

Hazardous Paths to the Columbia Gorge

Grade

9th–12th grade

Length

45–90 minutes

Subjects/strands

Ecology, biology

Topics

Natural-resource management, invasive species pathways

INTRODUCTION

Hazard Analysis and Critical Control Point (HACCP) planning is an important tool for managing harmful invasive species. HACCP planning engages students' critical thinking and logic skills to determine when and where to control the invasive species on its pathway of spread. This activity involves solving a puzzle: Students will use HACCP Planning logic to create a flow chart showing steps of electrofishing activities, how the activity can spread invasive species, and where invasive species can be controlled in that pathway.

LEARNING OBJECTIVES

Students will

- Learn about invasive species issues in the Columbia River Gorge.
- Learn about some pathways for invasive species spread.
- Learn about the science of electrofishing
- learn about the biology of a few aquatic invasive species and understand how the biology is related to their ability to spread.
- Use critical thinking and logic skills to determine when and where it is best to control invasive species.
- Unscramble an invasive species pathway puzzle and identify invasive species hazards on that pathway.

More information available from:

<http://haccp-nrm.org/Plans/NY/Electrof.pdf>

DESCRIPTION

Electrofishing is a natural-resource activity that could spread aquatic invasive species. Students will learn about electrofishing and then create a HACCP plan using all of the information pieces needed for a complete plan (steps in the management activity, potential contaminant species, and possible tools for

eliminating the hazard). “HACCP cards,” which are provided, show each step in the pathway, invasive species hazard, and control action on separate cards. Students will arrange the cards into a flow diagram that represents the steps in the electrofishing outing and inserts elements of a HACCP plan. Finally, students will apply their knowledge of HACCP planning to develop HACCP plans for other AIS pathways that apply to their own personal activities.

BACKGROUND

The way an invasive species is transported from one place to another is called an “invasion pathway.” For example, stocking a pond with fish from a hatchery may be a pathway for spreading Asian carps, if the water at the hatchery (drawn from a river) could be contaminated with the invasive carps. Many natural-resource management activities have the potential to spread invasive species. One way to slow the spread of invasive species is to eliminate their risk along the pathways. Natural-resource managers use the Hazard Analysis and Critical Control Point (HACCP) planning tool to identify when and how an invasive species should be removed from an invasion pathway. The “hazard” is the invasive species, and the “critical control point” is the place and time to remove the species from the pathway. For example, a fish hatchery HACCP plan might determine that the critical control point for the Asian carps (the hazard) occurs when the fish are loaded onto the distribution trucks, because this is the most efficient, effective, and strategic point in the invasion pathway for the species to be controlled. The HACCP planning process also includes determining ways or methods for removing the hazard (the invasive species). More information about HACCP is available from: <http://haccp-nrm.org/>

Hazardous Paths to the Columbia Gorge



What is electrofishing?

Electrofishing involves passing an electric current through the water to draw fish to the surface, where they can be captured alive in a dip net. Electrofishing is used as one technique by researchers and resource managers to determine fish populations in a specific water body. Electrofishing can be done with a specialized backpack or from a boat. When conducted from a specially equipped boat, a generator causes the metal boat to act as the cathode, which discharges electrons into the water. The electric current passes through the water and is picked up by positively charged wires (anodes) dangling from booms on the front of the boat. Fish within the current are stunned and orient in the direction of the current flow, swimming toward the anodes. The main purposes for electrofishing are stock assessment, sampling/health surveys, tagging, catching spawning fish, anesthetizing, or eliminating species. (Above image courtesy USFWS).

MATERIALS INCLUDED

All of these materials are available on MenaceToTheWest.org

- HACCP pathway, hazard, control, arrow, and stop-sign flow diagram or “puzzle” cards
- HACCP student pages
- PowerPoint presentation
- Asian carp video
- Fact cards on AIS (for reference)
- Answer sheet (see below)

MATERIALS NEEDED

- Computer with Internet connection
- LCD projector

VOCABULARY

Anode, Cathode, Critical Control Point, Electrofishing, Electron, HACCP (Hazardous Analysis and Critical Control Points), Hazard, Introduce, Introduced Species, Invasive Species, Monitor, Native Species, Pathway(s), Precautionary Principle, Risk, and Species

HACCP PATHWAY, HAZARD, AND CONTROL CARDS INCLUDE:

Task cards (one of each):

- 1 Boat, gear obtained from storage.
- 2 Crew and gear travel to sample location (lake or river).
- 3 Boat is launched into water.
- 4 Boat is driven to sample site(s); samples are collected.
- 5 Fish are kept or released; ept species are frozen or preserved.
- 6 Work is complete; boat is removed from water.
- 7 Crew and gear travel to a second lake or river.
- 8 Boat is launched into water.
- 9 Boat is driven to sample site(s); samples are collected
- 10 Fish are kept or released; kept species are frozen, preserved, or live; live specimens are kept in cooler or live-well.
- 11 Work is complete; boat is removed from water.
- 12 Crew and gear travel to boat storage/processing facility.
- 13 Boat and gear are stored.

Hazard cards (aquatic invasive species, or AIS) (seven copies each):

- 1 Vertebrates: red-eared slider turtle, Asian carps, bullfrogs.
- 2 Invertebrates: New Zealand mud snail, crayfish, zebra and quagga mussel adults and veligers.
- 3 Plants: hydrilla, Brazilian elodea, yellow flag iris, knotweed.

Control Cards:

- 1 Visually inspect dry boat, trailer, live-well, and gear; remove any materials that may transport AIS.
- 2 Inspect gear, boat, live-well, and coolers for remaining AIS, clean/disinfect if necessary.
- 3 No control necessary: Hazard controlled at previous/subsequent step (two copies).
- 4 Thoroughly clean or spray off the boat and trailer, to remove freshly attached materials. Rinse live-well/cooler; dip nets in disinfectant bath. Sign log.
- 5 Visually inspect catch and do not release AIS or unknown species (two copies).

PREPARATION

- Read and understand the Lesson Plan and the PowerPoint presentation. To familiarize yourself with HACCP planning, go to: <http://haccp-nrm.org/>
- Print out and/or photocopy and cut out the HACCP pathway, hazard, control cards, stop sign, and arrow cards. Use one set for every three to five students. You can also have your students cut out the cards.
- Make one copy of the student pages for each student.
- Follow the instructions and create a HACCP plan before teaching the lesson.

STEP-BY-STEP INSTRUCTIONS

Step 1: Introduction

- Use the PowerPoint presentation to review the topics of invasive species, invasive species issues specific to the Columbia Gorge, invasion pathways, electrofishing, and the HACCP planning tool.
- Watch the video about Asian carps.
- Introduce the topic of electrofishing and discuss how electrofishing may spread Asian carps and other aquatic invasive species. Record ideas on the board.

Step 2: Complete the HACCP Puzzle

- Divide students into groups and give each group a set of HACCP cards and the Fact Cards. Make sure to pass out the task cards to students in random order and assist them as they assemble the “puzzle.” Note that the pathway should lead them to launch the boat into two separate locations (lakes or rivers) throughout the exercise, although this can be reviewed at the end if students miss it.
- Ask students to create a flowchart for the invasion pathway by arranging the task cards in a logical order, connecting the tasks with arrows.

- Have students identify which tasks have the potential for invasive species to escape or be transported somewhere else. These tasks are where you can identify “critical control points.” Have students put critical control point or “stop sign” cards by these tasks.
- For each stop sign card, students list which category of invasive species (use hazard cards) may be spread and select the best control measure for that point. Students can use the Invasive Species Fact Cards as a reference at this point. Place the appropriate cards next to each stop sign.
- After each group has finished its flow chart, have them discuss which tasks they identified as critical control points, and why.

Step 3: Create your own HACCP Plan (optional homework assignment)

- Have each group select a new invasion pathway and create a HACCP plan by filling in the HACCP planning worksheet. This pathway could be any realistic example, such as recreating in a local waterway, hitchhikers in suitcases for international travel, classroom release of plants and animals, releasing unwanted pets or dumping an aquarium, etc.
- Note: This assignment involves creative thinking to determine the possible steps in each pathway and possible mechanisms for control. Students should be somewhat familiar with the species that could be spread at each step. Allow creative freedom in the possible steps and control methods for each pathway. To extend this assignment, ask students to research the pathway, species, and control methods.

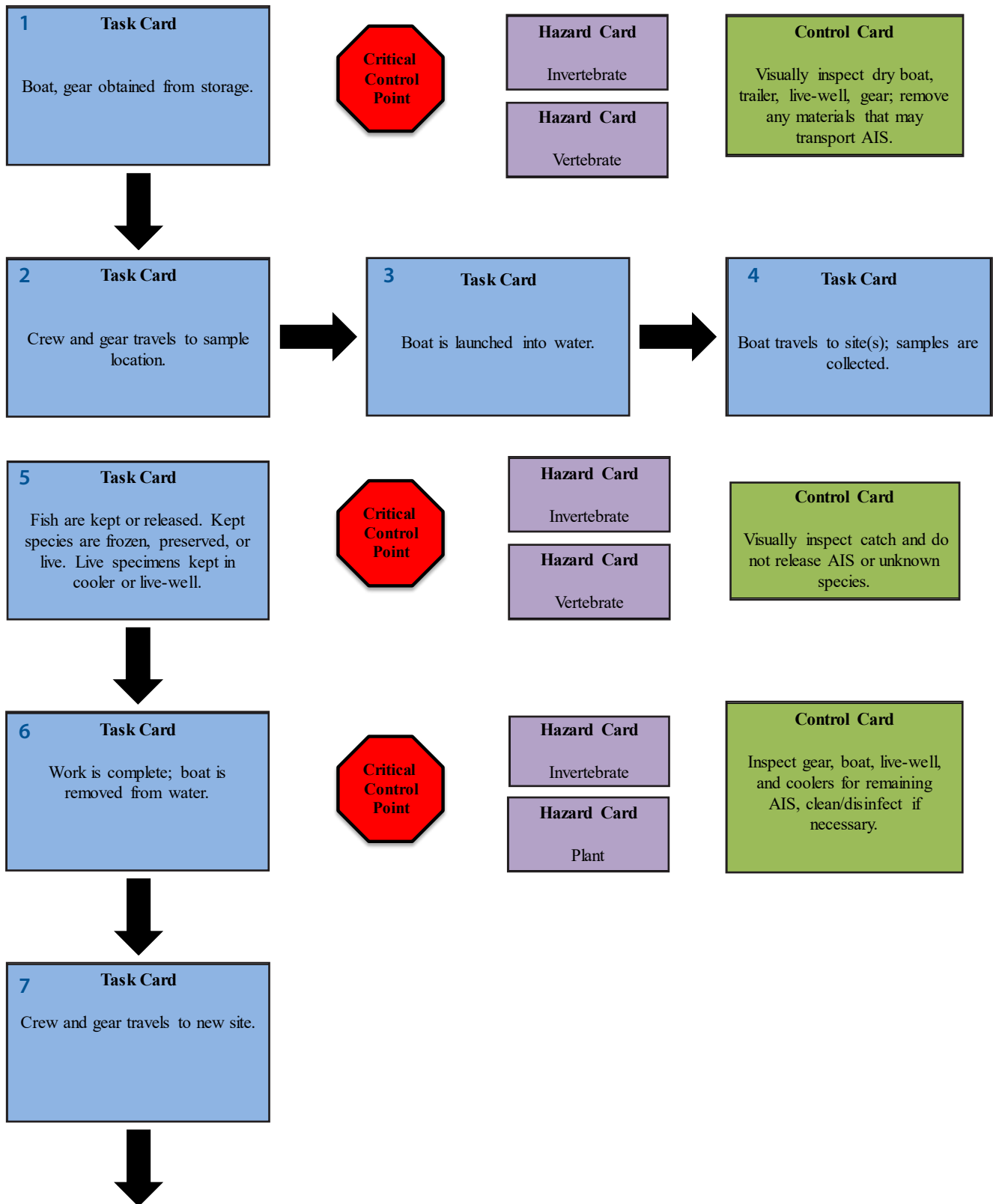
Step 4: Evaluate Students

- Use the following information to lead a closing discussion and/or discuss the conclusion and evaluation questions. Discuss answers to the conclusion and evaluation questions as a group, or assign the questions as homework.

Hazardous Paths to the Columbia Gorge

ANSWER KEY

The resulting flow chart should resemble the following:



Hazardous Paths to the Columbia Gorge

8 Task Card
Boat is launched into water.



Hazard Card
Invertebrate

Hazard Card
Plant

Control Card
No control necessary. Hazard controlled at previous/subsequent step.



9 Task Card
Boat travels to site(s); samples are collected.



10 Task Card
Fish are kept or released. Kept species are frozen, preserved, or live. Live specimens kept in cooler or live-well.



Hazard Card
Invertebrate

Hazard Card
Vertebrate

Control Card
Visually inspect catch and do not release AIS or unknown species.



11 Task Card
Work is complete; boat is removed from water.



Hazard Card
Invertebrate

Hazard Card
Plant

Control Card
Thoroughly clean or spray off the boat and trailer to remove freshly attached materials. Rinse live-well/cooler; dip nets in disinfectant bath. Sign log.



12 Task Card
Crew and gear travels to boat storage/ processing facility.



Hazard Card
Invertebrate

Hazard Card
Plant

Control Card
No control necessary. Hazard controlled at previous/subsequent step.



13 Task Card
Boat/ gear are stored.

Hazardous Paths to the Columbia Gorge

Step 5: Community Action Project

- Brainstorm with students how they can apply their knowledge of HACCP in their local community. Can students identify an invasive species pathway that goes through their own community. (For example, gardening, yard waste composting, moving firewood, aquarium releases, fishing, hiking and recreation). Is that pathway being addressed by their community? Could your class offer to develop a HACCP plan that could be used by a local organization or government? This is just one of many possible ideas. If you do a project with your class please let us know by going to MenaceToTheWest.org and click on Take Action.

FINAL DISCUSSION

Lead a discussion with the class that addresses the following question: What are unique features of invasive species that make them ideal for spreading into new environments? When taking into consideration the biology of an organism, what factors must you consider to determine whether it can be spread by an activity? What are the most logical steps in that activity for control? Focus the discussion on one or two species, such as the New Zealand mud snail and the zebra mussel. For example, Zebra mussel veligers are planktonic and not visible to the naked eye. Any time you transport water, you could transport the veligers. The adult mussels will colonize hard surfaces and can also survive outside the water for a few days. Whenever you transport an object that has been in contaminated water, you might spread the adult mussels.

Conclusion and evaluation

Have students answer the following questions (answers in parentheses) in a discussion or homework assignment.

6 What is an invasive species?

Nuisance or invasive species are plants, animals, and microbes that are not native to a given region and can negatively impact the environment, ecology, health, and economy.

7 What is an “invasion pathway”?

An invasion pathway is the route or mechanism that allows a species to be introduced into a new area. Pathways are created by human activities on the landscape.) (Example of an invasion pathway: The shipping industry moves species from one port to another through ballast water exchange.

8 What is Hazard Analysis and Critical Control Point Planning?

HACCP planning focuses attention on critical control points where potential AIS can be removed. Documenting risks and methods used to remove non-target species gives managers a strategic method to make consistent decisions based on identified risks. Planning builds a logical framework of information to weigh risks for species spread against management benefits.

9 What is the “hazard” in the HACCP plan?

The invasive species.

10 What is the “Critical Control Point” of a HACCP plan?

The step in the pathway where it is critical to remove a species.

11 In the electrofishing example, in how many steps was it possible to spread invasive species?

Seven.

12 How are the risks of electrofishing similar to other recreational fishing activities?

People move boats from one body of water to another. Recreational fishing boats may also have live-wells where invasive aquatic species could be transported from one body of water to another.

13 Is every step where it is possible to remove an invasive species always a critical control point? Why or why not?

No, an earlier step may be an easier or more economical time to remove the species. For example, it would be simpler to check a boat for invasive species when leaving a body of water and mitigate at the site of invasion, rather than when the boat is at the new site. This is because it would completely reduce the risk of spreading that invasive species throughout transportation and once at the new site.

- 14** How important is it to understand the biology of an organism in deciding when and how to control it on an invasion pathway?

Very important. The biology of the organisms will determine what conditions each life-stage needs to survive. If an activity involves contact with an invasive species and provides a way for the species to survive, that activity may help an invasive species to spread.

- 15** Do you have any activities (hobbies, work, transportation, school) that could spread invasive species? What would a HACCP plan for your activity look like?

Answers will vary.

- 16** What do you think you could do as an individual to help stop the spread of invasive species?

There are many possible answers; for example, take steps to stop the spread of invasive species and educate others about the biology and spread of the species so they can also take preventive action.

- 17** In electrofishing, an electrical field is created that causes the fish to be stunned and float to the surface. How is the electrical field created?

The electrical field is created when a generator causes a metal boat to act as a cathode and emit negatively charged electrons. Because positive and negative charges attract, these electrons are then attracted to the positively charged wires (the anodes) hanging from booms in the front of the boat. As the electrons travel, they create an electric field that stuns the fish and allows you to more easily count them.

VOCABULARY

- **Critical control point:** A specific point, procedure, or step in a plan that can be used to reduce, eliminate, or prevent potential hazards.
- **HACCP (Hazardous Analysis and Critical Control Points):** A systematic, preventive-planning approach to identify when and how an invasive species should be removed from an invasion pathway.
- **Hazard:** A danger or risk.
- **Introduce:** The intentional or unintentional process of releasing, or allowing to be released, a non-target species into an ecosystem, region, or specific geographical location where it is not native.
- **Introduced species:** Organism(s) that have been moved to a nonnative ecosystem or geographic area through human activity.
- **Monitor:** To observe and check the progress or quality of something over a period of time.
- **Native species:** A plant or animal species that naturally occurs in an area and has not been introduced from another area, state, or continent. Synonyms include indigenous species.
- **Pathway:** Natural and human connections that allow movement of species or their reproductive propagules from place to place.
- **Precautionary Principle:** The principle that the introduction of a new product or species whose ultimate effects are disputed or unknown should be resisted.
- **Risk:** A danger or hazard.
- **Species:** A group of organisms, all of which have a high degree of physical and genetic similarity, that can generally interbreed only among themselves and show persistent differences from members of allied species.
- **Electrofishing:** Electrofishing is a common scientific-survey method used to sample fish populations to determine abundance, density, and species composition. The method uses direct-current electricity flowing between a submerged cathode and anode. This affects the movement of the fish so that they swim toward the anode where they can be caught. When performed correctly, electrofishing results in no permanent harm to fish, which return to their natural state in as little as two minutes after being caught.
- **Anode:** The positively charged electrode by which electrons leave a device.
- **Cathode:** The negatively charged electrode by which electrons enter an electrical device.
- **Electron:** A stable subatomic particle with a negative charge, found in all atoms and acting as the primary carrier of electricity in solids.

Hazardous Paths to the Columbia Gorge

ADDITIONAL RESOURCES

Exploration Nation Electrofishing

This Exploration Nation video details the methods of electrofishing in easy-to-understand terms for all ages
<https://www.youtube.com/watch?v=9wJqwf66VxM>

HACCP: Managing Natural Resource Pathways

This informational page supported by the U.S. Fish and Wildlife Service details the importance of monitoring all pathways of natural resources and ensuring that non-target species are not transported when operating in the environment

<http://www.haccp-nrm.org/>

HACCP: Planning to Prevent the Spread of Invasive Species

This detailed training slideshow, created in partnership by NOAA and the U.S. Fish and Wildlife Service, can be used to educate students and teachers alike about the issues associated with intentional and unintentional dispersal of invasive species

<http://www.habitat.noaa.gov/pdf/HACCP%20Training%20Slides.pdf> <http://www.habitat.noaa.gov/pdf/HACCP%20Training%20Slides.pdf>

STANDARDS ADDRESSED

Common Core

Life Sciences (Grades 9–12)

- Ecosystems: Interactions, Energy, and Dynamics
HS-LS2-2, HS-LS2-6, HS-LS2-7

Earth and Space Sciences:

- Earth and Human Activity HS-ESS3-4

Next Generation Science Standards

Science and Technical Subjects (RST) (Grades 9-12)

- Research to Build and Present Knowledge 9-10.3, 9-10.7, 11-12.3

Writing (WHST) (Grades 9-12)

- Text Types and Purposes 9-10.2
- Production and Distribution of Writing 9-10.4, 11-12.2

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