

# Background and Motivation

One cannot imagine Alaska without the notorious brown bears rushing through the streams for salmon. But bears aren't the only creatures that desire the fish. Humans' Pacific salmon harvest in Alaska is responsible for 80% of total wild caught salmon catch. In 2017, over 200 million salmon were caught in Alaska. Salmon have been used as an important food source for native Alaskan communities. The main species of salmon in Alaska that are fished are Chinook, Sockeye, Coho, Pink and Chum. (Marine Stewardship Council)

Salmon fishing by humans for both food and sport has become much more popular, largely due to the better taste of fresh caught fish compared to salmon raised in farms and fisheries. Therefore we wonder how salmon fishing has affected brown bears' diets in Alaska.

# Hypothesis

We hypothesize that there is a relationship between salmon fishing and the diets of brown bears in Alaska.

# Predictions

We predict that an increase in overfishing of salmon in Alaska will lead in a decline in brown bear populations due to a lack of food availability, as well as an increase in plants and other different sources of food being consumed by bears also resulting from this loss of salmon.



Figure 1. A brown bear hunts for salmon alongside fisherman on the Kenai Peninsula, illustrating the dominant influence and significant conflict of human presence and activity on these Alaskan bears. Photo by Ron Niebrugge.

# Study Design

We will conduct an observational study to look at the relationship between commercial fisheries during their open season and the diet and survival rate for the brown bear population in that region. To conduct this study, we will be looking at the Cook Inlet Region, a part of the Gulf of Alaska. The Kenai River begins at Kenai Lake and enters the Kenai Peninsula 82 miles down south. The communities in the Kenai Peninsula are large fishing communities. The Kenai River Salmon Fisheries harvest up to 540,000 sockeye salmon per year. The Department of Fish and Game manage the open dipnetting season for the Kenai River so the salmon population is not depleted. The season opens for commercial fisheries July 10th and ends July 31st. During that 21 day period of open season for dipnetting in the Kenai River, we will be monitoring the bear's diets by collecting feces samples of 50 randomly sampled brown bears that we will tag. The month before, from June 10th to July 1st, we will be monitoring the same 50 tagged bears and taking samples of their feces. In that time, the fisheries will be closed. We expect there will be more sockeye salmon in the Kenai River. In the collected feces samples, we will be looking to see what is making up most of the diets of the brown bears. In those 21 days in July where the Kenai Fisheries are open, we expect to see that there will be less salmon in the Brown Bear feces, and more roots, berries, grasses, and rodents. In the first 21 days of August, when the peak harvest is over and the commercial fishing season is closed, we expect to once again see more salmon in the brown bear feces.

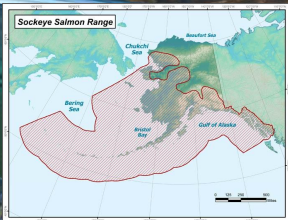


Figure 2. Range and Distribution of Sockeye Salmon in Alaska. From the Alaska Department of Fish and Game

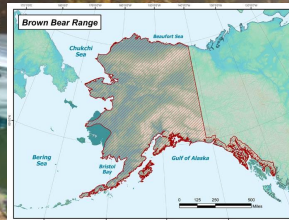


Figure 3. Range and Distribution of Brown Bears in Alaska. From the Alaska Department of Fish and Game

# Methods

The method to measure the diet content from the bears' feces was inspired by a study of bear fecal analysis by David G. Hewitt and Charles T. Robbins. After tracking the tagged bears for a while, we should be able to observe them defecating and we can collect the feces. Once the feces samples are collected, they will be spread evenly on a tray for analysis. The fecal samples will then be washed over soil screens with both hot and cold water in order to separate the diet contents of the feces. Correction factors will be used, which is the grams of dry matter ingested per ml of feces residue. With this analysis, study participants can differentiate the different items in the bears' diet, their fecal volume percentage, and food habits which is the percentage of dry matter. We are hypothesizing that during the open fishing harvesting time of salmon, the amount of salmon present in the bears' feces will be lower, so we would expect to see a lower fecal volume percentage and food habit of salmon. When salmon is not being harvested by humans, we will expect to see a higher fecal volume percentage and food habit of salmon. This would support our alternative hypothesis, and would prove that human salmon fishing has an affect on brown bear's diets.

Literature cited: Hewitt, D., & Robbins, C. (1996). Estimating Grizzly Bear Food Habits from Fecal Analysis. *Wildlife Society Bulletin (1973-2006)*, 24(3), 547-550. From <http://www.istor.org/stable/3783342>. A. (n.d.). Brown Bear Species Profile, Alaska Department of Fish and Game. From [https://www.adfg.alaska.gov/index.cfm?adfg=brownbear\\_main](https://www.adfg.alaska.gov/index.cfm?adfg=brownbear_main). A. (n.d.). Cook Inlet Personal Use Salmon Fishery, Alaska Department of Fish and Game. Retrieved November 23, 2020, from [http://www.adfg.alaska.gov/index.cfm?adfg=PersonalUsebyAreaSouthcentralkenaiSalmon\\_main](http://www.adfg.alaska.gov/index.cfm?adfg=PersonalUsebyAreaSouthcentralkenaiSalmon_main), Morton, J. M., Ph.D. (2013). THE KENAI BROWN BEAR POPULATION ON KENAI NATIONAL WILDLIFE REFUGE AND CHUGACH NATIONAL FOREST. *U.S Fish and Wildlife Service*. Retrieved from [https://www.fws.gov/uploadedFiles/Kenai\\_brown\\_bear\\_population\\_estimate\\_public\\_release.pdf](https://www.fws.gov/uploadedFiles/Kenai_brown_bear_population_estimate_public_release.pdf), M. (2020). Alaska salmon. Retrieved November 23, 2020, from <https://fisheries.msc.org/en/fisheries/alaska-salmon/>

# How is Salmon Fishing Affecting Brown Bear Diets in Alaska?

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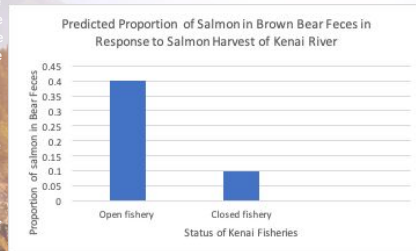


Figure 4. Our predictions for the relationship between salmon percentage in brown bear feces in open vs. closed fisheries.

# Intended Analysis

Our response variable is the percentage of salmon in the bear species and our independent variable is when in the season during which we take the samples, right before open harvest and then during open harvest. The percentage of fish in the bear feces is a continuous variable. The independent variable, the two different times during the summer, one when the harvesting season has closed and one when harvesting hasn't yet begun, is a categorical variable. Our hypothesis is that there is going to be a greater proportion of salmon in the bear feces during the month of June than the percentage of salmon in the bear feces during the open harvesting season in July. Our null hypothesis is that the proportions during the two different times are equal and there is no difference. The statistical test we will be using for this study is a two proportion Z-test, because we have 2 categorical independent variables that we are comparing the proportions for. This hypothesis test will tell us if the difference in proportions is significant enough to reject the null hypothesis.

# Expected Benefits

The brown bear populations in the Kenai Peninsula play an important role in the ecology of the community. They are important predators to herbivores, which keeps the vegetation in this area abundant. They also act as seed dispersers by eating plants and spreading the seeds through their scat. Without the brown bears, the plants in the ecosystem of the Kenai Peninsula would be consumed quickly. The brown bears support the ecosystem, and for that reason, it is important their population is supported through wildlife management. Making sure they are able to eat sufficient amounts of salmon to sustain their health will be important to keeping their population healthy.