



Science Unit: *The Journey of the Pacific Salmon*

Lesson 3: *The Salmon Estuary and Human Impacts*

School year: 2008/2009

Developed for: Grenfell Elementary School, Vancouver School District

Developed by: Jean Marcus (scientist), Jane Hughes and Gary Loong (teachers)

Grade level: Presented to grade 3; appropriate for grades 2 – 5 with age appropriate modifications.

Duration of lesson: 1 hour and 30 minutes

Objectives

1. Review the Pacific Salmon estuary life cycle stage: smolts.
2. Explore the many connections between salmon farms on the BC coast, sea lice and smolts.
3. Discover the basic biology of a marine parasite (gross anatomy, feeding behavior and reproduction of sea lice).

Background Information

Fish farming is a major industry in British Columbia, with 100s of farms located in sheltered bays and estuaries along the coast. Salmon farming is the most popular form, with smolts being grown to adults in open net systems located in coastal marine waters. Farms can hold about ½ million fish in areas the size of 4 football fields. This large concentration of fish makes the salmon very susceptible to diseases that spread easily from fish to fish, and increases the incidence of salmon parasites because the fish are farmed in high densities.

Sea lice are parasitic crustaceans that attach to the sides of salmon, feeding on skin and muscle tissue and causing lesions and bleeding. A fish with many sea lice can suffer considerable physical damage and is thought to be more susceptible to bacterial infection. Sea lice parasites, which look a bit like tadpoles, are usually low in numbers in natural ecosystems but occur in unusually high numbers in and near salmon farms due to the high density of fish and abundant food supply.

Before the arrival of salmon farms, sea lice were known parasites of adult salmon, but they typically did not cause much harm since adults are large fish and when they return to the stream for spawning the sea lice fall off (sea lice can not live in fresh water). With the arrival of salmon farms, sea lice began to appear on smaller salmon. As the juvenile salmon migrate out from the rivers to sea they pass by the open net farms and are exposed to unusually high concentrations of sea lice. Parasitism of sea lice on smolts and young adult salmon can cause severe illness and even death. For example, sea lice can cause up to 80% of juvenile Pink salmon to die.

Sea lice are one reason why coastal, open net salmon farms are controversial in BC. Many opponents of salmon farms are calling for closed aquaculture systems, where the fish are farmed in contained spaces thus eliminating the sea lice issue as well as ensuring farmed salmon do not escape into the wild.

Vocabulary

Word:	Brief definition.
Smolt	A young salmon that is at the stage of development when it assumes the silvery color



	of the adult and is ready to migrate to the ocean.
Salmon farm	A managed farm which grows salmon from smolt to adults for the market. In BC, farms are typically open net systems located in sheltered bays along the coast.
Sea louse	A parasitic copepod that commonly infects fish.
Parasite	An animal or plant that lives in or on a host (another animal or plant); it obtains nourishment from the host without benefiting the host. Typically parasites do not kill their host.
Farmed salmon	Salmon that have been reared in a salmon farm.
Wild salmon	Typically refers to native salmon that live in the open ocean and are fished for the market

Materials

Sea Lice Tag Game

- 10 Velcro belts
- 40 sea lice cutouts with Velcro

Sea Lice Demonstration

- 6 petrie dishes
- Sea lice specimens
- Tweezers
- 6 magnifying glasses (or dissecting microscopes)
- Worksheet 1

Journey of the Pacific Salmon Board Game

- game board (see lesson 2)
- estuary question cards (Worksheet 2)
- 4 magnets
- dice

In the Classroom

Introductory Discussion

1. Explain a salmon farm; introduce sea lice and how farms/sea lice impact the “estuary” stages of the salmon life cycle (smolts and young adults). Use pictures and other props and ask students the following questions:
 - What is a farm? What do you eat that comes from farms?
 - Do you eat any fish? Where do they come from?
 - What is a fish farm? How do they work?
 - What is a sea louse?
 - Why do salmon farms increase the number of sea lice? Why is this problem for young wild salmon?
 - What other parasites do you know?
 - Is there a better way to farm fish than how salmon are being farmed in BC right now?
2. Show the students the following video (~ 6 minutes), freely available online (it can be downloaded or directly viewed from the website): <http://www.watershed-watch.org/sealice.html>



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- Revisit any questions arising from the video
3. Brief description of the activities:
 - Activity 1: Sea lice specimen observation
 - Activity 2: Sea lice and salmon tag game
 - Activity 3: The Journey of the Pacific Salmon board game
 4. Processes of science that the students will focus on:
 - Activity 1 requires students to observe closely. Clear and detailed observation is an important part of being a good scientist. This activity requires good visual observation (with a hand held magnifying glass or dissecting microscope) to see details of the small, preserved sea lice.
 - Activity 2 requires students to integrate their knowledge that juvenile salmon are more negatively impacted by sea lice than adult salmon.

Science Activity

Activity #1: Sea lice specimen observation.

Purpose of Activity: To observe the external anatomy of preserved sea lice.

Methods and Instructions:

Set-up prior to activity:

Assemble all materials (see Sea Lice Demonstration Materials above) and photocopy Worksheet1, one per student. Divide the class into groups depending on how many sea lice specimens and magnifying glasses/microscopes are available. Ideally each student would have 1 sea louse each.

In class activity:

1. Each student examines a preserved sea lice specimen using either a magnifying glass or a dissecting microscope. The students are asked to pay particular attend to the size and shape of the parasite, and are asked to observe any details they can (such as eyes, grasping appendages, shape of the "tail" etc.).
2. Each student draws and labels their specimen (Worksheet 1).

Activity #2: Sea lice tag game.

Purpose of Activity: To understand parasite-host dynamics (i.e. that smolts are more negatively impacted by sea lice than adult salmon).

Methods and Instructions:

Set-up prior to activity:

Organize materials, including creating ~ 10 'belts' with Velcro on them and ~ 40 sea lice cutouts with Velcro too (so the sea lice attach to the salmon).

In class activity:

1. Organize the class into 3 groups: 1) sea lice (10 students), 2) juvenile salmon, aka smolts (7-8 students), and 3) adult salmon (2 students).



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2. Each salmon player places a Velcro belt around their waste and each sea lice player receives 5 sea lice cutouts.
3. The rules for the tag game: Sea lice players are trying to attach their sea lice cutouts to the salmon Velcro belts. Only one sea lice cutout can be attached at any given time: when a sea lice player catches a salmon (smolt or adult) they put sea lice one cut out on the player (and they have to count 5 sec before they can run after another salmon). Smolt players “die” (leave the game) when they have been tagged with 3 sea lice, adult players “die” when they have been tagged with 8 sea lice. Sea lice players “die” when they get rid of all 5 of their sea lice.
4. Pause the game after 5 minutes and count how many salmon still survive.
5. End the game after 10 minutes and have a final count. The game is followed by a discussion of why smolts are more severely impacted by sea lice than adults.

Note: A simple modification is to play 2 separate tag games, one with adult salmon and one with smolts.

Activity #3: The Journey of the Pacific Salmon board game (Estuary).

Purpose of Activity: To review the day’s lesson in a fun and engaging way.

Methods and Instructions:

Set-up prior to activity:

Print and cut out the estuary questions (Worksheet 2) and place them in an envelope.

In class activity:

1. Start the game with the team whose turn it is (from last lesson).
2. Explain that today we will play the ESTUARY section. The game questions reflect what we have explored and learnt in today’s lesson. The rules of the game are as follows:
 - a. The first team rolls the die and moves forward X squares by the number rolled. A volunteer from the team then picks a estuary question from the envelope and reads the question to the class. The team has 1 minute to decide how they will answer the question. If their answer is correct, they roll again. If incorrect, the scientist asks the rest of the class if they know the answer. Either a student or the scientist explains the correct answer to the class, and then the next team goes. Each team stops playing when they reach the end of the estuary section.
 - b. For the next 2 lessons we will end each day with playing this game. Next week the class will play the OCEAN section and the following week the STREAM IN section (note that an Estuary In section is present on the game board, but this section can be skipped by asking the students one question and if they answer it correctly they progress to the start of the STREAM IN section).

Closure Discussion

The board game is an effective way to review the lesson. After the board game, explain briefly the intent of next week’s lesson: to review adults, the life cycle stage that lives in the Open Ocean, and to explore how commercial fishing can impact wild adult salmon populations.



References

1. Wild Salmon in Trouble Video: The Link Between Farmed Salmon, Sea Lice and Wild Salmon. Watershed Watch Salmon Society. See <http://www.watershed-watch.org/sealice.html>. The video is 6 minutes and 47 seconds.
2. David Suzuki Foundation. Parasites and Disease: Sea Lice (many additional resources on this page): http://www.davidsuzuki.org/Oceans/Aquaculture/Salmon/Sea_Lice.asp
3. Drisdelle, Rosemary. 2007. Sea Lice and Salmon. Crustacean parasites kill wild and farmed salmon. http://biology.suite101.com/article.cfm/sea_lice_and_salmon#ixzz0HslazHTa&C

What is a salmon farm?	If many juvenile salmon die because of sea lice, fewer return to the stream to spawn. Give one reason how this effects the steam habitat.
Where are most salmon farms built?	Give 1 reason how we can help wild salmon survive.
What is a parasite? Give one example other than a sea louse.	When there are salmon farms present, what salmon life cycle stage do sea lice infect?
What do sea lice eat?	How many fish does 1 fish farm usually hold?
When there are no salmon farms, what salmon life cycle stage do sea lice infect?	Give 1 reason how we can help wild salmon survive.
Are salmon farms harmful for juvenile salmon? Why or why not?	Why type (species) of salmon is most harmed by salmon farms and sea lice?
What happens when sea lice infect an adult salmon? Think about the adult going back to its stream to spawn.	If many juvenile salmon die because of sea lice, fewer return to the stream to spawn. Give one reason how this effects the steam habitat.
Scientists think that ___% juvenile pink salmon die because of sea lice. (When there are fish farms nearby).	What is a natural predator on juvenile salmon?

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