Killer Whale Population in Decline

How is the decreasing population of Southern Resident killer whales connected to prey selection and availability?

Overview

The population of Southern Resident killer whales has been on the decline for decades, dropping 20% since the mid 1990s. Starvation appears to be a factor in the deaths of many of these whales. The Southern Resident killer whales survive mainly on a diet of Chinook salmon, which is another species in decline due to a variety of human impacts. In this lesson, students explore how the selective feeding practices of Southern Resident killer whales contribute to their declining numbers.

Learning Goals

Students will learn the following:

- *Southern Resident killer whale (SRKW) and Chinook salmon populations are in significant decline due to the impacts of human activities on marine ecosystems.*
- *Environmental changes affect food web dynamics.*
- *SRKWs and juvenile Chinook salmon are selective feeders.*
- *Effective species recovery plans for SRKW and Chinook salmon include an understanding of ecosystem relationships.*

Introduction

Southern Resident killer whales (SRKW) represent a small population of whales that spend several months of the summer and fall each year in Washington State's Puget Sound. Historically the population of SRKW was thought to number about 200 individuals, but hunting and live capture removed about half of the population until those practices were banned in the 1970s. The SRKW population made a slight recovery at first, but has since declined from a high of 98 individuals in 1995 to a 30-year low of only 73 by early 2019. This population is now listed as endangered.

Prey selection and prey availability are at the top of the list of threats thought to be impacting the SRKW population. These whales are strictly fish-eaters, so their selective diet may put them at risk if they are unable to find enough appropriate prey.

Image: NOAA

Authors

Carisa Ketchen
Toledo Jr/Sr High School
Mark McLaughlin
Neah-Kah-Nie High School
Elizabeth Daly
Oregon State University

Grade Level

9-12

Anchoring Phenomenon

Killer Whale Population in Decline

Driving Question

How is the decreasing population of Southern Resident killer whales connected to prey selection and availability?

Standards

Next Generation Science Standards

LS2.A: Interdependent Relationships in Ecosystems
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience
LS4.B Natural Selection
LS4.C Adaptation

Common Core Math Standards

HSS.ID.A.1
HSS.ID.A.2
HSS.ID.A.3
HSS.ID.B.5
HSS.ID.B.6
HSS.ID.C.7
HSS.ID.C.8

Learning Objectives

Students will be able to:

1. *Graph SRKW and Chinook salmon population data over time to explain trends and to make predictions.*
2. *Use data to explain relationships between selective feeding, population trends, and global climate change.*
3. *Identify policies that could help aid species recovery efforts.*

The anchoring phenomenon of this lesson centers around the observed declining population of Southern Resident killer whales in the Pacific Northwest. Not only are SRKW declining in numbers, but so are their primary prey, Chinook salmon. Both species have selective palates, meaning they specialize in feeding on particular prey species. In both cases, availability of their preferred prey is limited due to human impacts on ecosystems.

Juvenile Chinook salmon entering the ocean have selective palates for small, young-of-the-year fish. Their diets are so selective that they will not eat other, more plentiful prey, even when their chosen prey is limited. Many stocks of West Coast Chinook salmon are listed under the federal Endangered Species Act. How might the decline of salmon populations affect the predators that specialize in eating them? SRKWs only eat fish prey, and primarily Chinook salmon. Having a highly selective palate may be proving deadly to these apex predators.

Essential Questions

- *How do environmental changes affect food web dynamics?*
- *How does selective feeding impact SRKW and Chinook salmon populations?*
- *How does understanding the feeding preferences of SRKWs inform species recovery plans?*

Vocabulary

- *population*
- *threatened*
- *endangered*
- *predator*
- *prey*
- *palate*
- *selective feeding*
- *resilience*

Endangered Species Act

In 2005, the Southern Resident killer whale population was listed as endangered under the Endangered Species Act. Listed species or populations are provided with additional protection, conservation monitoring, and recovery efforts. Read more

Image: NOAA

Image: Screenshot from NOAA Fisheries video "Recovering the SRKW with Research and Conservation"

Lesson Procedure

ENGAGE

Activity: Taste Test

Begin the unit by having students perform a taste test using genetic taste testing strips (PTC paper). Most of the students will experience a bitter taste, but others will not notice a specific taste. Use this experience and *discussion prompts* to open a class discussion about selective feeding/palate preferences.

Activity: Video

Have the students watch the video: *Recovering the Southern Resident Killer Whale with Research and Conservation*. This film provides an introduction to the Southern Resident killer whale feeding preferences of Chinook salmon and the subsequent relationship to the decline of this population.

EXPLORE

Students will begin using a four-part webquest to explore both the Chinook salmon and SRKW populations along the west coast of the United States. Students will use a variety of web-based research sites to learn about the causal factors of the declining populations, and how selective feeding contributes to this dynamic. Extensions of this relationship will include linear and curvilinear, direct, and indirect proportional factors.

Activity: Webquest Part A – Killer Whales

The first webquest focuses on the relationship between SRKW population numbers and feeding behavior.

Activity: Webquest Part B – Chinook salmon

The second webquest focuses on Chinook salmon populations and how they are connected to killer whales.

EXPLAIN

Students will be able to analyze a variety of graphs and data to determine how global climate change is impacting the health of both marine and freshwater ecosystems. Students will be using claim-based evidence to explain how these changes are affecting the available prey for Chinook salmon and SRKWs, as their selective palates severely limit their feeding options.

Activity: Webquest Part C - Data

In this activity, students collect, present, and interpret data to uncover relationships between Chinook salmon populations and the number of SRKW calf births.

LESSON RESOURCES

Taste Test:

- *PTC paper source*

Discussion Prompts:

- *What reasons might an animal have for rejecting what appears to be an appropriate food item?*
- *Can you give examples of animals that are specialists, and examples of those that are generalists?*
- *How "easy" is it for selective feeder to switch to eating a different type of food?*

Why don't they just eat something else?

Elicit students' ideas about whether individual animals can intentionally change their physical characteristics or their inherited behaviors in response to a change in the environment.

- *Habitat Change formative assessment probe*

Address misconceptions as needed.

Video:

- *Recovering the SRKW with Research and Conservation [5:10]*

Webquests:

- *Part A, Killer whales (pdf)(doc)*
- *Part B, Chinook (pdf)(doc)*
- *Part C, Data (pdf)(doc)*
- *Part D, Policy (pdf)(doc)*

Image: NOAA

Activity: Webquest Part D – Policy implications
In the final webquest, students explore regulatory, management, and policy implications on SRKW and Chinook salmon populations.

ELABORATE

Take the students on a **field trip** to a local salmon hatchery. For example, an annual fin clipping party takes place at *Whiskey Creek Fish Hatchery* each year in early to mid-April on a Saturday. Students would get to see a Chinook salmon hatchery and participate in fin clipping the young salmon just before they migrate to sea. There are educational displays around the hatchery grounds, and the students will see the stream that the fish use to migrate out as juveniles and ultimately return as adults. The ocean is in close proximity, and the SRKW use this area as part of their adult Chinook salmon feeding regions. Once all juvenile salmon are fin clipped, there is a family style BBQ.

ODFW STEP biologists can also assist classrooms with learning activities and field trips related to *fish hatcheries* and watersheds.

EVALUATE

The formative assessment piece will be the completion of activities and exercises associated with the webquest research component. Students will be able to explain how the Chinook and SRKWs are in severe decline due to the relationship of climate change and selective palates. Students will learn to interpret data and use evidence obtained through research to identify causal factors to determine the effects on the marine and freshwater ecosystems. Additionally, students will evaluate current strategies being implemented for species recovery.

Next Generation Science Standards

Science & Engineering Practice:
Analyzing and Interpreting Data
Using mathematical & computational reasoning
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

Disciplinary Core Ideas:
LS2.A: Interdependent Relationships in Ecosystems
L22.B: Cycles of Matter and Energy Transfer in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience
LS4.B: Natural Selection
LS4.C: Adaptation

Field Trip
- *Whiskey Creek Fish Hatchery*
- *ODFW STEP biologists*
- *ODFW fish hatcheries*

Image: NOAA

Image: NOAA

Crosscutting Concepts:
Cause and Effect
Scale, Proportion, & Quantity
Energy and Matter
Stability and Change
Patterns

Math Practices:
Make sense of problems and persevere in solving them
Reason abstractly & quantitatively
Model with mathematics

CC Math Standards:
- *6.SP.A: Develop understanding of statistical variability.*
- *6.SP.B: Summarize and describe distributions.*
- *7.SP.4: Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.*
- *HSS.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).*
- *HSS.ID.A.2: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*
- *HSS.ID.A.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*
- *HSS.ID.B.5: Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.*
- *HSS.ID.B.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.*
- *HSS.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data*
- *HSS.ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.*

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See more lessons on the ORSEA webpage