PACIFIC SALMON FOUNDATION

# Eat Or Be Eaten

## Teacher's Answer Key

Presented by the Pacific Salmon Foundation

PSF.ca

# **Eat or Be Eaten:** Part 1

**Teacher's Answer Key**

Given the importance of salmon to the ecosystems and peoples in the North Pacific, there are many scientists and researchers studying the relationships between salmon and the other animals in the marine food chain to better understand how changes at one level might be affecting salmon health and abundance. If you were a salmon scientist, what questions would you be asking about the food chain?

Come up with 3 research questions, and then for each one, develop a hypothesis or a prediction of what you think the answer is. For example:

Research question: *How is climate change influencing energy production at the base of the food chain?*

Prediction: *Climate change is causing the timing of the phytoplankton bloom and the peak in zooplankton abundance to change*.

## TEACHER:

Once students have come up with their own research questions and hypotheses, share with them the following hypotheses that were developed by scientists working with the Pacific Salmon Foundation. Discuss whether or not the students had similar predictions/hypotheses, if students would change their predictions having seen these ones, or if they would recommend changes to the scientists' hypotheses based on what they've learned.

1. Juvenile salmon grow faster when there is more food available.
2. The composition and energetic quality of salmon prey (e.g. forage fish and zooplankton) influence salmon growth.
3. When the timing of the salmon migration lines up with the time when their prey is the most abundant, they grow faster and are bigger.
4. Where there are more predators, salmon have lower survival rates.
5. Some predators have become salmon specialists, knowing when and where to find salmon and eating more of them.
6. When there are fewer other fish for predators to eat (e.g. fewer forage fish), they will eat more salmon.

Artwork by Anish Parekh

Cover photos by: top - Eiko Jones, left - Mitch Miller, middle and right - Ryan Miller

# Eat or Be Eaten: Part 2

**Answer Key**

Scientists have similar research questions to you and go out and collect data to try to answer them. Below are a series of datasets related to salmon and the food chain. Use the data provided to create figures and draw inferences about the potential trophic interactions.

## SALMON DIETS:

A diet that's high in essential fatty acids is important for the health and growth of juvenile salmon. The amount of fatty acids can be quite variable between different prey types. Calculate the sum and percent of each prey type at each sampling location. With these values, create a circle chart for each location depicting the salmon's diet composition. Which location has better prey availability and a higher quality diet (refer to the table of total fatty acids per prey group)? What might be the impact of juvenile salmon spending more time feeding in Location 1?

| Location | Fish | Prey | Quantity |
|---|---|---|---|
| 1 | 1 | Crustaceans | 79 |
| 1 | 1 | Larval Fish | 3 |
| 1 | 1 | Gelatinous | 4 |
| 1 | 2 | Crustaceans | 23 |
| 1 | 2 | Larval Fish | 1 |
| 1 | 2 | Gelatinous | 9 |
| 1 | 3 | Crustaceans | 13 |
| 1 | 3 | Larval Fish | 0 |
| 1 | 3 | Gelatinous | 102 |
| 1 | 4 | Crustaceans | 17 |
| 1 | 4 | Larval Fish | 1 |
| 1 | 4 | Gelatinous | 64 |
| 1 | 5 | Crustaceans | 10 |
| 1 | 5 | Larval Fish | 0 |
| 1 | 5 | Gelatinous | 215 |

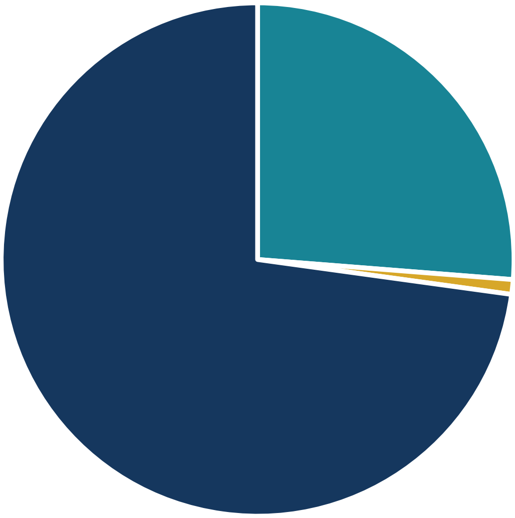
| Location | Fish | Prey | Quantity |
|---|---|---|---|
| 2 | 1 | Crustaceans | 175 |
| 2 | 1 | Larval Fish | 4 |
| 2 | 1 | Gelatinous | 0 |
| 2 | 2 | Crustaceans | 61 |
| 2 | 2 | Larval Fish | 7 |
| 2 | 2 | Gelatinous | 0 |
| 2 | 3 | Crustaceans | 5 |
| 2 | 3 | Larval Fish | 10 |
| 2 | 3 | Gelatinous | 10 |
| 2 | 4 | Crustaceans | 260 |
| 2 | 4 | Larval Fish | 3 |
| 2 | 4 | Gelatinous | 0 |
| 2 | 5 | Crustaceans | 121 |
| 2 | 5 | Larval Fish | 3 |
| 2 | 5 | Gelatinous | 0 |

| | | Sum | Percent |
|---|---|---|---|
| Totals | Crustaceans | 142 | 26 |
| | Larval Fish | 5 | 1 |
| | Gelatinous | 394 | 73 |
| | All | 541 | 100 |

| | | Sum | Percent |
|---|---|---|---|
| Totals | Crustaceans | 622 | 94 |
| | Larval Fish | 27 | 4 |
| | Gelatinous | 10 | 2 |
| | All | 659 | 100 |

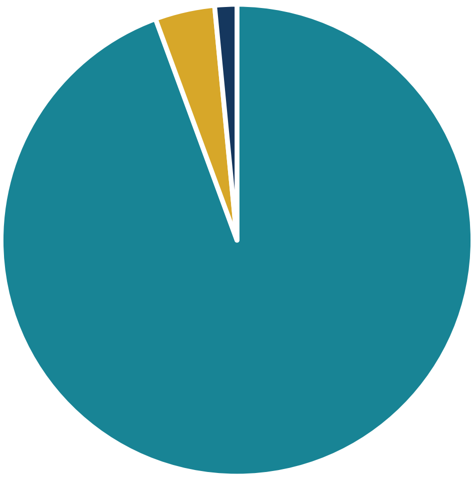
| Prey | Total fatty acids (mg/g) |
|---|---|
| Crustaceans | 16 |
| Larval Fish | 13 |
| Gelatinous | 0.8 |

**Salmon Diets at Location 1**



Crustaceans  Larval Fish  Gelatinous

**Salmon Diets at Location 2**

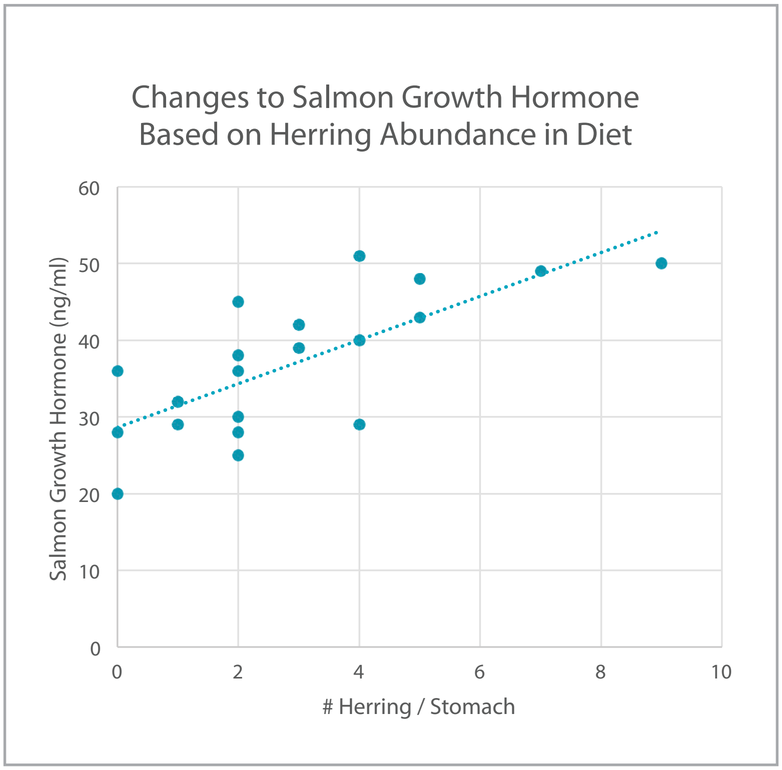


Crustaceans  Larval Fish  Gelatinous

## FORAGE FISH:

A survey was conducted throughout the Strait of Georgia to measure juvenile salmon growth rates. They also looked at the stomach contents to see if there was a relationship between the abundance of forage fish and salmon growth (measured using hormone levels in blood samples from the salmon). Create a scatter plot with the number of herring in the salmon diets along the x-axis and the salmon growth hormone on the y-axis. Is there a trend?

| Fish Sample | # Herring | Salmon Growth Hormone (ng/ml) |
|---|---|---|
| 1 | 0 | 20 |
| 2 | 1 | 29 |
| 3 | 2 | 30 |
| 4 | 0 | 28 |
| 5 | 0 | 36 |
| 6 | 2 | 25 |
| 7 | 2 | 38 |
| 8 | 3 | 42 |
| 9 | 4 | 40 |
| 10 | 5 | 48 |
| 11 | 2 | 45 |
| 12 | 4 | 29 |
| 13 | 2 | 36 |
| 14 | 4 | 51 |
| 15 | 1 | 32 |
| 16 | 3 | 39 |
| 17 | 7 | 49 |
| 18 | 5 | 43 |
| 19 | 9 | 50 |
| 20 | 2 | 28 |



## MATCH OR MISMATCH:

A survey was conducted in the Strait of Georgia to determine how the number of salmon returns would change when they entered the ocean at different times relative to the availability of their prey. Zooplankton abundance was measured approximately once per week and juvenile salmon were released into the ocean on 3 specific dates (bolded in the table). Using the data below, create a line graph of the zooplankton abundance over time. Then add a secondary axis on the right hand side and overlay bars to represent the salmon return rate. What's the relationship between release timing, prey abundance, and returns?

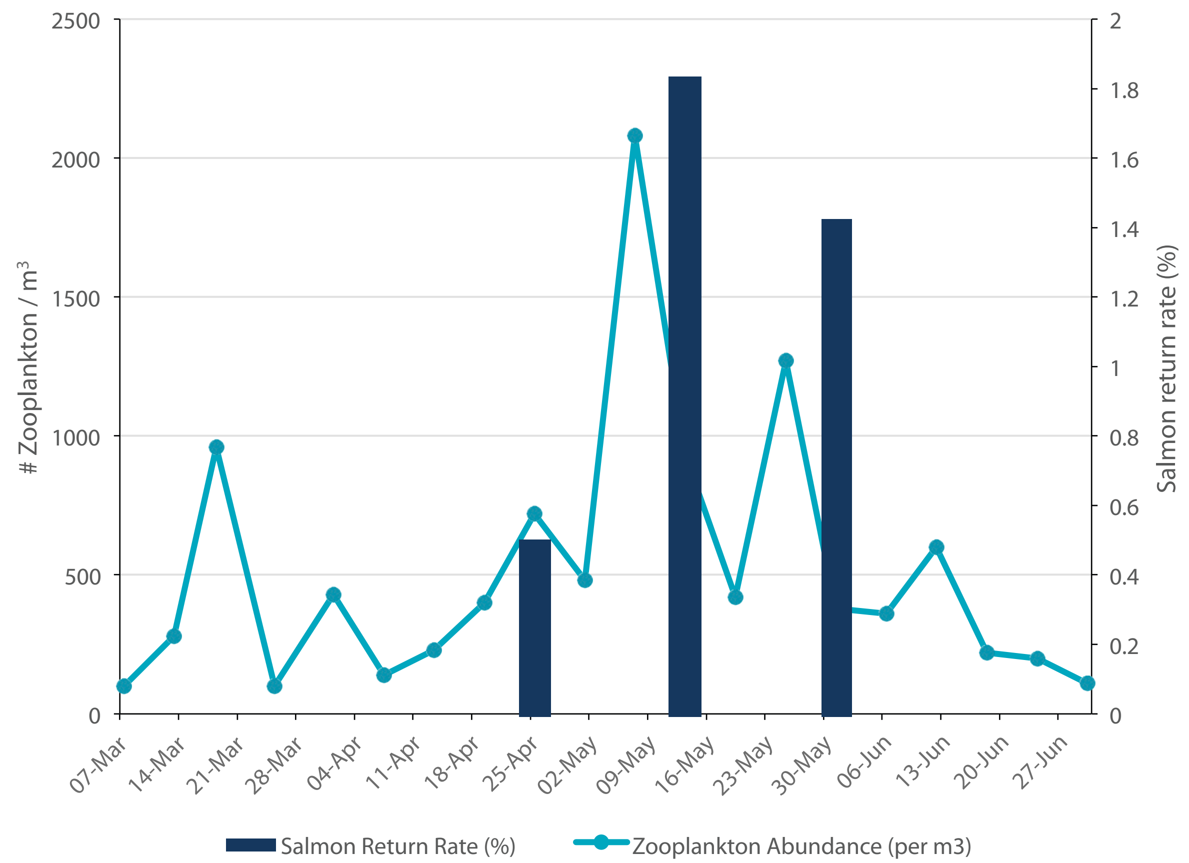
| Date | Zooplankton Abundance (per $m^3$) | % Salmon Returns |
|---|---|---|
| 07-Mar | 100 | |
| 13-Mar | 280 | |
| 18-Mar | 960 | |
| 25-Mar | 100 | |
| 01-Apr | 430 | |
| 07-Apr | 140 | |
| 13-Apr | 230 | |
| 19-Apr | 400 | |
| **25-Apr** | **720** | 0.5 |
| 01-May | 480 | |
| 07-May | 2080 | |
| **13-May** | **930** | 1.8 |
| 19-May | 420 | |
| 25-May | 1270 | |
| **31-May** | **380** | 1.4 |
| 06-Jun | 360 | |
| 12-Jun | 600 | |
| 18-Jun | 220 | |
| 24-Jun | 200 | |
| 30-Jun | 110 | |

## MATCH OR MISMATCH FIGURE:

### TEACHER:

How they choose to space out the axes may differ, but generally, figures should resemble this:

### Salmon Return Rate Relative to Zooplankton Abundance





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