Population Fluctuations in Salmon

Why can't all salmon be managed in the same fashion?

Overview

Salmon play an important ecological and cultural role in the Pacific Northwest. In this lesson, students will explore the life cycles of different species of salmon and examine how populations respond to changes in their environment. Students will learn about different management strategies and use graphs and models to predict growth and decline in salmon populations.

Essential Questions

- *How are the life cycles of different salmon species similar and different?*
- *How can we use models to predict population changes?*
- *How does the life cycle of a salmon impact the management of the species?*

Learning Goals

Students will learn the following:

- *Scientists use line graphs to visualize changes in populations over time.*
- *Different species of salmon have different life cycles.*
- *Scientists use models to predict how impacts at different life stages impact salmon populations.*
- *Understanding the life cycles and population histories of salmon can inform management decisions.*

Learning Objectives

Students will be able to:

- *create graphs and interpret trends in population data.*
- *describe factors that impact the life cycles and populations of salmon species.*
- *predict population responses to changes in survivorship at various life stages.*

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Grade Level

9-10

Time

1-2 weeks

Anchoring Phenomenon

Population Fluctuations in Salmon

Driving Question

Why can't all salmon be managed in the same fashion?

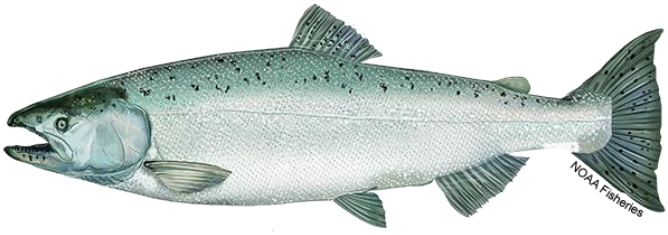
Standards

Next Generation Science Standards

LS2.A – Interdependent Relationships in Ecosystems
LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Common Core Math Standards

HS.NQ.B.4



Chinook salmon – Image: NOAA Fisheries

Introduction

Different species of salmon have different life cycles that impact how they respond to disturbances in their ecosystems. When we see a decline in the population, we may be tempted to make a management decision to help the species rebound. Understanding the life cycles and population histories of these species may help us make better management decisions.

Throughout the lesson, students will practice analyzing graphs, learn about general and specific life histories of salmon, use a model to examine how impacts to different life stages impact population, examine different management strategies, and write an autobiographical story from the point of view of a salmon.

Salmonids in Oregon

- *Chinook*
- *Sockeye*
- *Coho*
- *Chum*
- *Pink*
- *Steelhead*

Chum salmon – Photo: ODFW

Lesson Procedure

ENGAGE

In Oregon, many students learn about salmon in elementary school. To asses student knowledge and ideas, begin the unit by asking students what they already know about salmon. Students can share their prior knowledge, stories, and experiences related to salmon with each other in pairs, small groups, and/or through a classroom discussion.

Then, show the students two short videos about salmon. The first, *From the Spawning Grounds*, provides underwater visual images of spawning salmon as well as a song and poem by Karuk artist Brian D. Tripp. Then, the Ocean Wise video *Salmon's life cycle* describes the impact that salmon have on ecosystems. Have students reflect on the the similarities and differences between these two introductory videos.

Next, have students use the *What Salmon Are You?* interactive quiz to learn about five different salmon species. If you want to use their quiz results later as a grouping technique, make sure the students remember their answers.

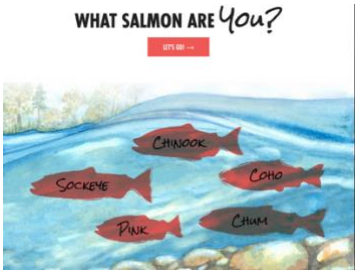
Conclude this section of the lesson with a discussion about the cultural and ecological importance of salmon. Prompts:

- *Why are salmon important to you?*
- *Why are salmon important to ecosystems?*
- *In what ways do native populations rely on salmon?*
- *What do you think are some of the issues facing salmon?*

LESSON RESOURCES

Introduction

- *Video: From the Spawning Grounds [3:08]*
- *Video: Salmon's life cycle [3:47]*
- *Quiz: What Salmon are You?*



Screenshot from salmonsociety.com

EXPLORE

In this section, students will analyze salmon population data to looks for patterns and changes over time.

Activity: Statistical Salmon Analysis

Using *Student Worksheet #1*, students analyze line graphs of salmon population data and describe how the number of returning adult Coho salmon over the Willamette Falls on the Willamette River has changed since 1965. After completing each section of the worksheet, take some time to discuss the questions with the students. A *Teacher Key* for the worksheet is provided.

Activity: Salmon Life Cycle

In this activity, students explore resources to review and learn more about salmon life cycles. Begin by sharing the *Salmon Life Cycle* presentation adapted from the Oregon Department of Fish and Wildlife (ODFW) Eggs to Fry program. Students can use *Student Worksheet #2* to organize their notes about salmon life stage characteristics. Alternatively, learners can color and label the *Lifecycle Coloring Page* as they make observations. Following the presentation, students can obtain additional information from the NOAA animated video *Life Cycle of the Pacific Salmon* or from the Bob Turner video *Pacific Salmon and their Circle of Life* which focuses on coastal Chum salmon.

Activity: Salmon Species

Next, students learn how life histories among salmon species in Oregon differ from one another. Present the *Salmon Species* slides adapted from ODFW Eggs to Fry while students record their observations. You can have students use *Student Worksheet #3a* to organize their notes as they explore and compare life histories of **six** Oregon salmon species. Alternatively, you can choose to have students compare just **two** species, Coho and Chinook, using *Student Worksheet #3b*.

EXPLAIN

In this section, students interact with data and explore how survivorship of salmon at various life stages impacts the number of salmon that return to spawn.

Activity: Salmon Survivorship Warm Up

The *Salmon Survival Activity Packet* from AquaCase includes several activities that can supplement this lesson. For example, use the story on page 10 to provide the basis for *Student Worksheet #4* in which students create a spreadsheet and calculate the loss and survival rate salmon after each of the situations described.

Statistical Salmon Analysis

- *Student worksheet #1 (pdf)(doc)*
- *Teacher Key (pdf)*

Discussion Topics

- *How do you read a graph?*
- *What do you notice?*
- *What do you think is happening to the salmon?*
- *How does looking at a bigger window of time help managers make decisions?*

Salmon Life Cycle

- *Presentation (ppt)(pdf)*
- *Student worksheet #2 (pdf)(doc)*
- *Lifecycle Coloring page (pdf)*
- *Video: Life Cycle of the Pacific Salmon [5:37]*
- *Video: Pacific Salmon and their Circle of Life [13:17]*

Salmon Species

- *Presentation (ppt)(pdf)*
- *Student worksheet #3a 6 species (pdf)(doc)*
- *Student worksheet #3b 2 species (pdf)(doc)*

Black bear with salmon - Wikimedia

Salmon Survivorship Warm Up

- *Salmon Survival Activity Packet, AquaCase*
- *Student worksheet #4 (xls)*

Activity: Salmon Models
Use the following model(s) to let students interact with data and to explore how survivorship of salmon at various life stages impacts the number of salmon who return to spawn.

The **fixed model** worksheet is less involved and the numbers do not change. Students examine *Fixed Model* and use the *Student Worksheet #5* to try a few different strategies to help keep the population from going extinct.

In the **random model**, students will run the model multiple times because the numbers change each time the model is run. There are two options in the *Random Model*. The "Returning spawners - 100 year average" has students collect the 100 year return over 10 runs and then find an average. Students use *Student Worksheet #6* to compare the average numbers and observe how the graph changes. If you want to challenge your students a bit more, the "Returning spawners - all years average" has students collect the data for every year over ten runs. Following instructions in *Student Worksheet #7*, they find an average for each year and use these to create their own graph. This option is good for teaching students how to use spreadsheets or for students who are familiar with using spreadsheets already. More instructions can be found on the "Returning spawners -100 year average" and "Returning spawners - all years average" tabs of the model.

NOTE: It is important that students do not mess with the tab titled "Model - Coho" because it may ruin the simulation on the worksheet tab.

Activity: Model Extensions
Some of the data in the models above came from *Columbia River DART* (Data Access in Real Time). Students could delve deeper into these data to produce additional graphs.

Additional NOAA Fisheries resources for *Chinook*, *Coho*, and other salmonids can help students evaluate how changes at life cycle stages could impact population numbers.

Activity: Career Connection
Meet Dr. Selina Heppell, Department Head and Professor of marine fisheries ecology at Oregon State University. She works on marine ecology, conservation, and resource management issues in Oregon and around the world, and strives to bridge quantitative ecology and practical solutions to marine resource issues.

Concepts Developed
- *converting percent to decimal*
- *survivorship*
- *replacement*
- *harvest*
- *average*

Fixed Salmon Model
- *Fixed Model (xls)*
- *Student Worksheet #5 (pdf)(doc)*

Random Salmon Model
- *Random Model (xls)*
- *Student Worksheet #6 100 year average (pdf)(doc)*
- *Student Worksheet #7 All years average (pdf)(doc)*

Columbia River DART
- *Overview*

NOAA Fisheries: Salmonids
- *Chinook*
- *Coho*
- *Chum*
- *Pink*
- *Sockeye*
- *Steelhead*

Career Connection
- *Researcher Bio: Dr. Selina Heppell*

Dr. Selina Heppell

ELABORATE

In this section, students will learn about threats to salmon and salmon habitat.

Activity: Salmon Conservation, Culture, and Economy
First, share the *Salmon Conservation, Culture, and Economy* presentation adapted from the ODFW Eggs to Fry program, and have students answer the questions in the *Student Worksheet #8*.

Activity: Salmon Habitat
Next, share the *Salmon Habitat* presentation adapted from the ODFW Eggs to Fry program. Have students share some of the threats they think will impact each life stage and how threats might impact the overall population.

Provide students with potential scenarios that pose *Threats to Salmon*. Students can discuss one or more scenarios in the list, and brainstorm management strategies to counteract some of these threats.

Activity: Wild vs. Hatchery
How do survival rates compare between wild and hatchery raised Coho? In the *Salmon Survival 10.1* lesson from the Fisheries and Oceans Canada *Salmonids in the Classroom*, students compare wild and hatchery Coho survival rates. This lesson allows for an interesting discussion about hatchery and wild salmon and why we can't just add more fish to the rivers.

EVALUATE

To wrap up what they have learned about salmon, students will incorporate their learning into writing either a salmon story or by creating a found poem.

Activity: Salmon Autobiographical Journey
Students will use the prompts in *Student Worksheet #9* to write an autobiographical story from the point of view of a salmon. Depending on the level of your students, they can write about Coho which they have learned the most about, or they can have a challenge and write about the species of salmon they got from the "What Salmon Are You?" quiz in the beginning of the lesson. The specific life history of their species will influence their story and how they may react to changes and challenges in their environment.

Salmon Conservation, Culture, and Economy
- *Presentation (ppt)(pdf)*
- *Student worksheet #8 (pdf)(doc)*

Salmon Habitat
- *Presentation (ppt)(pdf)*
- *Threats to Salmon (pdf)(doc)*

Salmon Survival
- *Salmon Survival 10.1 (pdf)*
- *Salmonids in the Classroom resource*

Salmon Autobiographical Journey
- *Student worksheet #9 (pdf)(doc)*

Activity: Found Poem
A "found poem" is a form of poetry that comprises borrowed text from different sources. Ask students to read a passage about salmon and highlight significant terms, phrases, or sentences (if you want the poem to be more minimalistic, have them stick to terms). Then students can arrange their chosen segments into their poem. *Student worksheet #10* provides an example of how text is made into a found poem.

Activity Extensions
Provide students with the *Salmon Species Population Data* for salmon species around Oregon and have them use this data to practice making graphs, examine trends, compare populations, etc.

Next Generation Science Standards

Performance Expectations:
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Science & Engineering Practices:
Using Mathematics and Computational Thinking

Disciplinary Core Ideas:
LS2.A – Interdependent Relationships in Ecosystems
LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concepts:
Scale, Proportion, and Quantity

Common Core Math Standards

Math Standard:
HS.NQ.B.4 – Define, manipulate, and interpret appropriate quantities using rational and irrational numbers to authentically model situations and use reasoning to justify these choices.

Math Practices:
MP.2 – Reason abstractly and quantitatively.
MP.4 – Model with mathematics.

Found Poem
- *Student worksheet #10 (pdf)(doc)*

Salmon Species Population Data
- *Population data (xls)*

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See more lessons on the ORSEA webpage: oregoncoaststem.oregonstate.edu/orsea