

LESSON 3 Are Hawai'i's Wetlands Changing?

Lesson at a Glance

Students first discuss and brainstorm how changes in the land can impact the wetland environment and food chains. Then students read about the introduction of non-native organisms to the islands, and the effect these organisms have on the fragile ecosystems of Hawai'i. Students learn to identify several organisms that have altered the food chain of Hawai'i's coastal marshes. The class, together, diagrams the resulting food chain on the board. Students then compare the food chain they made in previous lessons with the current food chain. Lastly, students play a Wetland Predator and Prey game in which they take on the roles of native and non-native organisms.

Lesson Duration

Two 45-minute periods

Essential Question(s)

How has the size of Hawai'i's wetlands changed over time?

How has the food chain of Hawai'i's wetlands been affected by introduced species and human activity?

How have humans impacted wetland ecosystems?

Key Concepts

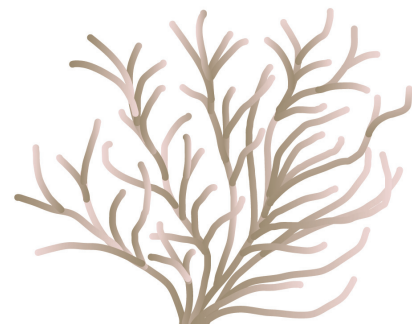
- In the last 150 years, Hawai'i's wetland areas have decreased in size and have been impacted by introduced organisms.
- Recent human activity, such as population growth and development, has changed the size of wetlands.
- Introduced organisms have altered or disrupted the food chain in the wetlands, causing several endemic organisms to now be endangered.
- Humans now take an active role in protecting endangered species and the remaining wetlands.

Instructional Objectives

- I can describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem.
- I can describe changes in Hawai'i's wetlands, including the effect of introduced species and human activity on interdependent relationships within a wetland ecosystem.

Related HCPSIII Benchmark(s):

Science SC.5.3.2
Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter.



Assessment Tools

Benchmark Rubric:

Topic		Interdependence	
Benchmark SC.5.3.2		Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Explain and give examples of how specific relationships among producers, consumers, and decomposers in an ecosystem affect the cycling of matter	Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycling of matter	Identify a few relationships between producers, consumers, or decomposers in an ecosystem in terms of the cycling of matter	Recall, with assistance, that matter cycles in an ecosystem among producers, consumers, and decomposers

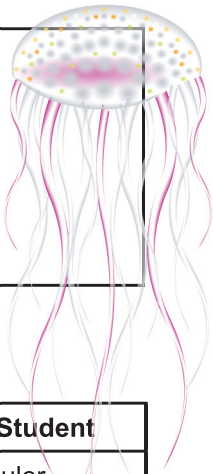
Assessment/Evidence Pieces

Lesson

- *Food Chain Comparison Worksheet*
- *Food Chain Self-Reflection*

Unit

- The wetlands concept map can be used as a monitoring device throughout the unit.



Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> • Whiteboard and markers • Computer with Internet access • Projector to show map and PowerPoint presentations 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Materials for illustrations • Copies of Student Worksheets (See Below) 	<ul style="list-style-type: none"> • Ruler



Instructional Resources

Teacher Reading: *Hawai‘i’s Changing Wetlands*

Student Reading: (Photos) *Modern Day Waikiki and Waikiki of the Past*

Student Reading: *Introducing Organisms to a Fragile Island*

Student Worksheet: *Food Chain Comparison*

Teacher Answer Key: *Food Chain Comparison*

Assessment Tool: *Food Chain Self-Reflection*

PowerPoint Presentations: *Wetland Habitat Loss and Disrupting A Delicate Ecosystem*

Student Vocabulary Words

area: the surface included within a specific space; a particular extent of space or surface within a closed boundary.

distance: the amount of separation between two objects or points.

endangered: a species whose continued existence is threatened with extinction.

introduced species: a species that is not native or indigenous to a given place or area and has been accidentally or deliberately transported to this new location by human activity.

native species: species that are naturally found in an area or habitat; not introduced by humans.

non-native species: synonymous with introduced species.

predator: a species that kills and consumes other organisms (their prey), primarily for food

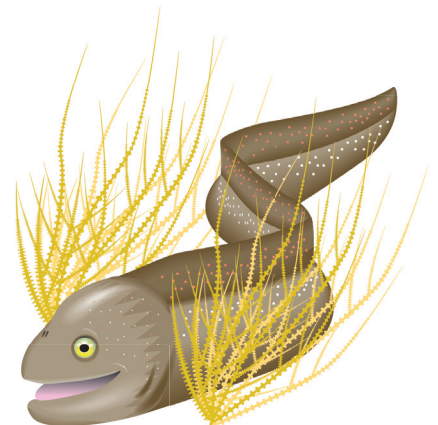
prey: an animal eaten by a predator as food.

Venn diagram: a graphic organizer tool used to show similarities and differences between two things.

Lesson Plan

Lesson Preparation

- Review the Science Background provided in the Unit Overview, and the Teacher Reading *Hawai‘i’s Changing Wetlands*.
- Prepare copies of the student readings *Modern Day Waikiki*, *Waikiki of the Past*, *Introducing Organisms to a Fragile Island* and worksheets *Food Chain Comparison* and *Self-Reflection*, one for each student.
- Preview the Student Reading *Introducing Organisms to a Fragile Island* and the *Food Chain Comparison Teacher Answer Key*. You may also wish to refer back to the Lesson 1 food chain information in the slideshow. Be prepared to diagram on the board the changed food chain as a result of the introduced organisms, especially the cats, rats, mongoose, cattle egret, pickleweed, and Plucheia.
- Preview and arrange to project the PowerPoint Presentations *Wetland Habitat Loss* and *Disrupting A Delicate Ecosystem*.



I. *Impact of Habitat Loss on Hawai'i's Wetlands*

- A. Distribute Student Readings *Modern-Day Waikiki* and *Waikiki of the Past*. Tell students that today they are going to learn about one of the things that impacts habitat loss of Hawai'i's wetlands. Show PowerPoint *Wetland Habitat Loss*. The notes on the bottom of the slide will guide the discussion. When you reach the second slide of the presentation have the students refer to the photos on the student reading sheets they were given. To orient students with the images conduct a brief discussion about some of the notable features. Point out the wetlands on the old *Waikiki* picture and the development, i.e. the Ala Wai Canal, in the modern *Waikiki* picture. This is mainly to show that Hawai'i has experienced a significant loss of wetlands. Discuss some of the positive and negative effects of the Ala Wai Canal or the loss of wetlands.
- B. Have students view a map of total wetland loss in the United States. Project from your computer to a screen or else have on at least one computer in the classroom letting students take turns viewing. The map is on the following website: http://www.epa.gov/owow/wetlands/vital/epa_media/usa.gif.
- C. After all students have had a chance to view the map of wetland loss, discuss with students how Hawai'i compares to other mainland states. Although Hawai'i's wetland loss is smaller than other states, explain that 12% loss of wetlands might have a bigger impact due to the fact that these are islands surrounded by ocean and coral reef.

II. *Introduced Organisms on a Fragile Island*

- A. Explain to students that they only have identified one way in which the wetlands have changed in recent history. Now, they will look at another way in which wetlands have changed. Show PowerPoint *Disrupting A Delicate Ecosystem*.
- B. Pass out the student reading: *Introducing Organisms to a Fragile Island*, and have the students take turns reading out loud. Ask students to circle each organism mentioned in the reading that is an *introduced* species as the class proceeds through the reading selection. After students have completed the reading have the class assist you in recreating a Wetland Food Chain like the one the class created in Lesson 1. Make sure that the class assists with labeling each organism as a producer, consumer, or decomposer (See student reading for food chain ideas.).
[Suggestion: You may want to use large sticky notes or tape and scratch paper so that parts of the food chain can be rearranged during the class discussion below.]
- C. Facilitate a discussion having students describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in relation to the carbon cycle.
- D. Ask students to help modify the Wetland Food Chain on the board because of *introduced* organisms. Encourage students to raise their hands and name one of the organisms they circled in the reading to this new food chain. As each new organism is added, discuss the effect it has on the other organisms.
[Suggestion: have students manipulate the sticky notes and/or add additional organisms during the discussion to demonstrate the impact of introduced species.]
- E. Pass out the *Food Chain Comparison* worksheet, and ask students to pull out their *Wetland Food Chain* worksheet from Lesson 1. Review the directions and explain that students are to compare the original *Wetland Food Chain* on their worksheet and the current *Wetland Food Chain* up on the board. Also encourage students to use information from the student reading. Collect worksheets for assessment.

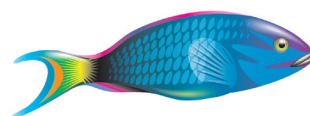
III. Wetlands Predator and Prey Game

- A. Before beginning the game have students review wetland organisms by referring to their *Wetland Food Chain* worksheet. Ask for a student volunteer to be an *introduced* predator (i.e., cat, rat, or mongoose). Tell the chosen student which *introduced* predator they will be during the game. Assign the rest of the class organisms from the *Wetland Food Chain* worksheet, using native consumers only.
- B. Once outside, gather students in a grassy area to play the Predator and Prey Wetland Game. Choose an area like a soccer field, using the width of the field. Cones may be needed to form boundaries. [Note: Please go over safety and rules for running games.]
- C. Have all students who are playing the role of a consumer line up on one side of the field. The student who is the *introduced* predator will stand in the middle of the field. When the teacher says, “A new predator has arrived. Look out!” The various wetland organisms (consumers) run across the field while the *introduced* predator attempts to tag as many consumers as possible. When the *introduced* predator tags the consumer organism it represents the consumer getting eaten so the tagged student(s) in each round will step out on the sideline by the teacher until the round is over.
- D. After each round, the teacher needs to reinforce that the *introduced* predator has consumed “X” number of consumer organisms and that, by eating these consumers, the *introduced* predator has now been able to reproduce. So the tagged consumer organisms, in order to stay in the game, will now represent additional members of the *introduced* predator (NOTE: Make sure students understand that, even though they started out as consumers, being eaten by a predator **does not turn** them into a predator.).
- E. Repeat until about half of your class has been eaten and now represents the *introduced* predator. Explain that, due to situations like the class just demonstrated, the state of Hawai‘i has created a wildlife sanctuary to protect the endemic and endangered organisms of the wetlands from the issues caused due to *introduced* predators.
- F. Let students know that, once sanctuary managers are aware of these *introduced* predators they then set traps and poisonous bait to get rid of them. Go back to the classroom and debrief on what students observed during the game.

IV. Assessment

NOTE: You may want to use the worksheets and class participation in the Wetlands Predator and Prey Game as assessment evidence.

- A. Hand out *Food Chain Self-Reflection* worksheet. Have students complete the worksheet independently.
- B. Have students add to their concept maps from Lesson 1 in a different color (You may want to have them include a color key to make it easier to monitor changes over time.).



Extended Activities

Science:

1. Take a field trip to a local coastal wetland. While there, have students investigate the presence of a food chain, and document that food chain with photographs taken with digital cameras and written notes. Create and show a class slideshow after the field trip to review the pictures taken.

Language Arts:

Have students make flash cards of the vocabulary words using their own definitions with graphic representations.

Technology Integration Ideas:

1. Sign up for time in your school computer lab, or facilitate use of your classroom computers to allow students to read additional information about the topics introduced in Lesson 3, such as Hawai'i's coastal marsh predators and the sanctuaries and refuges that have been established to protect endangered organisms.



LESSON 3 - Teacher Reading

Hawai‘i’s Changing Wetlands

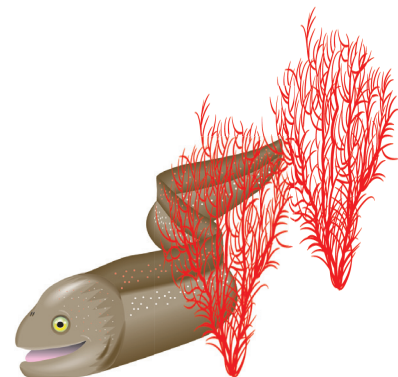
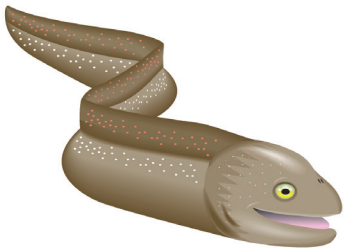
Human use of wetlands and of land surrounding the wetlands over the past two centuries has had a cumulative, negative impact on the ecosystem. As newcomers arrived and settled on the islands, they brought and (deliberately or accidentally) introduced many non-native organisms, such as pigs, rats, domestic ducks, and mosquitoes. Some introduced plant and animal species have drastically altered the food chain and the natural cycle of matter in the wetlands. In more recent history, residential and commercial development has encroached significantly on wetlands. Once, the islands had more than 52,000 acres of wetlands. The wetland acreage has decreased by 12% over the past century. As a result, birds endemic to Hawai‘i’s wetland habitats are now endangered, and regular flood damage has been recorded in urban areas that were once wetlands.

Fortunately, the decrease in wetland habitat has slowed. Today, humans play an important role in the preservation and maintenance of Hawai‘i’s wetlands. State and federal laws now protect from further development on wetlands. Additionally, there are now established state and federal wildlife refuges and sanctuaries that have helped the conservation effort. The three primary challenges of conservation efforts are to: 1) facilitate sufficient and clean water flow to the areas; 2) trap and remove mammal predators; and 3) eradicate invasive plant species. There are efforts across the state to restore former wetland areas, as well.

The following resources provide additional information:

Idaho Fish and Game. (2007). *What is a wetland?* Retrieved January 18, 2007, from <http://www.idahoptv.org/dialogue4kids/season6/wetlands/facts.cfm>

LET Academy. (2006). *How can we restore Hamakua marsh for native Hawaiian waterbirds?* Retrieved January 18, 2007, from <http://hamakuamarsh.com/mainmenu.htm>



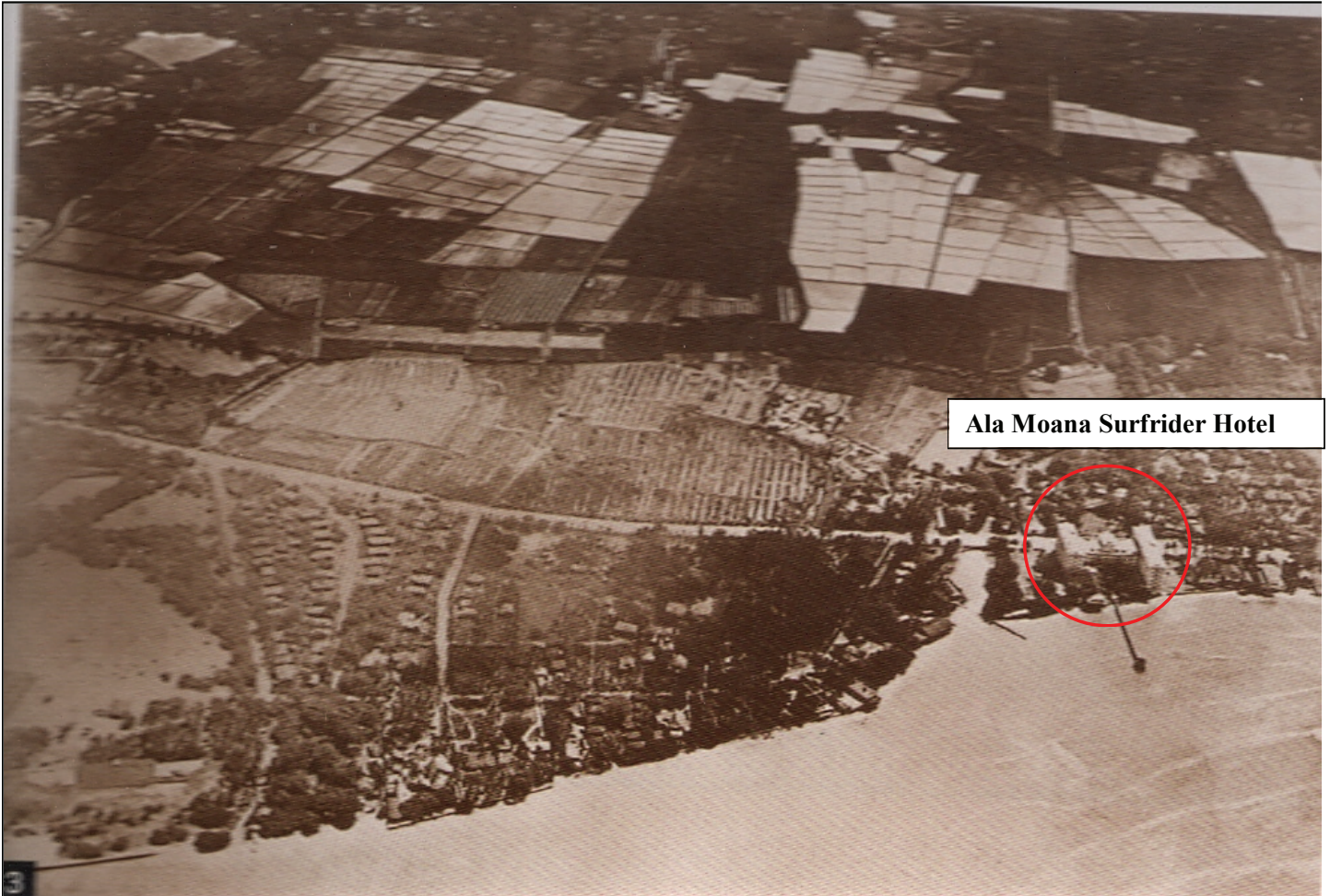
LESSON 3

Modern-Day Waikīkī



LESSON 3

Waikīkī of the Past



This picture taken before the completion of the Ala Wai Canal shows how the streams of *Mānoa* Valley watered the rice farms and taro *lo'i* of *Mō'ili'ili*, and the *Kālia* fishponds along the shore (on the extreme left). Image Source: Hawai'i State Archives

LESSON 3 - Student Reading

Introducing Organisms to a Fragile Island

Native

Native species in the islands arrive in one of three ways: 1) wind, 2) waves, or 3) wings, also referred to as *the three W's*. The wind carried seedlings and small insects a very long way until they reached Hawai'i. Some animals arrived via the waves by hitching rides on floating debris in the ocean. *Wings* refer to the birds that flew here and stayed, as well as the bird droppings that they brought with them. Bird droppings often have seedlings in them. These are the ways that Native species arrived here. For thousands of years, these plants and animals adapted to the island environments and learned to thrive. As a result, Hawai'i has thousands of species that are found nowhere else in the world. These are called *endemic* species. Hawai'i also has many native species that can also be found in other parts of the world. These are called *indigenous* species.

Endemic wetland species include:

Birds: *Ae'o* (Hawaiian Stilt*), *Ala'e'ula* (Hawaiian Moorhen*), *Alae ke'oke'o* (Hawaiian Coot*), *Koloa* (Hawaiian Duck*).

Fish and Shellfish: *O'opu naniha* (goby) and *o'opu 'akupa*.

Insects: Dragonfly and Damselfly (33 endemic species).

Plants: Hawaiian seagrass.

*endangered

Native wetland species include:

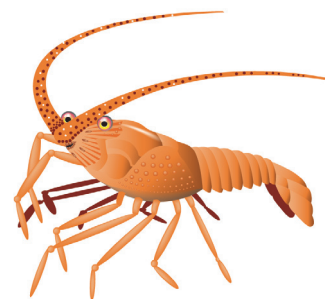
Birds: Black crowned night heron.

Migratory birds: *Kolea* (Pacific Golden Plover), *Hunakai* (Sanderling), and more.

Fish and Shellfish: *Opae 'oeha'a* (shrimp) *opae huna*, and *opae 'ula* (shrimp in anchiline ponds), *Aholehole*.

Plants: *Uki* (saw grass), *Makaloa* (smooth flatsedge), *Aki-aki grass*, *'Akulihuli* (sea purslane).

Insect: true bugs and beetles (19 species).



Non-native

Non-native species, also called introduced species, arrived because humans brought them here, intentionally and, sometimes, unintentionally. For example, the Polynesians that first arrived here brought many plants and animals, such as taro and pig. More recently, introduced plants and animals have been brought unintentionally through human activities like ocean shipping and airline cargo.

Non-native (introduced) wetland species include:

Birds: Cattle Egret.

Mammals: Rats, Mice, Cats, Pig, Mongoose.

Amphibians: North American bullfrog, Cane Toad.

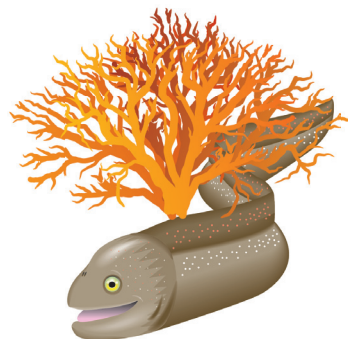
Fish and marine invertebrates: Tilapia (10 spp.) Asian clam.

Insect: Mosquitoes, flies (although there are some native spp.).

Plants: Common Cattail (native to Africa and N. America), Papyrus (native to Africa), Guinea grass (introduced 1871), California Grass (introduced 1924 0-1100m elevation), Mangroves (invasive: first introduced to *Molokai* 1902), Taro/Kalo (introduced but not invasive).

Fragile Island

The balance of all the native species in the islands is fragile. This means that the introduction of a new species could very quickly change things here. For instance, when the mongoose and rat were introduced in Hawai'i, the effects were devastating. Both of these animals became predators of native birds' eggs and chicks. As a result, many native birds are either extinct, or endangered. Other insects, like the gall wasp, and other plants, such as miconia, are having similar types of negative effects on native organisms. With so many people, airplanes, and ships coming to the islands, it is difficult to prevent more unintentional organisms from arriving that could do damage. Non-native species that become well-established and end up dominating a particular habitat are sometimes called *invasive* species.

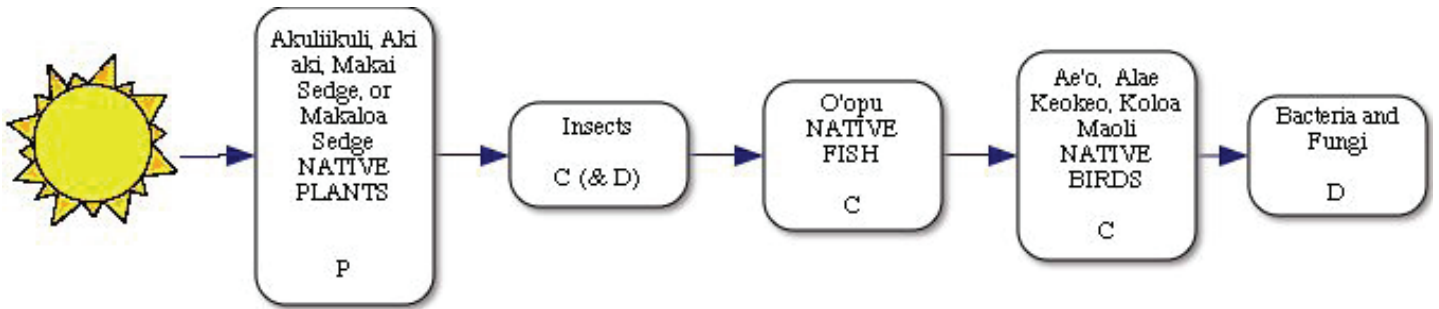


LESSON 3

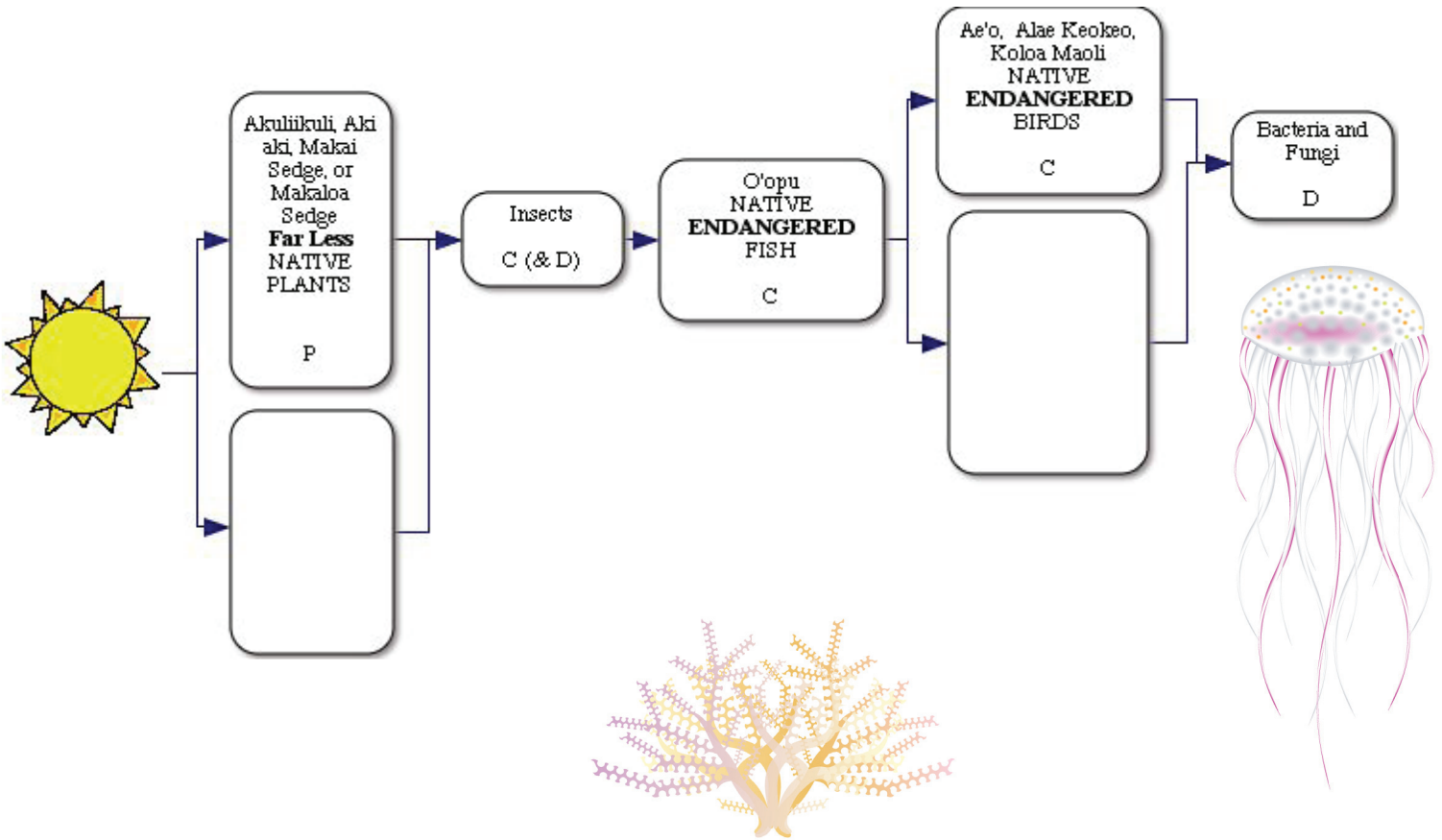
Name: _____ Date: _____

Food Chain Comparison

1. Review the Coastal Marsh Food Chain that you developed in Lesson 3 (A sample is below).



2. Fill in the blanks for the following Coastal Marsh Food Chain that includes the invasive species found in Hawai'i (See the front of the classroom, or your teacher, for the information needed here.).



3. Compare the two food chains above.

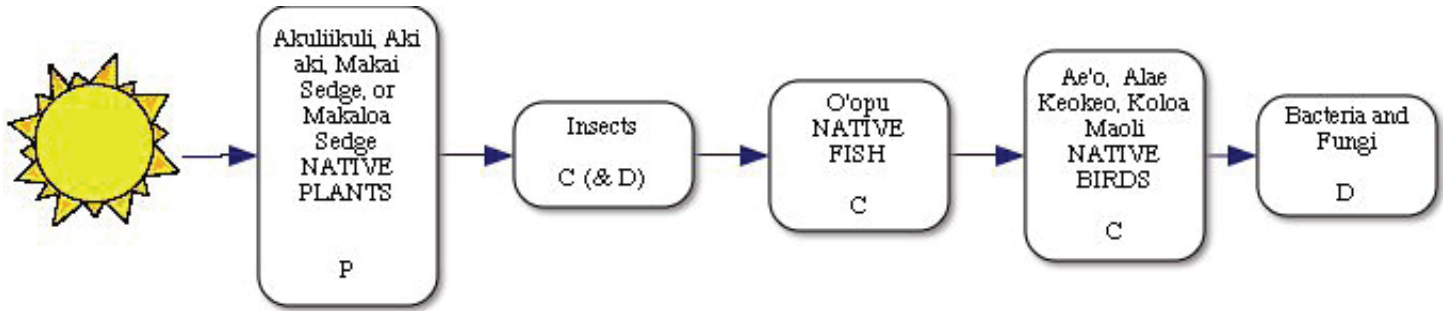
Draw at least two conclusions, and write each conclusion using complete sentences.

**4. How are the animals in the food chain interdependent?**

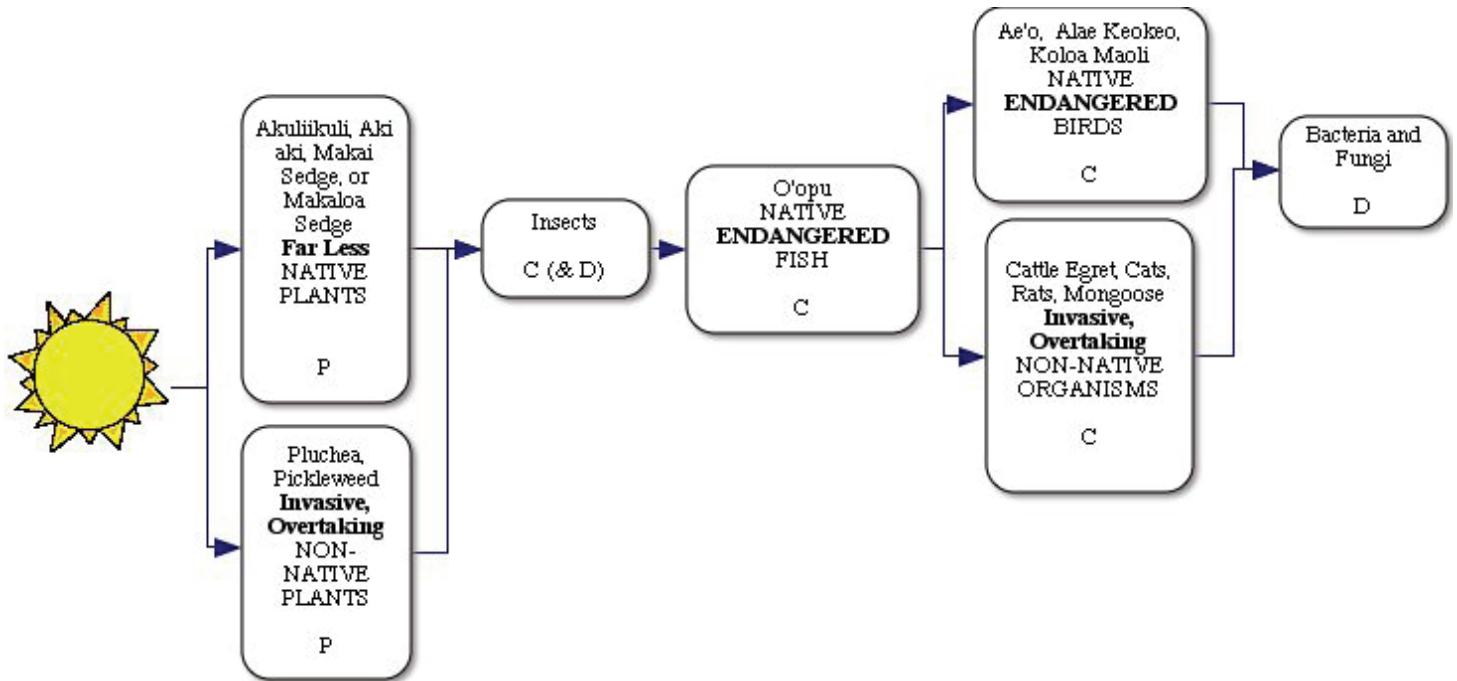
LESSON 3 - Teacher Answer Key

Food Chain Comparison (Possible Responses)

1. Review the Coastal Marsh Food Chain that you developed in Lesson 2. It should look something like this:



2. Fill in the blanks for the following Coastal Marsh Food Chain that is the more current situation in Hawai'i (See the front of the classroom, or your teacher, for the information needed here.).



3. Compare the two food chains above (on previous page). Draw at least two conclusions, and write each conclusion using complete sentences.

Examples:

Conclusion 1:

The introduction of non-native organisms seems to have caused some native birds to become endangered.

Conclusion 2:

The introduction of non-native plants seems to have reduced the amount of native plants.



LESSON 3

Food Chain Self-Reflection

Name: _____ Date: _____

Check the appropriate column with an X below.

Benchmark	I can	Almost	Not yet	Evidence (list where someone could find evidence of your meeting the expectation.)
I can describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem.				



Reflections:

Describe the changes in Hawaiian wetlands, including the effect of introduced species and human activity on interdependent relationships within this wetland ecosystem.

