STREAM TO SEA ACTIVITY

Difficult Decisions: The Sakinaw Sockeye Case Study

An exercise in consensus decision-making through role playing that enables students to devise a solution for managing dwindling Sakinaw sockeye salmon stocks.

Prescribed Learning Outcome(s) met and Curriculum Organizer(s)
It is expected that students will:

Science 8

Life Science (Diversity)

- compare and contrast how organisms have adapted to the conditions in their biome and how these organisms interact with each other

Life Science (Social Issues)

- assess different impacts of using renewable and non-renewable natural resources.
- relate the extraction and harvest of earth's resources to sustainability and reduction of waste

Life Science (Global Ecosystems)

- evaluate how major natural events and human activity can affect local and global environments and climate change.

Social Studies 8

Applications of Social Studies

- identify and clarify a problem, an issue, or an inquiry
- assess a variety of positions on controversial issues

Overview of Activity:
This lesson plan over two classes introduces students to decision-making on an individual and group level. Then, students will use their critical thinking in a role playing exercise by considering the different perspectives of various interest groups. Students, in their character roles, will try to come to consensus on how to deal with the dwindling Sakinaw sockeye species while best meeting the needs of all the stakeholder groups represented.

Estimate of time required:
Number of lessons: 2 lessons
Each lesson requires: 1-2 hours
Can be done: Anytime ☒ Fall ☒ Winter ☒ Spring ☒ Summer
Notes:

Natural Area Required: None - Indoor Activity ☐ Ocean OR ☐ Stream OR ☐ Estuary

Overview of Materials and Resources Required:
Material Available for downloading:

☒ Activity Description(s)
- "Activity Description"

☒ Student Handout(s)
- "The Species at Risk Act"

☒ Background Information

- (Included in Student Handout document)

☒Discussion Questions

- (Included in Evaluation/Assessment Tool document)

☒Evaluation /Assessment Tool(s)

- "Student Questions and Answer Key"

Other Required Material:

- Fish-shaped crackers; one bowl for each 4 students; 1 cup per student.

Suggested Assessment Activities:

- Discussion questions may be used as an assessment tool; an answer key is provided.

Recommended Additional Resources and Optional Enrichment Activities:
(E.g. Web-sites, Teaching Guides, Student Reading, Videos/Audio-tapes, Posters and Brochures, Field Trips):

- "Table Talk – A Learning Resource for the Study of Land and Water Allocation in British Columbia" Fisheries and Oceans Canada.
- "Salmonids in the Classroom – Intermediate" (2002). Fisheries and Oceans Canada. Handout 9.6, "Salmon Harvesting in BC", pp.213-214; Handout 9.7, "A Code of Responsible Fishing for Canada", p.215.
- Environment Canada's Species at Risk website www.speciesatrisk.gc.ca
- The BC Salmon Marketing Council developed the "Salmon Market Database" to provide historical data regarding salmon; these statistics are conveniently available in a variety of formats for easy analysis. www.bcsalmon.ca/market-database/index.html
- Results of public consultations on SARA-listed species www-comm.pac.dfo-mpo.gc.ca/pages/consultations/sara/listings_e.htm
- "Status of Sakinaw Lake Sockeye Salmon" (2002). Canadian Science Advisory Secretariat. www.dfo-mpo.gc.ca/csas/Csas/publications/ResDocs-DocRech/2002/2002_088_e.htm
- Fisheries and Oceans Canada Recreational Fishing guidelines www.pac.dfo-mpo.gc.ca/recfish/default_e.htm

Support may be Available.

Contact your local Stream to Sea Education Coordinator or Community Advisor.
www-heb.pac.dfo-mpo.gc.ca/community/contacts/ec_e.htm
or phone (604) 666-6614 to find out if an Education Coordinator in your area assists with this activity.

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ACTIVITY DESCRIPTION

This is a two-part lesson. In the first hour, the lesson first introduces two decision-making activities. Then, based on their background reading, students take on roles of different community members and prepare to present their opinion according to the group they represent. In the second hour, students learn through role-playing the value of cooperative decision-making and the human role in sustaining natural populations.

PREPARATION

- Teacher: Review this "Activity Description", "The Species at Risk Act", and the "Student Questions and Answer Key".
- Students: during class time or as homework, students should read "The Species at Risk Act" in preparation for the final activity of Part One.

PART ONE

Materials required: Fish crackers, bowls, cups, one "Role Introduction" page per student

1. Decision-making processes (modified from Table Talk (DFO), page 828).

Many decision-making activities involve ranking items from a list based on personal experiences, values, commonsense and knowledge. The following ranking activities will allow students to discover decision-making processes, and will point out the differences and similarities between individual and shared decision-making in small and large groups.

A. Select a type of trip for the class: e.g., arctic exploration, astronaut on a mission, jungle safari, etc.

B. Write out the following list for all to see: shovel, rope, water, heat source, candy, tent, paper, radio, telephone, games, clock, compass, map, book, first aid kit, television, axe, oil, extra clothes, medicine, cutlery, boat, canned food, fresh fruit, vitamins, skateboard, insect repellent, matches, weapons, blanket, mattress, chainsaw, hammer, nails, juice, refrigerator, paper, seeds, pen, pencil, truck.

C. Individually, have students select the top 10 items from the list of items they deem essential to take along on the selected trip.

D. Pair students up. Have paired students compare their individual top 10 lists and compromise to create a new top-10 list they can both agree on.

E. Form groups of 5 or 6 students. Have each group of students collaboratively decide which top 10 items from the provided list they would want on their shared trip.

2. "Cooperative Fishing and the Tragedy of the Commons"

Using fish-shaped crackers, conduct the "Cooperative Fishing and the Tragedy of the Commons" activity (appended below). This activity will point out benefits of cooperative decision-making, the concept of sustainability, and resource overuse problems. During this activity, students are given the challenge of cooperating with their group to ensure they get the most "fish" in their cup. By trial and error, then by working cooperatively and strategizing, they will strive to get the most fish.

3. Role-playing

A. Assign each student the role of a person from a group that has an interest in the Sakinaw sockeye or its habitat: commercial fishers, recreational fishers, shoreline land owners, government representatives, conservationists, local business owners, etc.

B. Provide each student the "Role Introduction" page of the handout to complete describing their assumed role/character. The completion of this handout is in preparation for Part Two (below).

Cooperative Fishing and the Tragedy of the Commons

Learning Objectives:	Familiarity with concepts of the tragedy of the commons, free-rider problem, role of government and social rules in protecting the common good, sustainability, over-fishing and other resource overuse problems.
Materials:	One bowl for each 4 students and one cup for each student. Box of fish crackers.
How to Perform the Experiment:	First explain that there are 8 fish in each bowl and there will be two turns per round and several rounds per game. For each turn, each student can remove one fish or zero fish and put it in their cup. Once fish are taken from the bowl they cannot be put back. Explain that after the two turns, you will double the fish in the bowl and then there will be more turns where they can withdraw a fish, etc. Explain also that the object is to get the most fish in your cup and that at the end of the game only fish in your cup count. Explain that no fish are to be eaten during the game. For the first game I tell them there is to be no talking or other communication. At least some groups will deplete all their fish after the first round, but go ahead and play three rounds—they are just out of luck, but it is still good to emphasize the long term consequences of their "overfishing". They may try to put fish back in the bowl, but explain that the fish are already dead and therefore can't reproduce to make more fish. For the second game, I tell them they can talk for 30 seconds and then we will play another game in silence. Usually results improve somewhat. For the third game I tell them that they can create rules among themselves about how to play the game (but that the rules of the overall game cannot be changed). To enact the rules a majority must agree and then all must follow the rules.
Explanation of What's Happening:	This is an example of a tragedy of the commons where doing what is best individually does not lead to the best result in the long run. Optimally, students will remove one fish per round (forgo one of their two turns) and then each round their fish are replenished. But if everybody else follows this strategy, it still pays an individual not to. If 3 players take 1 and one player takes 2, then there are 3 left and they double to 6. Then if all take one, the "defecting" player ends up with 3 total compared to 2 total for the "cooperators". If the students know how many rounds will be played, then it makes sense to take all the fish on the last round, so leave the number of rounds ambiguous.
References (if applicable):	There are similar exercises I saw on the web. Search: "Tragedy of the commons" "fish crackers"

PART TWO

Materials required: one"The Species at Risk Act" document and "Decision-Making Chart" per student, "Student Questions and Answer Key", colour pens optional.

1. With the teacher, have students read over the pages titled "The Species at Risk Act" and "Sakinaw Lake Sockeye Backgrounder". Have students review the map of the Sakinaw Watershed (since the map will print in black and white, it may help to have students find the lake, its various inlets and outlet and highlight them in colour).

2. Provide students the "Decision-making Chart" page. Using the roles that they developed for themselves in the last part of the lesson ("Role Introduction"), have them individually fill out each section with their ideas around making decisions for the management of the Sakinaw sockeye species.

3. Using the "Roles Introduction" and "Decision-making Chart" pages, have students present or discuss their character's individual views about the the management options for Sakinaw sockeye (within the context of their interest group (i.e., land owners, business people, etc.).

4. Lead a discussion based on the "Student Questions and Answer Key".

5. Students will now use the decision-making and collaboration skills they learned from the last part of the lesson. Have students (in their character's roles) try to come to a group consensus on how to deal with the dwindling Sakinaw sockeye population. Ensure the interest groups the students represent speculate on the effect that local water concerns, development, and pollution will have given current population growth rates.

CONCLUSIONS OF LESSON PLAN

- The decision-making process is not an easy one; decisions agreeable to all parties may or may not be possible.
- Differing viewpoints have a large influence on decision-making.
- Decisions can have different impacts on a large variety of groups.
- Implementing a decision is the most difficult part.
- Regulation may or may not be effective in protecting an animal population.
- Mistakes may be made in managing animal populations; there is also often not enough data to determine what path to take for the best recovery effort.

THE SPECIES AT RISK ACT
Working together to Protect Aquatic Species

The Species at Risk Act (SARA) was created to protect wildlife species from becoming extinct in two ways:

- By providing for the recovery of species at risk due to human activity; and
- By ensuring through sound management that species of special concern don't become endangered or threatened.

The Act became law in June 2003. It includes prohibitions against killing, harming, harassing, capturing or taking species at risk.

A Collaborative Effort

Three government departments are directly involved in protecting species at risk: Environment Canada, Parks Canada, and Fisheries and Oceans Canada. Fisheries and Oceans is responsible for all aquatic species, freshwater and saltwater alike.

From the beginning, it was recognized that no single government, industry or community could protect Canadian species at risk on its own. Governments and stakeholder groups across Canada must all work together. In fact, SARA was designed to encourage such cooperation.

The good news is that everyone can help in some way: by knowing the species at risk and understanding why they're threatened (for example), or by taking steps to care for their habitat.

How Does A Species Get on the List?

Species are designated "at risk" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent body of experts that assesses wildlife according to a broad range of scientific data. The federal Cabinet then decides whether those species should get legal protection under the Act. These decisions are made after consultations with affected stakeholders and other groups.

Species Can Be Listed As:

- **Extinct**: no longer found anywhere on the planet.
- **Extirpated**: no longer in the wild in Canada, but existing in the wild elsewhere.
- **Endangered**: a wildlife species facing imminent extirpation or extinction.
- **Threatened**: likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
- **Special concern**: a wildlife species that may become a threatened or endangered species because of a combination of biological characteristics and identified threats.

More information about Species at Risk can be found at www.speciesatrisk.gc.ca

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SAKINAW LAKE SOCKEYE BACKGROUNDER

Sakinaw Lake is located in Pender Harbour on the Sunshine Coast in south-western British Columbia. There are ten lakes that feed into Sakinaw Lake, forming part of its watershed (see map). Its surface area is 8 km^2, and its average depth is 43 meters. The lake is unique in that the water in the deepest section of the lake (below 30 metres' depth) is salt, a remnant of geological times when there was a direct connection between Sakinaw Lake and the ocean. Scientists believe that after the kilometres-thick glaciers receded from the coast, the land rose and cut off the direct connection that Sakinaw Lake had with the sea. The deep salty area of the lake has oxygen levels of low to nil, making that part of the lake unusable for sockeye.

Sakinaw lake sockeye salmon (*Onchorhynchus nerka*) are a unique population due to the fact that they spawn specifically in Sakinaw Lake, and unlike other sockeye salmon (which spawn in rivers), they spawn on lake beaches and require beaches near creeks or ground water sources. These sockeye return to spawn earlier than most, and over a longer period of time, with an unusually long stay in the lake before spawning. The adult fish have a small body size in comparison to other adult sockeye. The smolts (fish ready to return to sea) are large in comparison to other sockeye smolts.

Although the Sakinaw sockeye reproduce only within Sakinaw Lake, it shares migration routes and feeding habitat in the Pacific Ocean with other sockeye salmon populations. The Sakinaw Lake sockeye are killed as direct catch in terminal fisheries (where this species is specifically targeted), but more significantly, as incidental catch in fisheries where they are not the target species. Sockeye salmon have generally declined in abundance in the southern parts of their range and no longer naturally occur in California.

In the early 1900, the lake was dammed at its outlet (Sakinaw creek) for log and water storage. In 1952, a permanent dam and fishway were built by Fisheries and Oceans near the lake outlet. This fishway is a structure that enables movement of fish past the dam, allowing spawners to return to the lake, and smolts to migrate to sea. The problem with this fishway was that fish were vulnerable to predation, most notably by river otters and seals, and also illegal fishing. High water temperatures of 22 – 24°C during adult salmon migration are a major stress factor (warm water has low oxygen levels).

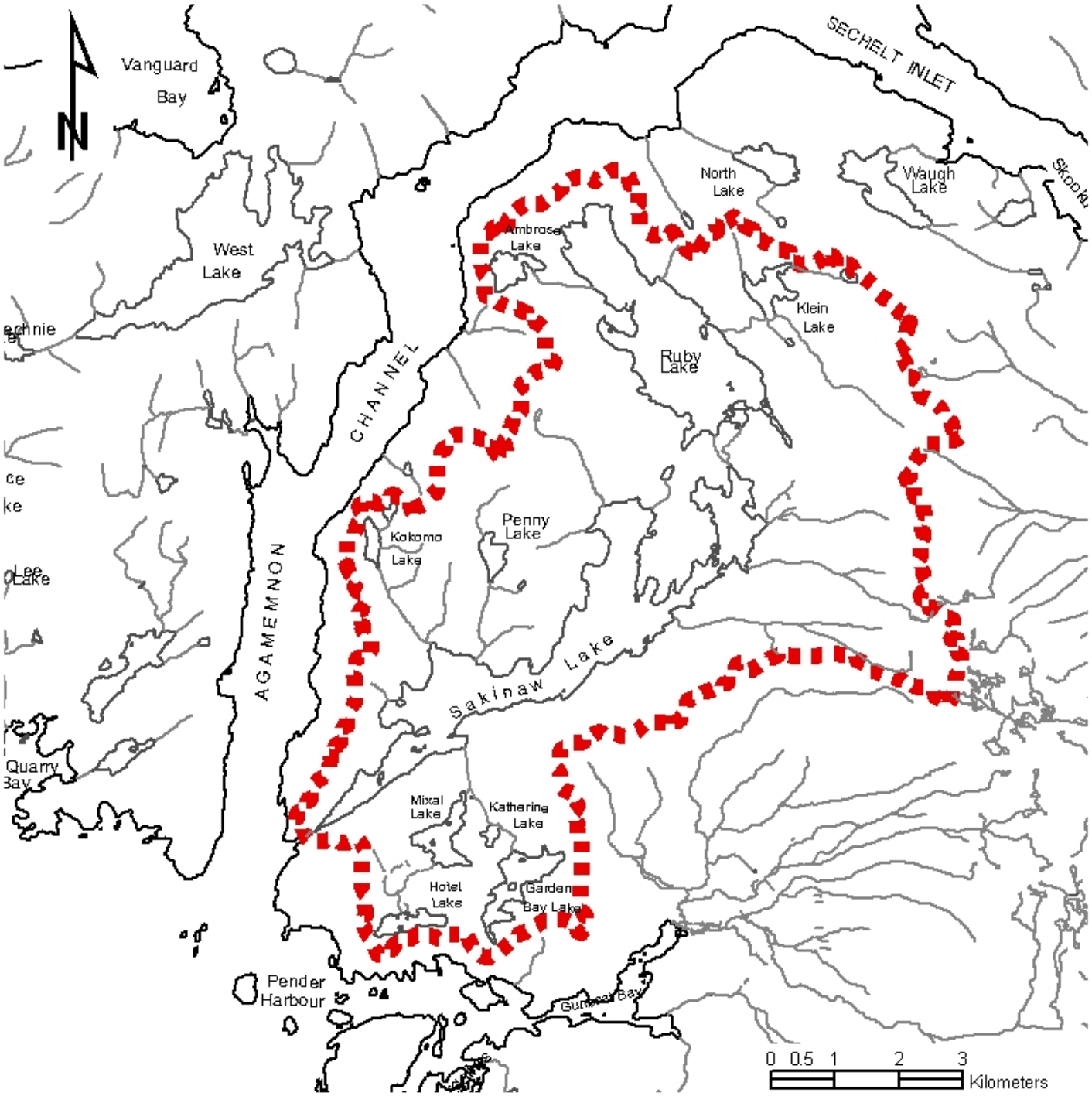
In 1995, passage to the fishway was improved by the installation of two large rock weirs below the fishway which created large pools in the creek. These pools reduced the height salmon needed to jump from 2 metres to 1 metre (reducing the height the fish have to jump helps reduce the stress to the fish). These pools also provide protection from predation and illegal fishing.

Recreational and residential development within the Sakinaw lake watershed has affected the water level and temperature. Feeder lakes and streams (e.g, Ruby Lake) provide warm water at lesser rates as demand for water increases. Domestic water useage contributes to low summer flows, which impedes adult salmon migration into the lake; without enough water to fill the fishway, salmon can not access the lake.

Although COSEWIC has recommended that the Sakinaw sockeye salmon be listed as "Endangered", to date the decision has been not to list this species.

References: (Committee on the Status of Endangered Wildlife in Canada -COSEWIC- Status Report on Sakinaw Lake Sockeye Salmon, Chris Wood, 2003, and pers. comm. with Grant McBain, Community Advisor, Fisheries and Oceans Canada).

MAP OF THE SAKINAW LAKE WATERSHED



Stream to Sea Secondary

Role Introduction

Real Name _____ Date _____

Assigned Group:	Role Name:	Age:	Sex:

Something Unusual About Me	Main Interests
(picture & key words, web, chart)	_____ _____ _____ _____ _____ _____ _____ _____ _____

At the Round Table (Why were you chosen to represent your group?)	My Pciture
_____ _____ _____ _____ _____ _____ _____ _____ _____	

On the back of this page, write down what you will say at Round Table 1 to introduce yourself to the other students.

Decision-making Chart

The issue

Your interests

What are your criteria?

What are some options?

Research each option

Select the best option

Evaluate

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STUDENT QUESTIONS AND ANSWER KEY

1. What factors can negatively affect the Sakinaw sockeye stocks?

- *Habitat degradation: increased use by power boats, water-skiers, and lakeside developments can cause erosion, disturbance of shorelines, diversion of streams, and fuel and septic tank pollution.*
- *Predation: natural predators can take fish from the fishway and its approaches.*
- *Poaching: People may poach fish when they are vulnerable in the fishway.*
- *Loss of spawning areas: water levels in Sakinaw Lake have dropped due to increased demand for water by local area residents; gravel shoreline spawning areas are being left above water line. Salmon are competing with people for water.*
- *Commercial ocean by-catch: Sakinaw sockeye are caught in commercial fisheries for other salmon species as they migrate with other salmon groups through the Johnstone and Georgia Straits.*
- *Stress from warm water: cold water can hold more dissolved oxygen than warm water; at warmer temperatures, salmon do not get enough oxygen.*
- *Barriers to migration: dams at the lake outlet for logging and water storage purposes and lowered water levels in the creek (due to high demand for water by local residents) connecting the lake to the sea hinders salmon's passage.*
- *Competition for food: from other fish species, food availability, water temperature*
- *Lack of cooperative management: The public, government, and environmental managers must coordinate their efforts to not further damage this species or its habitat.*

2. What could be done to mitigate or lessen the negative effects on the Sakinaw Sockeye stocks?

- *Policing and regulation;*
- *Habitat enhancement work;*
- *Reduction of water consumption;*
- *Limitation and careful planning of property development in Sakinaw watershed;*
- *Protection of Sakinaw sockeye run during ocean migration.*

3. What factors can shift management decisions away from benefiting a biome or species?

Management decisions can be influenced by many different things, not always resulting in what is best for a biome or species:

- *Economic pressures (e.g., businesses or industries closing);*
- *Interest groups that are effective at lobbying (i.e., taking a coordinated stance on a position);*
- *Politically-motivated decisions (from various levels of government);*
- *Ease of keeping things the same (it's hard to begin to see and do things differently);*
- *Social pressures (e.g., loss of jobs from a community).*

4. What effects might unchecked human population growth in the Sakinaw Lake watershed have on the Sakinaw sockeye?

- *Loss of spawning habitat;*
- *Loss of water;*
- *Increase in water temperatures;*
- *Increased predation;*
- *Increased pollution.*

5. What effect could the events at Sakinaw, human or natural, have on global environments and climate change?

- *Loss of species due to habitat loss;*
- *Competition for resources;*
- *Continued pollution will destroy habitat, increase disease, degrade quality of life for all living things.*
- *Climate change can be accelerated by people clearing areas of trees and vegetation, using fossil fuels, paving areas, etc.*

ADDITIONAL SUGGESTED DISCUSSION POINTS

- Adaptation of organisms to their biome (the Sakinaw sockeye and their unique adaptations for survival in Sakinaw Lake in the coastal rainforest; possible effects of human interference within the biome).
- Is there value in protecting endangered species?
- The implications of having a species listed as endangered are many. What factors influence management decisions (e.g., politics, economics, other)? In the case of the Sakinaw Lake sockeye salmon, there are economic, social, biological, and recreational impacts. The Fisheries and Oceans Ministerial decision not to list the species was based on socio-economic factors.
- The effect of the Fisheries and Oceans fishway (a corridor created to enable fish to pass a barrier) and the dam on Sakinaw Lake. The dam is now needed more than ever to handle reduced flows going into storage which is compounded by increased water use and global warming.
- Human impacts on the renewable and non-renewable resources of the Sakinaw area, i.e., Sakinaw Lake water usage, (not enough water passing through fishway for sockeye migrations), other species introduced to ecosystem, development along the shoreline and surrounding forests, etc.
- What happens to a resource if left unmanaged on local and global levels?
- Are there parallels between this local issue and the larger global scene?