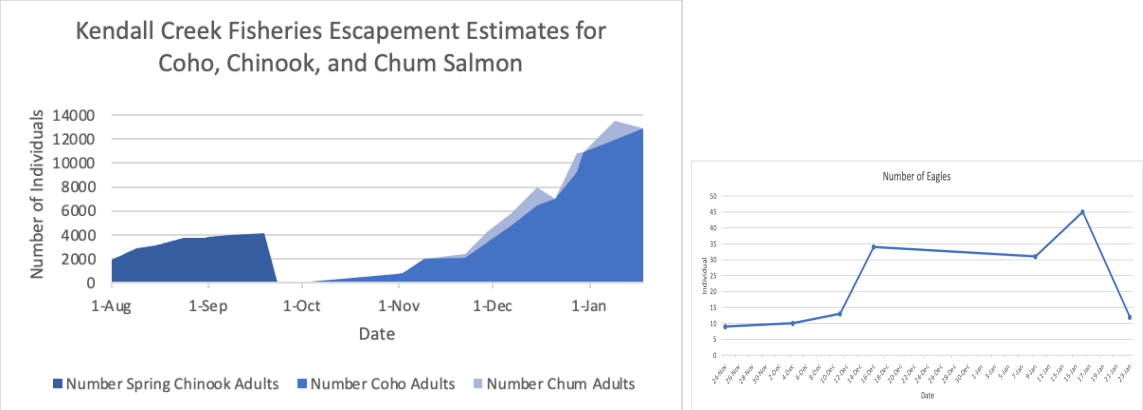

Figure 3.5.1: I repeated these graphs to show the relationship between increasing eagle numbers and increases in the salmon escapement numbers (returns). The eagle numbers seem to peak around the same time the coho and chum runs are. It would be interesting to have seen numbers during the chinook run and after it to see if there was a sharp decrease in eagle presence after that run died down before the next runs.

4. Implications and Future Studies:

Observational studies such as this allows us to understand the trophic cascade relationships that salmon are a part of and how their declines might be affecting eagles. Eagles expend a lot of energy migrating to rivers such as the Nooksack for the purpose of feeding on the nutrient and energetically favorable salmon carcasses. If that supply is limited either the eagles will not make it through the winter or they will start to look for alternate sources such as in agricultural areas (Duvall, 2022). Either way it is important to note that salmon policy is going to affect eagles as well and it is important to acquire data such as mine to understand what those effects may be and if they are beneficial or not. Along with that, are the observations on behavior and habitat choices that can be important for salmon river restoration projects to inform what kinds of riparian vegetation may be beneficial to the surrounding ecosystem.

Future studies to further inform scientific inquiry and potential policy could include long-term surveying both yearly and in a survey season. It would be beneficial to have a larger survey area with several stretches along the river. These studies could also be compared to the salmon runs to understand the significance of correlation and any changes that might be occurring. Along with surveying long-term, comes the ability to assess what the effects of climate change may be on the eagle populations. Taking a deeper dive into juvenile success would create a better understanding of the next generation's ability to survive and reproduce.

Although this may have been just a brief look into the eagles of the Nooksack River, I feel confident that it is the start of increasing the knowledge on the topic. I also gained personal benefit from conducting the surveys as they allowed me to feel more connected to this place and become more aware of what knowledge nature has to offer us. I hope that policy will be driven towards conservation of salmon and subsequently conserving the eagle populations that rely so heavily upon their success.

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