A TEACHER'S GUIDE TO HAWAIIAN BIRDS

A COMPANION TO EDUCATIONAL POSTERS:
FOREST BIRDS OF HAWAIʻI and
OPEN COUNTRY AND WETLAND BIRDS OF HAWAIʻI

PRODUCED BY
HAWAIʻI DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE

GLOSSARY

Adaptation: A change in plant or animal that increases its chances for survival.
Adaptive radiation: Extensive speciation from a common ancestral population.
Alien: In the text, this refers to plants or animals that were introduced to Hawai‘i by people.
Asymmetrical: When corresponding parts, such as the upper and lower beak of a bird, exhibit differences in size, shape, or relative position. This is seen in the crossed beak of the Hawai‘i Akepa.
‘Aumakua: Household or personal god in Hawaiian culture.
Degrade: To reduce in quality or value.
Disharmonic biota: A flora and fauna lacking many of the plants and animals found on continents. (Many plants and animals that one might expect to find in a continental environment did not reach Hawai‘i due to the islands extreme isolation.)
Diurnal: The name given to creatures active during the day.
Drepanids: Classification of birds that feed primarily on nectar, the Hawaiian honeycreepers are in this group.
Endangered species: Government agencies list a species as endangered (under the Endangered Species Act) when it is threatened with extinction in the foreseeable future.
Endemic: Native to a particular place and found nowhere else.
Extinct: A species that no longer exists.
Fall-out: When seabirds become tired, disoriented and fall to the ground due to an unnatural attraction to bright, man-made lights. Example: Newell’s Shearwater.
Fledge: The point at which a young bird has grown enough to begin to fly. A fledgling is the name for these young birds.
Glean: To gather (drepanids often glean nectar from ‘ōhi‘a blossoms for food.)
Habitat: The place where a plant or animal lives and, which provides all they need to survive.
Indigenous: Native to a particular place, but also found elsewhere (Many of Hawai‘i’s seabirds are indigenous; they arrived here without human assistance, but they also occur in other areas.)
Insectivorous: An animal that feeds primarily on insects.
Invertebrate: Lacking a spinal column. Example: Insects
Lobed: In this context, feet that have reduced or no webbing.
Microclimate: A distinct climate found in a small or confined area.
Migrate: To move from one region or climate to another (for birds this is for feeding or breeding.)
Mutation: Changes that occur at the genetic level in an organism.
Native: In Hawai‘i, this term refers to plants and animals that arrived here without human assistance.
Niche: The function or ecological roll of an organism within its particular environment or community.
Nocturnal: The name given to creatures active during the night.
Plumage: Feathers on a bird.
Population: The number of animals of one species that live in a specific place.
Predation: The act of one animal consuming another as food.
Raptor: A bird of prey. Hawai‘i has two native raptors, the Pueo and the ‘Io.
Seabird: A bird that frequents the open ocean, coming ashore to roost and nest.
Specialized: Habits developed to make use of a specific element of a habitat that other animals do not. This can lead to a survival advantage in isolated island environments to avoid competition for a finite resource.
Speciation: Evolution of a new species.
Species: A population of plants or animals that cannot or will not interbreed with related populations.
Threatened species: Government agencies will designate a species as threatened (under the Endangered Species Act) if it is likely to become endangered in the foreseeable future.
Vertebrate: Animals with a spinal column.
Webbing: A membrane or fold of skin connecting toes. This characteristic is seen on many waterbirds.

*This Glossary may also be used as an accompaniment to the **Forest Birds of Hawai‘i** and **Open Country and Wetland Birds of Hawai‘i** Posters.

A TEACHER'S GUIDE TO ENDANGERED BIRDS OF HAWAI'I

Published by the Department of Land and Natural Resources
Division of Forestry & Wildlife

Hawai'i is home to a diverse array of beautiful birds that occur nowhere else on Earth. It is believed that fewer than 20 species of birds are the ancestors of Hawai'i's native bird species. The original colonists that made it to Hawai'i's isolated shores probably arrived bedraggled and exhausted after being blown off course in a storm. The descendants of successful pioneers developed adaptations for their new environment and some evolved into entirely new bird species. These new species are endemic, that is unique to Hawai'i. From the original colonists, more than 100 species of birds are known to have evolved on the islands before the first people arrived.

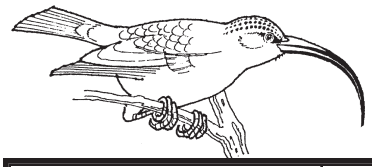
When the Polynesians arrived in the islands they cleared the lowlands for agriculture. This was the first of many impacts people would have on the environment as they sought to meet their needs for survival. Changes to the land were accelerated after the arrival of Captain Cook in 1778. The introduction of animals such as cattle, goats and sheep, and the ten-year kapu that was placed on hunting them in 1794, led to overgrazing and severe impacts on native forests.

The overgrazed slopes were replanted with trees and shrubs beginning in the 1880's. Trees were brought in from all over the world, but many of the native birds found the newly planted forests to be unsuitable habitat. As a result of the introduction of plants and animals, and the large-scale clearing of land, populations of native birds began to decline.

Of the more than 140 native breeding species and subspecies present prior to the colonization of the islands by humans, more than half have been lost to extinction. Among the remaining 71 endemic species, 30 are federally listed as endangered, and fifteen of these are literally on the brink of extinction, numbering fewer than 500 individuals. There are more birds now threatened with extinction in Hawai'i than in any other place of comparable land size on Earth. Factors such as avian diseases, competition from introduced birds, and the spread of introduced plants and animals are threatening the survival of native bird species. Human population growth and the economic pressures of development continue to place a strain on the islands' native ecosystems. In the last 20 years more than 40,000 acres of native forests have been cleared. The fact that Hawai'i tops the list for number of endangered bird species in the United States is an indication that we have much to lose if present efforts to save endangered species are not successful.

Government agencies, such as the Hawai'i Department of Land and Natural Resources and The U.S. Fish and Wildlife Service, are working to protect endangered species. These agencies are concerned with conserving the essential habitat of each species and managing the habitat to control predators and introduced plants and animals. Private agencies, such as the Nature Conservancy of Hawai'i, and public-private partnerships such as Watershed Partnerships also play a key role in conservation programs.

As part of our rich natural heritage, the native birds of Hawai'i can be a fascinating topic of study. By exciting your students' curiosity to learn more about these birds, you may open the door to a new opportunity for discovering more about the diverse and colorful wildlife that Hawai'i has to offer. The activities presented in this guide are designed to raise students' awareness so that as concerned citizens they may help to prevent further loss of Hawai'i's unique and endangered bird species.



CREATURE FEATURE

Grades 3-5

OBJECTIVE	Students will use inferring, art, writing, and communication skills to: • Determine why some of Hawai'i's birds are endangered. • Communicate information about endangered species to others.
KEY CONCEPT	Endangered bird species have declined due to loss of habitat, disease, predation, and introduced plants and animals.
MATERIALS	clear contact paper, colored markers, and scissors
VOCABULARY	endangered species, endemic, habitat, predation, threatened species
SUBJECT AREAS	science, language arts
2005 HAWAI'I STATE CONTENT STANDARDS	
STANDARD	BENCHMARK
3.5.1	Describe the relationship between structure and function in organisms.
4.2.1	Describe how the use of technology has influenced the economy, demography, and environment of Hawaii. (complete section 3)
4.3.2	Describe how an organism's behavior is determined by its environment. (complete section 2)
4.5.3	Describe how different organisms need specific environmental conditions to survive (achieved by comprehension of sections 2 and 3, grade 4 extension)
5.1.2	Formulate and defend conclusions based on evidence (achieved by completing the grade 5 extension, see below)

OVERVIEW: This activity introduces students to the unique and endangered birds of Hawai'i by a regularly scheduled "Creature Feature" highlighting a different bird each week, or every couple of days, depending on time available. Students will add color to the bird pictures provided, cut them out and wear them as stickers. By celebrating the uniqueness of Hawai'i's native birds, students will become familiar with endangered species. Building on that awareness, they may choose to take action by raising the awareness of others in the school.

The bird illustrations provided for this activity were chosen to represent an endangered bird from each of the main islands and to provide a variety of colors and bill shapes. However, other birds could be featured by referring to the references listed at the end of this guide. (Note: fact sheets for each of the birds included on the Forest Bird's of Hawai'i poster are available from the Department of Land and Natural Resources on the Division of Forestry and Wildlife's website: www.dofaw.net. Follow the link to Hawai'i's Comprehensive Wildlife Conservation Strategy- Species of Greatest Conservation Need)

PROCEDURE:

1) Copy the "creature features" (pages 4 & 5) onto heavy paper and cut them into strips.

2) Set up a "creature feature" area in the classroom with a picture of one of the endangered birds (included with this activity) placed in a prominent spot, perhaps within a bright star on a bulletin board. Cover the area with a cloth so that you can create some fanfare around the unveiling of each week's feature and excite students' curiosity to learn more about the unique and beautiful birds of Hawai'i. You may also want to use construction paper to cover areas of information about the bird. On separate sheets of paper, write the following questions: Where do I live?; What do I eat?; Why am I endangered? Using the information provided on the fact sheets write answers to these questions and

staple them to the bulletin board. Cover the answers with the question sheets; attaching them so that they flip up to reveal the answers.

3) As you introduce each creature, give students hints to help them answer the questions about the bird's distribution, diet, and decline. Such as, I am found on the biggest island in the Hawaiian Islands; my food comes from the forest; and people have introduced some animals that have disturbed my habitat. Use the information provided on the fact sheets to relate some of the bird's life history to your students. Make a list on the blackboard to summarize the reasons for the bird's decline: a) loss of habitat due to man's encroachment, b) disease, c) predation by other animals such as rats, mongooses, and cats, and d) habitat disturbances by introduced animals such as pigs, goats, and cattle.

4) Ask students what they might do to help others become aware of Hawai'i's endangered birds. Suggest that they make "creature feature" stickers to wear around the school.

5) Distribute copies of the illustration of the bird to be featured so that students may make them into stickers. They should cut them out, compose a slogan or message, and write it on the sticker. Possible slogans: "Endangered means there's still time", "Save Hawai'i's endangered birds", "Mālama our endangered birds" or "Endangered!"

6) Provide two strips of clear contact paper to place over the birds once they have been colored. One strip of contact paper should be used to protect and strengthen the colored side of the bird and the other should be stapled sticky side up on the back of the bird to make the sticker.

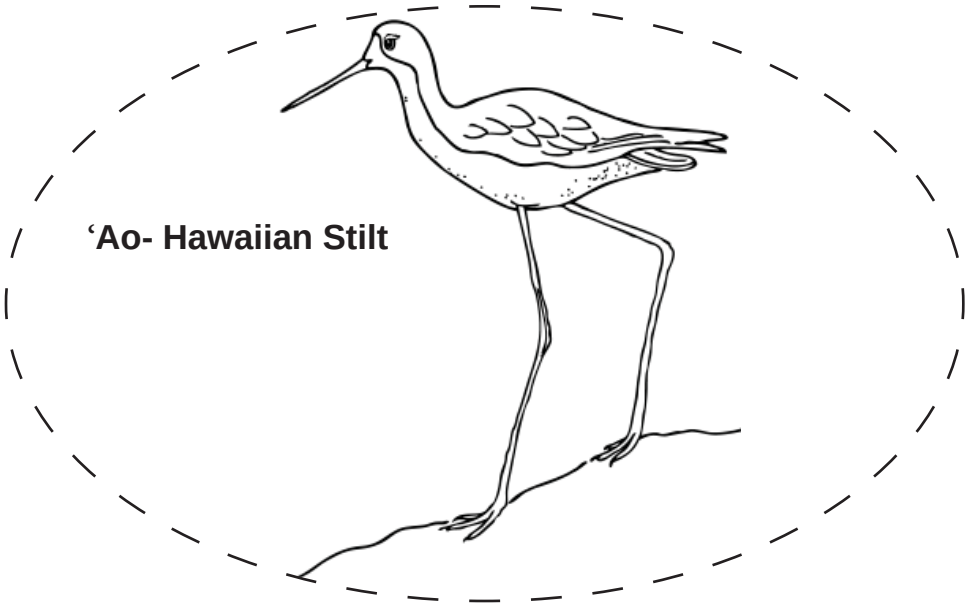
7) Students could wear the stickers around the school for a day and keep track of the number of students who ask them about the bird featured on their sticker. They should make written notes of the responses they receive from other students as they inform them about their sticker. After recess or lunch initiate a class discussion about the value of making others aware of the plight of Hawai'i's birds.

EXTENSIONS:
Creature Feature booklets composed of the stickers and information students write about each bird and their experience wearing the sticker would provide a good follow-up to this activity.

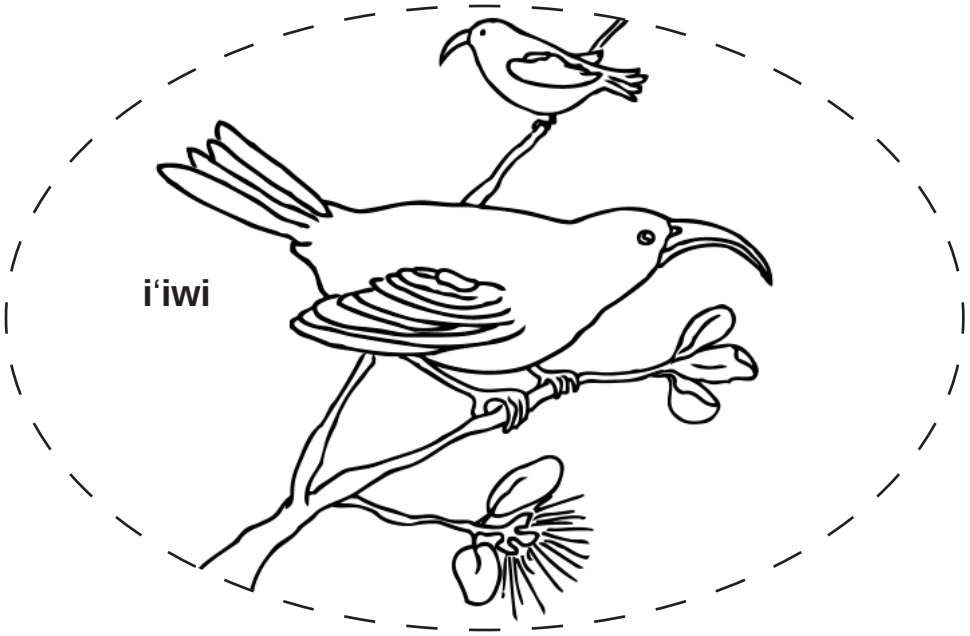
Grade 3 students could solve the riddles presented in the next activity and compose riddles about introduced birds found in the area around the school. Distinguish between introduced and endemic birds.

Grade 4: To cover Standard 4.5.3, advanced students could explain why different organisms need different environmental conditions to survive (e.g. ocean fish need salt water and fresh water fish will not survive in salty conditions) Then, students can more specifically explain the reasons behind why forest birds and open country birds need the conditions they live in to survive. To narrow the scope, students could focus on one type of endangered bird from one of the two posters and detail how and why it became endangered.

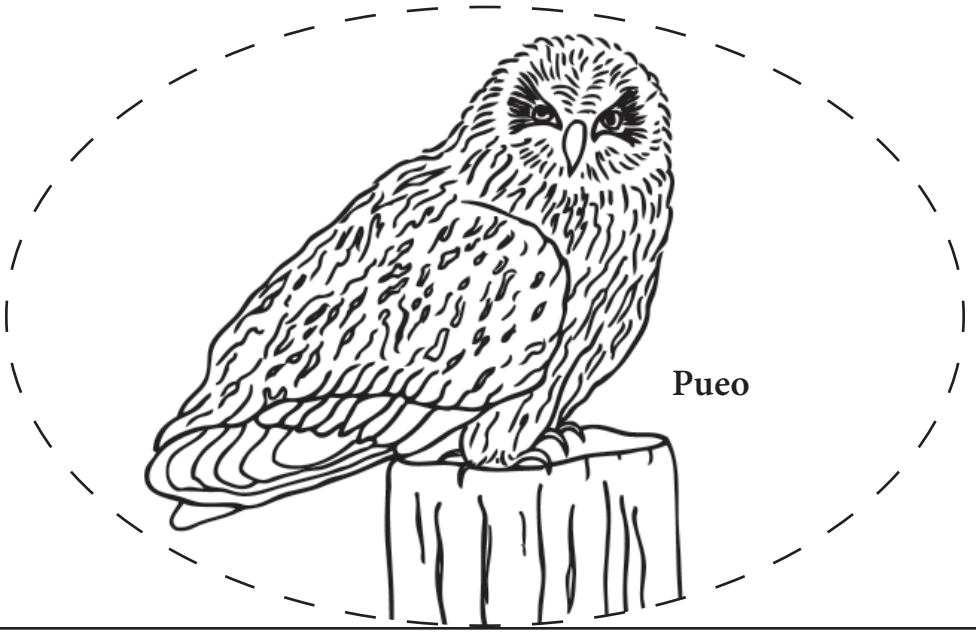
Grade 5: To address the Benchmark for Standard 5.1.2, students could choose one of Hawai'i's unique honeycreepers and give a more in-depth report on the birds specific habits and conditions (forest type, eating habits, adaptations -beak, feet, coloration, etc.) that have assisted in the successful continuation of their species. Students could also discuss how these conditions have altered over time and what this means for the future of the birds. For extra credit, the students could go further and offer some suggestions on how to mitigate negative impacts on these bird species.



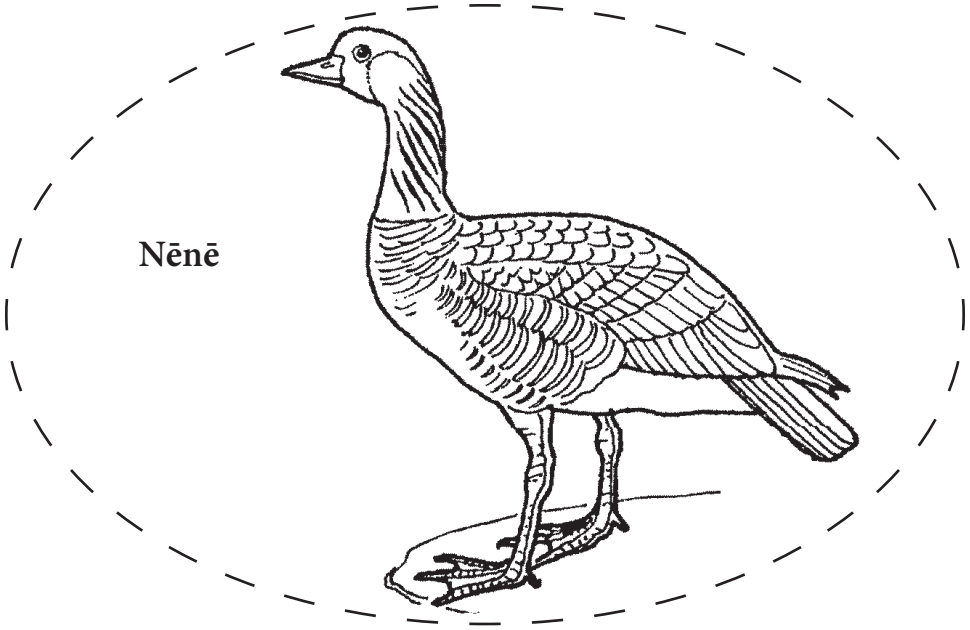
ʻAo- Hawaiian Stilt



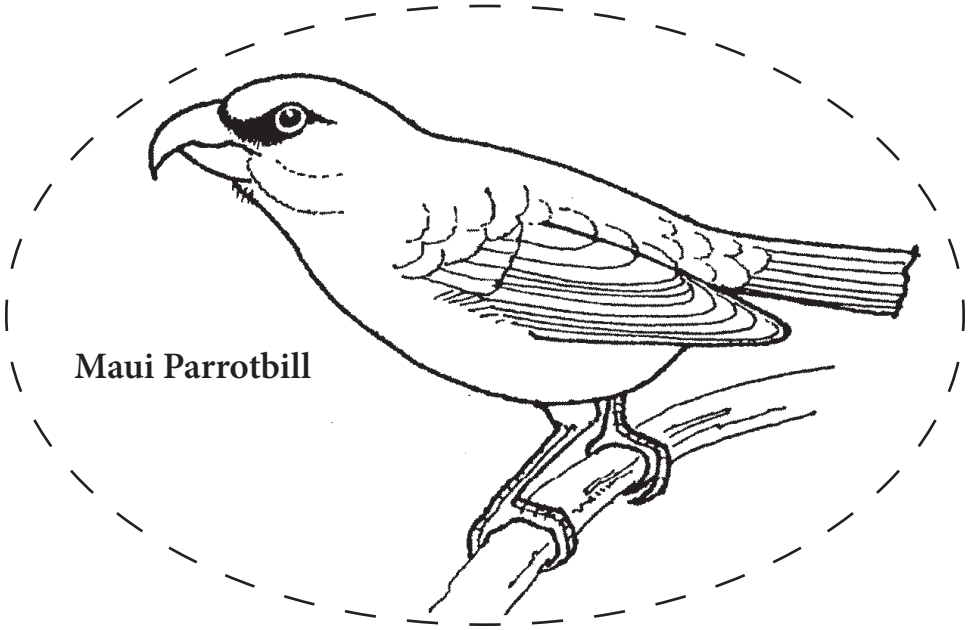
iʻiwi



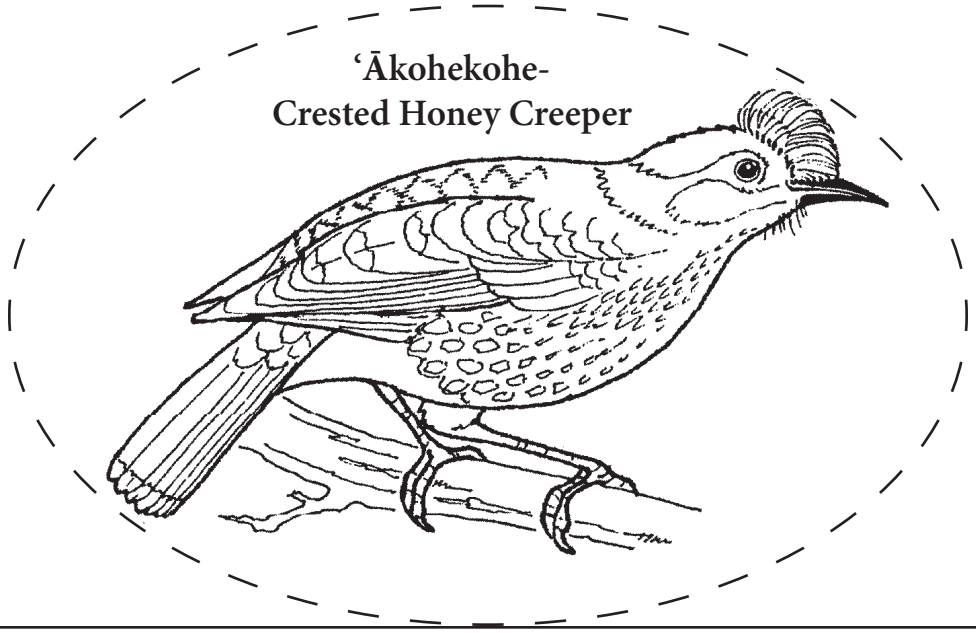
Pueo



Nēnē



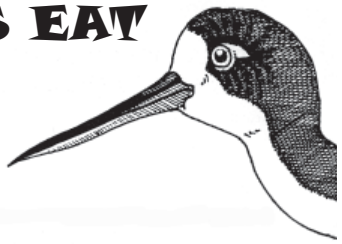
Maui Parrotbill

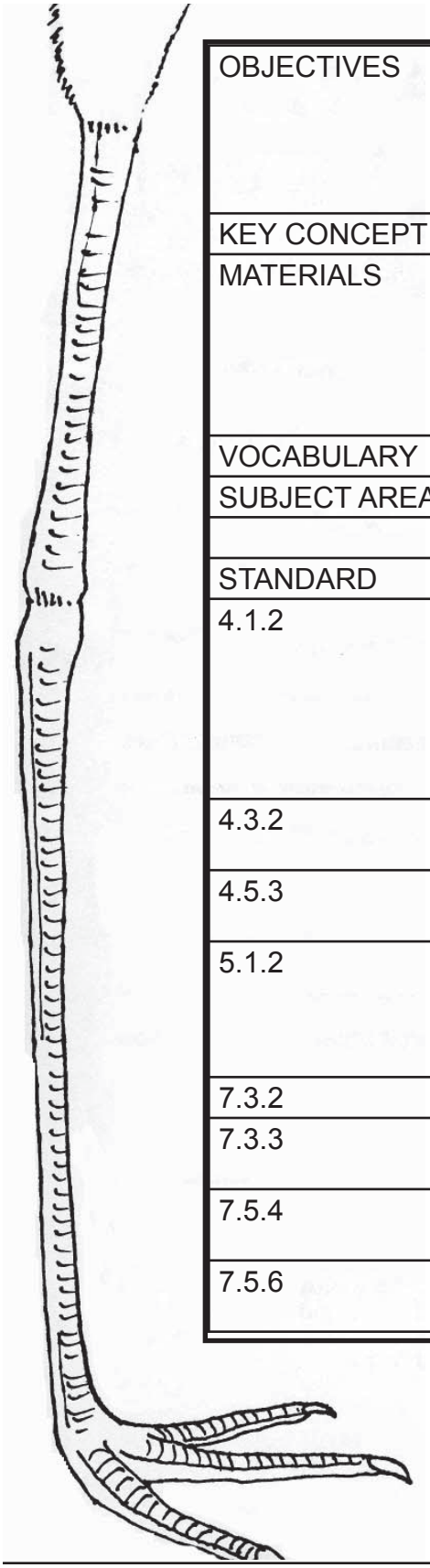


ʻĀkohekohe-
Crested Honey Creeper

BILLS AND FEET AND WHAT BIRDS EAT

Grades 4,5,7





OBJECTIVES	Students will use deductive reasoning, observing and writing skills to: • Observe and describe how birds' bills and feet are adaptations for obtaining food. • Compare the advantages of having a bill suited to obtain a specialized diet versus a bill suited to eating a generalized diet .
KEY CONCEPT	The bills and feet of birds are adapted for obtaining various foods.
MATERIALS	a nutcracker, a straw* or eyedropper, needle-nose pliers, a pair of chopsticks with pointed ends, a few hard-shelled nuts, a beaker of water, a few dried peas or beans, and a couple of tiny dried shrimp [adaptations sheet provided] *DO not use straws in the demonstration if any of the foods are small enough to be inhaled.
VOCABULARY	Adaptation, adaptive radiation, mandible, specialized
SUBJECT AREAS	science, language arts
2005 HAWAIʻI STATE CONTENT STANDARDS	
STANDARD	BENCHMARK
4.1.2	Differentiate between an observation and an inference (Sections 4-6: Students should do a bit of research to observe the bird's food(s) of choice and infer why the beak is shaped the way it is. For example – The iʻiwi drinks the nectar of ʻōhiʻa and tubular flowers. Over time, it has evolved to have a curved beak and it fills a niche other species cannot.)
4.3.2	Describe how an organism's behavior is affected by its environment. (e.g. courting, nesting, feeding patterns) (Section 1)
4.5.3	Describe how different organisms need specific environmental conditions to survive. (Section 6)
5.1.2	Formulate and defend conclusions based on evidence (Sections 4–6. Students can work on the exercises determining bird foot and beak type and how the form and function of these parts correspond to their common environment.)
7.3.2	Explain the interaction and dependence of organisms on one another.
7.3.3	Explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem.
7.5.4	Analyze how organisms' body structures contribute to their ability to survive and reproduce.
7.5.6	Explain why variation(s) in a species's gene pool contributed to its survival in a constantly changing environment.

OVERVIEW: Students play a matching game using simulated beaks to attempt to "eat" a variety of foods. They then match illustrations of birds' beaks and feet to the birds' food sources by determining how the bills and feet are adapted for obtaining various foods.

BACKGROUND: The bills and feet of birds are adaptations to various habitats. The bills allow different species of birds to obtain particular foods and the feet are adapted for grasping branches or wading in water where the food source is found. It is interesting to note that one of the more common species of Hawaiian honeycreeper, the 'Amakihi, is the most adaptable. This bird eats insects, nectar, and fruit and frequents rain forests as well as dry māmane-naio forests on Mauna Kea- two widely different habitat types. Most of the Hawaiian birds with highly specialized bills are either rare or extinct. Scientists are not certain how much the overly-specialized bills and specific food needs have contributed to the extinction of these birds, particularly since so many other factors, such as disease, may have contributed to the birds' demise. Yet, it has been hypothesized that overspecialization in feeding habits and bill structure may have made them more vulnerable to decline following habitat degradation by people.

PROCEDURE:

1) Ask four students to volunteer to be birds and give each a "beak". If possible, involve more students by taking turns with the beaks or by providing more beaks for groups of students to use. The beaks, a nutcracker, needle-nose pliers, a straw, and a pair of chopsticks are suited for eating the following foods:

"BEAK"	USED FOR…
nutcracker	Breaking open hard-shelled nuts.
needle-nose pliers	Probing for small insects in bark (Use dried peas or beans to simulate insects.)
straw	Sipping nectar (A beaker of water could simulate nectar.)
pair of chopsticks	Probing for tiny insects or shrimp in the mud (Use tiny dried shrimp.)

2) The volunteer birds should attempt to "eat" the foods and determine which food can be obtained with their beaks.

3) When the birds have found their food source, discuss the suitability of each bill for obtaining food. Which bills are most versatile? For instance, the needle-nose pliers "beak" could eat both the shrimp and the peas or beans. Could it be used to sip nectar? If a bird's habitat were disturbed, which bird would have a better chance for survival, a bird with a bill suited to only one food source, or a bird with a bill suited to obtaining a variety of foods?

4) Distribute the student activity sheet and ask students to match the bills and feet of the birds to their food source.

5) Discuss their answers and compare the simulated beaks to the actual bills of some of the endangered birds on the student activity sheet.

- The nutcracker could be compared to the palila's beak, which is used for cracking open māmane seedpods.
- The i'iwi feeds on 'ōhi'a and lobelia nectar, and the straw could be used to make a very rough comparison; note that it also feeds on insect larvae.
- The Hawaiian Stilt uses its long bill to probe in the mud for its diet, which includes crustaceans. The chopsticks could be compared to its bill.
- The needle-nose pliers could similarly be compared to the bill of the 'amakihi that is suited to eat-

ing a variety of foods including insects, nectar, and fruit. Note that the ‘amakihi is not endangered.
- The unusual bill of the ‘akiapōlā‘au is adapted for obtaining insect larvae from trees. The lower part of its bill (the mandible) is used for pecking; the upper mandible is used for probing.

6) Ask students to think about how the feet of each bird might be adapted to suit its environment and feeding habits. The feet of the palila, the i‘iwi, and the ‘amakihi wrap around small branches, which helps to hold the birds in place. The feet of the ‘akiapōlā’au are adapted to grasping the surface of larger branches which balances the bird as it pecks for food. The feet and long legs of the Hawaiian Stilt are suited to wading in water in search of food. Ask students to imagine some of these birds switching roles. For example, a Stilt perched on a small branch sipping nectar and a palila probing in the mud.

7) The students should take home the activity sheets and compare the adaptations to those they observe in birds in their neighborhoods. They should make a written report of their observations and share them with the class on the following day. What did they notice birds eating? How were the bills and feet suited to obtain these foods?

EXTENSIONS:

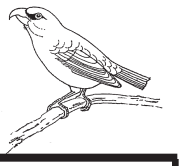
Grade 4:
4.5.3 Explain and give examples of how other organisms need specific environmental conditions to survive.
1) Have students pick out three organisms native to Hawai‘i (refer to list from the Comprehensive Wildlife Conservation Strategy- page 27 of this guidebook.)
2) Next, students will list for each species environmental conditions the organisms need to survive. Research on the web or in encyclopedias would add to the activity- if time and resources allow. This will help students start to establish fundamental inquiry skills necessary later in school.
3) Have students write/present to the class or a peer why different organisms need specific conditions for survival.

Grade 5:
5.1.2 Formulate and defend conclusions based on evidence.
1) Have students pick one bird that is on the poster but was not explained in detail in class.
2) Students should, using what they’ve learned, note the reasons why this bird has the beak and feet they do. Students should answer what environmental conditions could have possibly contributed to the evolution of the chosen bird’s beak and foot type. Teacher’s example: Pueo. This bird is a raptor, or a bird of prey. Their attributes include a beak that is sturdy with a pointed tip. This helps them feed on the rodents they catch. The tip is narrow which helps them gather insects. Their feet and toes are separated with long talons, which aid in catching and holding live prey as well as holding onto branches of trees.

Grade 7:
7.5.4: Analyze how organisms’ body structures contribute to their ability to survive and reproduce.
1) Have students research the term adaptive radiation and apply it to Hawaiian honeycreepers in a sentence.
2) After discussing the proper definition of adaptive radiation, students should write a paragraph on the following: If the honeycreepers are all from a common ancestor, why have they developed specialized beaks? Select one of the five groups found in “If unique is what you seek” and explain why and how their beaks have adapted to accommodate their food choice.

ENDEMIC BIRDS: RIDDLES & RESEARCH

Grades 4-7



OBJECTIVES	Students will use reading comprehension, writing, mapping and creative arts skills to: • Distinguish between endemic, indigenous, and alien birds. • Conduct research to determine which endangered and alien birds are found on each of the main Hawaiian Islands. • Create a map/mural depicting the location of endangered birds, in Hawai'i.
KEY CONCEPT	Endangered bird species differ from island to island and they are not as widely distributed as alien birds.
MATERIALS	student riddle sheet [provided], map of the Hawaiian Islands, large sheet of blue paper, green construction paper, and colored markers
VOCABULARY	endangered, endemic, indigenous, alien
SUBJECT AREAS	science, social studies, language arts, art
2005 HAWAI'I STATE CONTENT STANDARDS	
STANDARD	BENCHMARK
4.1.2	Differentiate between an observation and an inference (Sections 2 and 6)
4.2.1	Describe how the use of technology has influenced the economy, demography, and environment of Hawai'i. (Section 6 – during the discussion of conclusions the students have formulated by following the exercise in section 6, expand to discuss how technology, demography, and environment affect endemic bird numbers and extinction rate.)
4.3.2	Describe how an organism's behavior is determined by its environment- *e.g. courting, nesting, feeding patterns*. (Section 4 – Discuss how introduction of alien birds and habitat modification affects endemic bird behavior- Example: Newell's Shearwaters are attracted to the bright lights of civilization causing disorientation and fall-out- see Soaring Seabirds)
4.5.3	Describe how different organisms need specific environmental conditions to survive (Section 6)
5.1.2	Formulate and defend conclusions based on evidence (Section 5 – students can, when putting their islands up on the map, articulate conclusions based on evidence acquired through their library research on endemic birds. This helps meet all four rubrics for this standard.)
6.1.2	Explain how technology has an impact on society and science. (Section 5 – see suggested extension if desired)
7.1.3	Explain the need to revise conclusions and explanations based on new scientific evidence. (Sections 5 and 6)
7.3.2	Explain the interaction and dependence of organisms on one another. (Sections 4 – 6)
7.3.3	Explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem (Sections 4-6: Example: The more alien species there are competing with endemic birds, the less food and habitat there is available for all species. This results in intense competition for resources. Native Hawaiian birds, which have often evolved into specialized niches in the absence of such competition, often fail to compete. Most alien bird species have faced competition, so they often succeed where natives fail.)

OVERVIEW: Students will review information from the previous activity by solving riddles describing the habitat and description of some of Hawai'i's endangered birds. Older students not exposed to the previous activity could work in groups to solve the riddles by conducting research and using fact sheets[1]. The information obtained from students' research, combined with that presented in the riddles, will be incorporated into a large map/mural of the islands depicting which endangered birds are found on each island. Students will also make lists of alien birds found on each island and compare their findings.

BACKGROUND: Hawai'i's endangered birds range from sea level to above the tree line in the sub alpine zone of Mauna Loa and Mauna Kea where the Hawaiian Petrel makes its nests. Our endangered forest birds usually have narrow ranges, which correspond to their requirements for native forest habitat. Most of the endangered birds now occupy a small fraction of their historic ranges. Changes to their habitat by the direct and indirect actions of people are largely responsible for the decline of so many of Hawai'i's native birds. The alien or introduced birds occupy a much wider range since the more widely available introduced plants provide them with suitable habitat.

PROCEDURE:

1) Challenge students to solve the riddles provided as a follow-up to the "creature feature" presentation. Either read the riddles to your students or distribute copies of them for students to solve individually.

2) As you review the information presented in the riddles, ask students to determine (***observe***) what all of the birds have in common. They are all endangered and endemic to Hawai'i. Distinguish between endemic, indigenous, and alien species.

3) Divide students into 5 groups to represent: (a) Hawai'i, (b) Maui, (c) Moloka'i and Lāna'i (d) O'ahu, and (&) Kaua'i.

4) Each "island group" should divide the following tasks:

- Conduct library research to determine which birds are endangered on their island[1] and discuss the reasons. Students should cite evidence from their research to support their conclusions.
- Make a list of alien or introduced birds found on the island.
- Draw a small picture (or trace one) of each of the endangered birds, label it with the bird's name and cut it out.
- Draw an outline of their island on construction paper and cut it out to be used in the creation of a map. (Have students make these roughly in proportion to one another.)

5) As each group presents their island's endangered birds, they could place their island on the map. It will become more of a mural as they staple or glue the endangered birds around each island. When a bird is found on more than one island, draw a line from the bird to the islands it inhabits.

6) Ask each group to list the alien birds found on their island. Then have groups compare their lists. Are the alien birds found on more than one island? Which of these birds have students observed outdoors? What conclusions can they draw (***infer***) about the distribution of endangered birds vs the distribution of introduced birds? Note that the endangered forest birds occupy narrow ranges that correspond to the location of our dwindling native forests and that waterbirds are dependent upon wetlands. The protection of these dwindling habitats is crucial to the survival of Hawai'i's endangered birds.

7) The mural could be placed in a central location in the school to arouse the interest and concern of

other students. It should be titled to attract attention to the fact that these birds occur nowhere else on Earth! As part of Hawai'i's rich and colorful natural heritage, these endangered birds will benefit from a sense of caring or stewardship on the part of all our citizens.

[1] Note references listed at back of this guide. Hawai'i's Birds, by the Hawai'i Audubon Society, is a concise reference for students to use. It includes color photos of the birds and indicates which are endangered with a red-circled E at the top of a page. The Atlas of Hawai'i, second edition, is also a good reference. On page 78 are maps of each island color-coded by vegetation type and a key to many of the birds found on each island. The most complete and up-to-date reference is the Hawai'i comprehensive Wildlife Conservation Strategy (CWCS), which includes fact sheets about each native bird. These can be accessed on the web at: www.dofaw.net (look for the link to CWCS and Species of Greatest Conservation Need.)

ENDEMIC BIRDS: RIDDLES

1) The webbing is reduced between my toes to help me walk on lava flows. My ancestors were more likely to swim, but it won't be water you'll find me in. I am the State bird of Hawai'i. Who am I?

2) My thick bill can make branches crunch and the larvae inside make a tasty lunch. My habitat is on the Valley Isle where koa forests were my home for awhile. But crops and cattle have taken their place, so 'ōhi'a forests are my only living space. Who am I?

3) My legs are long to assist me in wading. I dig in the mud with my long beak to catch my prey. Crustaceans and insects are among my favorite treats. I am easy to spot with my pretty pink legs and feet. Who am I?

4) My mainland cousins are nocturnal, but since I can be seen during the day that makes me diurnal. I like to eat mice and other small mammals. These were brought here by humans and I came here after. Who am I?

5) My long curved beak is great for sippin'. You will often see me fly from tree to tree, my beak a dippin'. 'Ōhi'a nectar is one of my favorites to drink as my other favorite has gone extinct. Who am I?

Answers: 1) Nēnē. 2) Maui Parrotbill. 3)Hawaiian Stilt 4) Pueo 5) I'iwi

EXTENSIONS:
Grade 4:
4.1.2 – Read the riddles and infer what birds have in common for section 2.
1) After working on section 6, have students complete research to compare the number of aliens vs the number of endangered endemic species.
2) Students should note characteristics of the islands including human influence on the islands, age of the island, etc. and model their observations and inferences after an example such as this: "On *student's island*, I observed *# of* native birds including species examples and *# of* non-natives including species examples. I also observed these characteristics: *examples of characteristics*. I can infer that…" (for example: a larger number of non-natives exist on O'ahu because it is the center for travel and it has the largest population of people and people bring birds, like parakeets, from other places.)

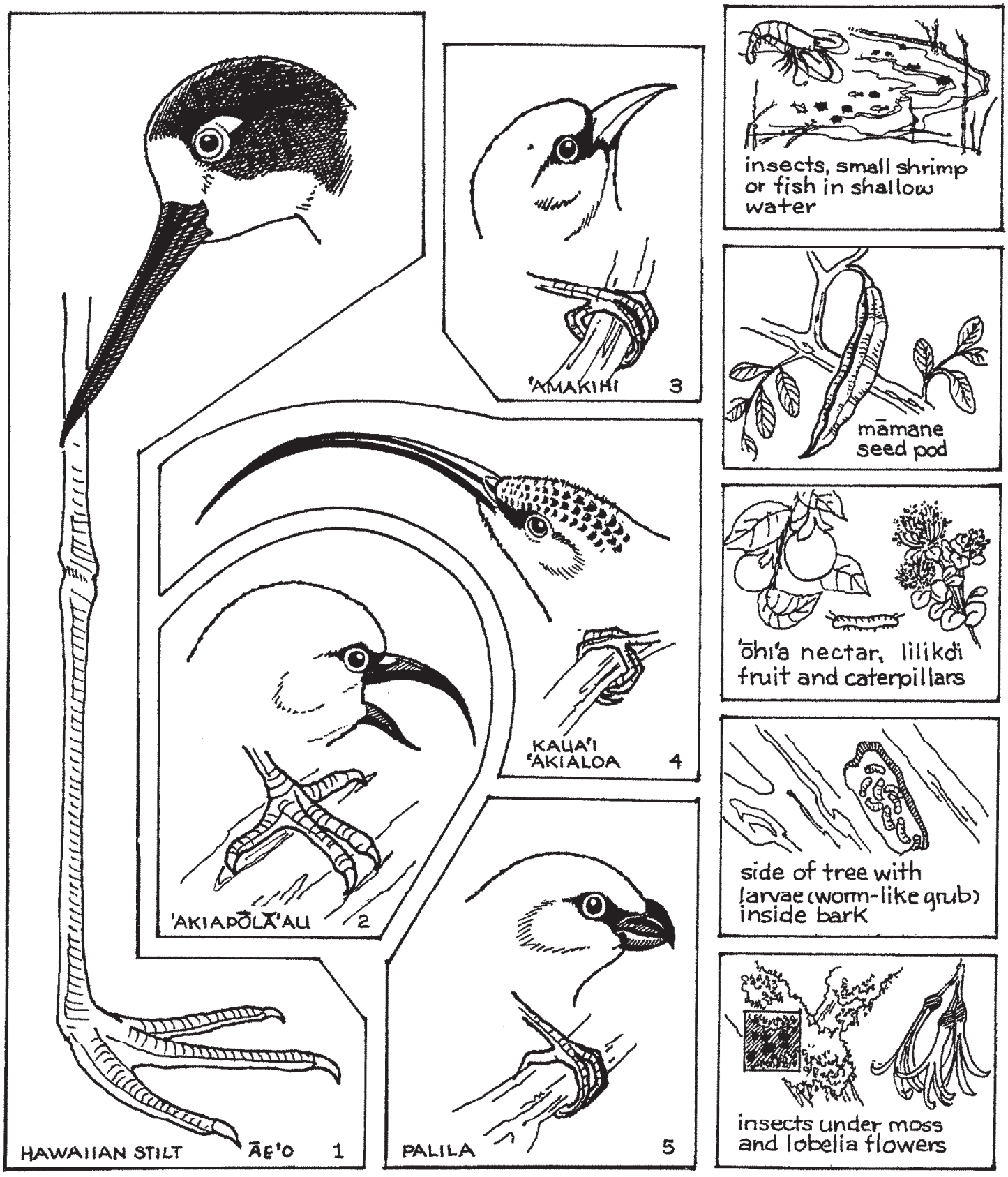
Grade 6:
6.1.2 - Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data. Expand on this standard by having students expand on their research. Different island groups could use and share information sources so they can learn what is available. Library research rather then web-based would help them learn the value of books.
1) Using a display, have each island group share with the class why scientists believe their island's endangered species are extinct.
2) They should share their specific methods of data collection (web, encyclopedia, bird books, field guides, etc.), why they chose to display the data the way they did, and their steps in analyzing the information they obtained (why are only web-based sources not appropriate, etc).
3) Student groups could go even further by compiling data of alien birds found on their island and endangered birds on their island and make a graph or pie chart detailing bird numbers in percentages.

Grade 7:
7.1.3 – Explain the need to revise conclusions and explanations based on new scientific evidence. Sections 5 and 6.
1) Teachers: preface this activity by offering a bit of an introduction into the scientific process for students: Hypothesis, research, experimentation, and conclusion. Scientists continually have reasons to complete new research on a previously studied subject due to the constant state of change in the environment and technological applications.
2) Have students complete research on endemic and alien birds and their existence in the wild in the 1970's and how they changed from earlier dates. They should come up with a hypothesis as to why numbers are what they are in the 1970's.
3) They should then compare the endemic and alien bird numbers from the 1970's with the numbers from today and hypothesize why the numbers have changed. (note to teachers – alien bird species as well as the numbers of endangered and threatened endemic birds have dramatically increased in the past 35+ years.)
4) Students should evaluate and revise their conclusion from step two once they fully understand the research found in step 3.

Other Suggestions:
- Students could compose riddles about alien and endemic birds and challenge their classmates to solve them. These could be presented as a riddle-a-day and could serve to arouse interest in endangered and introduced birds.
- Have birds hanging from the rafters! Cutouts of endangered birds from each island could be suspended in the classroom as colorful mobiles.
- Older students could make more detailed maps, indicating the present range of some of the endangered birds on each island. They will need to contact the government agencies listed at the end of this guide to obtain more information.

BILLS AND FEET AND WHAT BIRDS EAT

Activity Handout



INSTRUCTIONS: Look at the bills and feet of each bird to find clues as to what it eats. Then draw a line from each bird to its food.

SOARING SEABIRDS

Grades 3-5

OBJECTIVES	Students will use art and communication skills to: • Construct models of native seabirds in flight • Create a display illustrating the birds' various habitats • Describe how people can help endangered and threatened species to survive.
KEY CONCEPT	Electric lights have confused fledgling seabirds, causing them to fall during their flight from their mountain burrows to the sea. The cooperative efforts of island residents and government agencies are helping to save native seabirds from extinction.
MATERIALS	bird drawing (provided), for birds: two 8 1/2" x 11" sheets of card stock or heavy white paper for each bird, black crayons or felt-tip markers, scissors, tape, and string; for background scene: a large sheet of butcher paper and colored markers.
VOCABULARY	seabirds, fledgling, fall-out, predation, threatened species
SUBJECT AREAS	art and science
2005 HAWAIʻI STATE CONTENT STANDARDS	
STANDARD	BENCHMARK
3.1.1	Pose a question and develop a hypothesis based on observations. (Section 5)
3.5.1	Describe the relationship between structure and function in organisms. (Section 2)
4.1.2	Differentiate between an observation and an inference (Sections 2 and 6)
4.3.1	Explain how simple food chains and food webs can be traced back to plants. (Section 2 and 3)
4.5.3	Describe how different organisms need specific environmental conditions to survive. (Section 3 & 6)
5.1.2	Formulate and defend conclusions based on evidence. (Section 1, 5 & 6)
5.3.1	Describe the cycle of energy among producers, consumers and decomposers (Section 3 and the 5.3.1 extension described at the end of the exercises.)

OVERVIEW:

In this activity students will cut out and construct models of a native seabird that nests on Kauaʻi- the Newell's Shearwater. The models will be suspended from the ceiling at various heights depicting birds descending from their high elevation mountain burrows down to the sea. If desired, a background scene of burrow nests and the sea surface could be illustrated. [Another endemic seabird, the Hawaiian Petrel, formerly named Dark-rumped Petrel, could also be featured. It nests at high elevations on Maui and the Big Island and possibly on Kauaʻi and Lānaʻi. A fact sheet is available on the CWCS website: http://www.state.hi.us/dlnr/dofaw/cwcs/index.html and an illustration of the bird in flight can be found in "Seabirds of Hawaiʻi" (see references).]

BACKGROUND:

The Newell's Shearwater (ʻUaʻu Kani), one of Hawaiʻi's two endemic seabirds, is the subject of a success story that offers hope for threatened and endangered species. ʻUaʻu Kani nest in mountain burrows high above the sea. The burrows may be used by the same pair of birds from year to year. During, the breeding season from May to November, one chick is reared in each burrow. Adult birds soar down to the sea each day to feed. They return to the burrow at sunset and regurgitate partially digested seafood, usually squid, to their hungry chicks.

Newell's Shearwaters are known to breed on Kauaʻi, Hawaiʻi, and Molokaʻi and were federally listed as Threatened in 1975, primarily because of predation and habitat loss. Chicks are often the target of predators such as rats and feral cats. Disturbances to Shearwater habitat are caused by development, destruction of ground cover, which conceals a burrow, and the introduction of less suitable alien plants. Lighting from streetlights, homes, athletic fields, and hotels pose a serious problem for Shearwaters. The birds, particularly the fledglings, are attracted to light during their first flight from the burrow. This attraction causes them to become disoriented, and they often crash into power lines and other obstructions. Fallen birds may suffer injuries from the impact or from predators.

Adult shearwaters apparently are not attracted to lights to the same degree as fledglings, but do collide with power lines. In 2003, Kauaʻi Island Utility Cooperative completed shielding all street lights on Kauaʻi but there remain many lights to attract fledgling shearwaters. Since 1978, the organization Save Our Shearwaters has banded and released about 23,000 shearwaters picked up by Kauaʻi residents and brought to stations set up around the island. The program, run by conservation organizations (Department of Land and Natural Resources, The Nature Conservancy, and the U.S. Fish and Wildlife Service) alerts residents to the problem and directs them to take fallen birds to pick-up centers around the island. The fallen birds are collected each day and taken to a release site where they are banded and weighed. The birds then climb a ramp within a release pen and soar off to sea. Birds unable to climb the ramp are treated for injuries and released.

PROCEDURE:

1) Distinguish between birds that live in the forest or in urban areas and birds that live near the sea. Ask students to describe any bird that they see only at the beach. How are these birds different from birds they see inland? Some have webbed feet, longer beaks, longer wings, and fewer colors. Seabirds, such as the Hawaiian Petrel and Shearwaters, come ashore only to breed. They are distinguished from waterbirds, such as the Hawaiian Stilt and Coot, who live in Hawaiʻi's wetlands. Students may be more familiar with indigenous seabirds, such as the Iwa (Frigatebird) or the Fairy Tern.

2) Distribute the student worksheets illustrating body parts of the Newell's Shearwater. Review the body parts, summarizing the differences between seabirds and land-dwelling birds.

head and bill

Note the gland above the nostril where excess salt from drinking and feeding at sea is excreted. The bill is used for picking up food, preening- spreading oil from the oil gland to keep feathers waterproof, and for excavating burrows.

wings

The wings of seabirds are narrower, longer, and more pointed than land-dwelling birds which enables them to soar and glide on high winds at sea. (The Shearwater is named for its habit of dipping a wing tip while soaring on air currents close to the sea's surface. They seem to 'shear' or slice through the ocean as they search for food.)

color

Seabirds tend to be dark above and white below. The white underparts probably serve to make them less noticeable to fish.

legs and feet

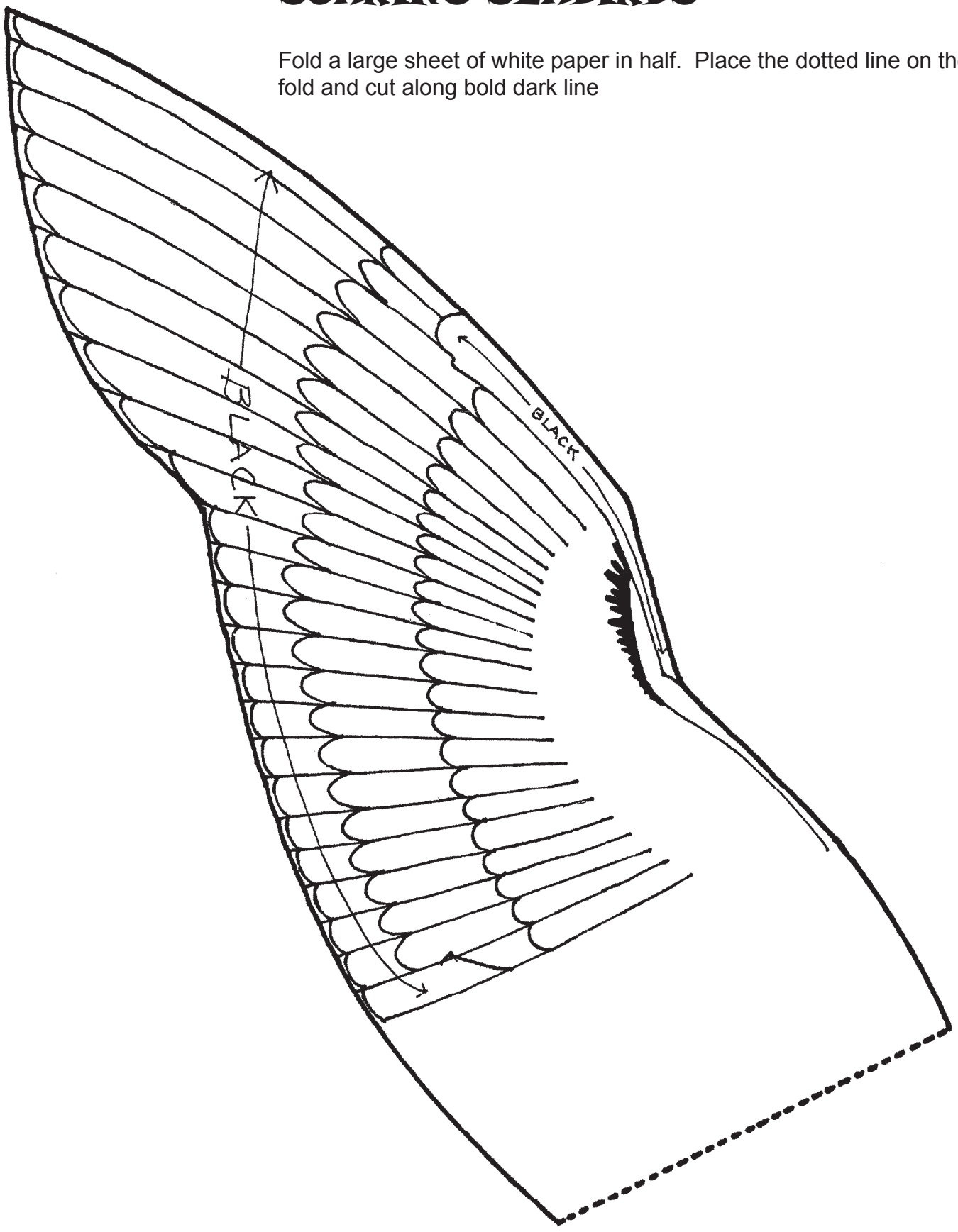
The legs are set far back on the body and feet are webbed. These are adaptations for swimming rather than walking. Shearwaters have difficulty walking on the ground and tend to shuffle or lurch along. Their claws are used to dig nesting burrows.

3) Have students, cut, color and construct models of the birds. If you wish to create background scenery of the bird's habitat, ask for volunteers to draw tunnels or burrows in the side of a cliff and draw the side of the mountain down to the sea. Downy chicks could be painted in the burrows and squid could be painted in the sea.

(continued on p. 19)

SOARING SEABIRDS

Fold a large sheet of white paper in half. Place the dotted line on the fold and cut along bold dark line



NEWELL'S SHEARWATER
('A'o)

4) Cut strings of various lengths. Place the strings through the bodies of the birds and tape in place. Hang the birds with the shortest strings near the mountain burrows and, using increasingly longer lengths of string, arrange the birds so that they appear to be flying down to sea level.

5) Discuss the threatened status of the birds and reasons for their decline. See if students can think of ways to help the birds survive and then relate the rescue efforts that have been so successful.

6) In groups or individually, ask students to each pick a different seabird and research challenges to survival. Discuss the different challenges facing seabirds that nest close to shore (such as Wedge-tailed Shearwaters) versus high in the mountains (Newell's Shearwaters.) Refer to the open Country & Wetland Birds Poster and bird fact sheets.

EXTENSIONS:

Grade 3:
- 3.1.1 Pose a question and develop a hypothesis based on observations. Section 5

1) Before starting this lesson, have students look at the DOFAW Open Country & Wetland Birds Poster. Have them write down one question that they have about the birds structure (i.e. why is the beak shaped the way it is? Or why are the tops of the wing light and the bottoms dark?)
2) At the end of the lesson after they have learned a bit about the birds, have students try to come up with a hypothesis to answer their question. [Teachers: This is a good opportunity to write the definition of a hypothesis on the board and discuss (or review) the scientific process.]

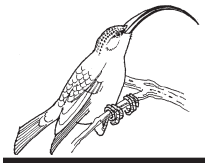
Grade 4:
- 4.5.3 Describe how different organisms need specific environmental conditions to survive.

1) Prior to randomly drawing tunnels, nests, and food sources on their map, have each student (or student pair) choose a bird to study more in-depth. Students should research the type of nest their species makes, their species' favorite foods, and their favored habitat. Teachers will want to alert students to the fact that they should understand why their bird needs specific conditions to survive. Students might need help with this.
2) Students should then draw these nests and food types with as much detail as possible and place them in their island map.
3) For a take home/in class assignment, students could write a bit about why they believe their bird has the described traits.

Grade 5:
- 5.3.1 Describe the cycle of energy among producers, consumers and decomposers.

1) When completing step 3, students should draw the energy cycle [i.e. some shearwaters' food includes squid which eat gobies which eat micro-fauna (organisms too small to be distinguished without a microscope) which eat fungi and bacteria found on the ocean floor].
2) Energy cycles can be posted up and students can give mini presentations about their energy cycle picture and what it means.

Other Suggestions
- Initiate a study of seabirds and waterbirds to familiarize students with birds that visit their island and birds that live in their island's wetlands. Note that wetlands are often the site of development, and that as habitat for our endangered native waterbirds, these areas need protection.



IF UNIQUE IS WHAT YOU SEEK

Grades 4,5,7

OBJECTIVES	Students will use deductive reasoning, critical thinking, and creative art skills to: • Determine how a bird's physical features are adaptations to its environment. • Design a bird to fit an available niche in a native forest • Describe the factors, which fostered adaptive radiation of the Hawaiian honeycreepers.
KEY CONCEPT	Through evolutionary change, descendants of a pioneer bird species developed adaptations to new niches available in the Hawaiian environment.
MATERIALS	large pieces of paper, colored markers
VOCABULARY	niche, adaptation, microclimate, mutation, speciation, adaptive radiation, disharmonic biota, Drepanidinae, plumage.
SUBJECT AREAS	science, art
2005 HAWAI'I STATE CONTENT STANDARDS	
STANDARD	BENCHMARK
4.3.2	Describe how its' environment affects an organisms behavior (e.g. courting, nesting, feeding patterns.) (Sections 1 – 6)
4.5.2	Describe the roles of various organisms in the same environment. (Sec. 2 – 6) As students make modifications to the common ancestral species to create a bird that would survive in a native Hawaiian Forest, they can make written comments that will help reinforce the idea that species adapt to their environment, not vise-versa.. Plants with long, tubular flowers will only survive if there is a species that can pollinate it, and the same goes for the pollinator.
4.5.3	Describe how different organisms need specific environmental conditions to survive. Throughout this exercise students will learn that each bird species is uniquely adapted to its environment. Due to extreme isolation over time and adaptation, organisms-in this case, Hawaiian honeycreepers- specialize and rely on specific environmental conditions for survival. In an isolated island environment, this specialization a survival advantage, however, in a non-isolated environment, it can become a disadvantage.
5.1.2	Formulate and defend conclusions based on evidence. (Throughout)
7.3.2	Explain the interaction and dependence of organisms on one another. (Section 2 and Grade 7 extension below)
7.3.3	Explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem. (Sections 3 – 4)
7.5.4	Analyze how organisms' body structures contribute to their ability to survive and reproduce (Sections 1 – 6)
7.5.6	Explain why variation(s) in a species' gene pool contributes to its survival in a constantly changing environment. (Sections 1 – 6)

OVERVIEW: In this activity, students will design new bird species to adapt to a variety of ecological niches by modifying some of the physical features of a common ancestor.

BACKGROUND: The striking difference in the bills and tongues of the Hawaiian honeycreepers (subfamily Drepanidinae) led nineteenth century scientists to place them in several unrelated families.

The current theory holds that these beautiful and varied birds all evolved from a common ancestor. A new species could arise from a common ancestor when gene changes or mutations had the effect of isolating populations reproductively. For example, if mutations cause changes which result in different breeding seasons, courtship displays, breeding plumage, or songs, such differing birds will no longer be able to breed with one another and thus be "isolated reproductively." A possible scenario would be the arrival of a pair of birds on an island. If offspring of the birds remained on separate islands, cut off from their ancestral population, and mutations occurred over time causing the population to change physically or in behavior, then these changes might prevent the populations from interbreeding, should they meet in the future. In this way, reproductive isolation creates new species. This process is known as speciation.

When extensive speciation from a common ancestral species occurs, as it did with the Hawaiian honeycreepers, it is referred to as adaptive radiation. The honeycreepers radiated out into a variety of diverse ecological niches or "occupations", such as seed-eating or nectar-feeding. Four factors set the stage for adaptive radiation:

1) Hawai'i's isolation also had the effect of forcing the pioneer populations to remain geographically isolated from their parental populations, thus preventing genetic interchange.
2) The extreme isolation of the islands prevented many species of plants and animals from reaching Hawai'i. This gave rise to Hawai'i s disharmonic biota and left a diversity of niches available.
3) The lack of seasonal climatic extremes in Hawai'i combined with a range in elevation provided a variety of stable microclimates. This helped to create a diversity of niches.
4) As the population of the pioneer species increased, competition arose among the birds for the same foods. As new species arose and expanded their ranges, some to other islands, competition for food developed among species.

The small pioneer honeycreeper population successfully colonized the Hawaiian islands and remained geographically and genetically isolated from its parental population. With the abundance of ecological niches, new species of honeycreepers evolved and made use of a variety of food sources. The honeycreepers exploited available niches by evolving a variety of bills, such as:

- Long, curved bills for reaching nectar at the base of tubular flowers or reaching insects in narrow crevices.
- Heavy parrot-like bills for cracking branches to obtain insect larvae.
- Short thin bills adapted for feeding on nectar or insects.

Procedure:
1) Divide students into small groups (2-3 at most). Give each group a copy of the student handout, which illustrates a hypothetical common ancestor and a koa-'ōhi'a forest with available niches.

2) The hypothetical common ancestor that successfully colonized the islands is believed to be a relative of the Cardueline finches (a group of birds that includes the House Finch). It is generally adapted to eat some insects, seeds, and nectar. Point out the available niches circled on the student handout. Ask students to study the bill of the pioneer species and determine which of the foods it would be able to eat. Note that with its short stubby bill, this bird is unable to reach insects under dense masses of moss, or insects inside branches, or larvae found inside trees. Nectar at the base of tubular flowers is also beyond its reach.

3) The population of the pioneer species will grow and the birds will soon be competing for a dwindling food resource. Challenge students to design a new species to occupy an available niche by specializing in eating one or more of the new foods. (The shape and size of bills and feet should be

emphasized.) Groups should note how their modifications have specialized the bird.

4) Each group should then display their unique new species to their classmates and describe how the specific changes they have made provide advantages for inhabiting the new environment.

5) In the follow-up discussion, distinguish between making a conscious decision to change, as students are doing and the mechanism for evolution of new species of birds (gene mutations.) Mutations occur randomly and only some are helpful. Beneficial mutations may give a bird a competitive advantage in adapting to a new environment. Birds that survive to reproduce pass on the new genetic information.

6) Discuss how a new species evolves when birds are isolated reproductively. Introduce the terms speciation and adaptive radiation and compare students' newly designed birds to the diagram of the Hawaiian honeycreepers (which could be used as a transparency). Were any of the students' designs similar to the honeycreepers that evolved and occupied available niches? Note that the honeycreepers are endemic, or unique, to various islands in Hawai‘i and that most of them are endangered, and some are extinct. Students should also be aware that in addition to the wet-to-mesic forests illustrated on the student handout, dry forests also provided a variety of niches in the islands.

EXTENSIONS:
Grade 4:
4.5.2:
1) After students have created a bird from a common Hawaiian ancestor, have students with birds living in the same (or similar) forest types work together in groups.
2) Student groups should discuss the different characteristics their birds have adapted: wing type, food preference (nectar, seeds, insects), beak and foot characteristics, etc.
3) Students should discuss the pro's and cons of their bird's specialization (e.g. Pointy/curved beak– great for sipping nectar, but not for cracking seeds, what if their was a severe draught one year?)

Hoike o Haleakalā curriculum has a fun bird activity called win, loose, or adapt located on the web (hard copies are also found in most public school libraries on Maui). This game is appropriate for grades 4 – 7. Visit www.hear.org/hoike. The game is in the rainforest module under Unit 3.

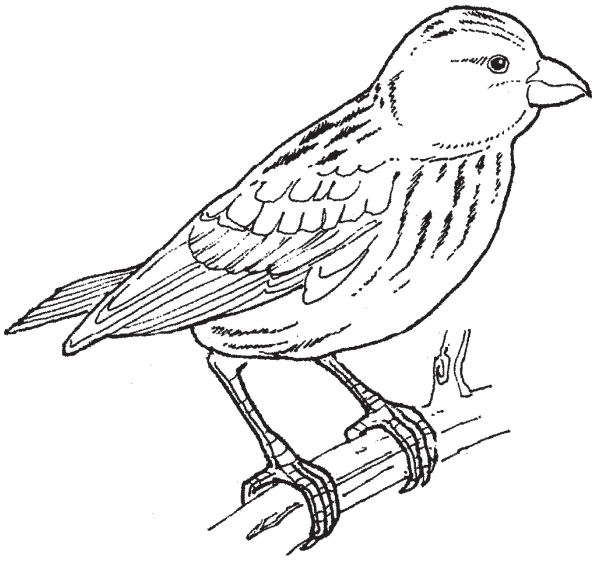
Grade 7:
7.3.2 Explain the interaction and dependence of organisms on one another.
1) Have students expand on the material they wrote up about their bird species. For example: If they chose that their bird was a seed and insect eater, the student should detail four insects and seeds that were eaten by their species. Students should choose insects and plants that are native to Hawaii. This may require a bit of library research.
2) Following this information, students should research, if necessary, what conditions are necessary for their plant(s) to grow properly, what type of environment would be necessary for their insect to survive, etc. This will help students understand the interconnectedness of the environment.
3) Students should share their results either with the teacher on paper or to the class as a presentation.

Other Suggestions:
Challenge students to hypothesize the factors which, fostered the remarkable adaptive radiation of the Hawaiian honeycreepers. You may need to assist them by relating some of the four factors noted in the background information above. Ask students to describe how these factors set the stage for adaptive radiation.

IF UNIQUE IS WHAT YOU SEEK

Activity Handout

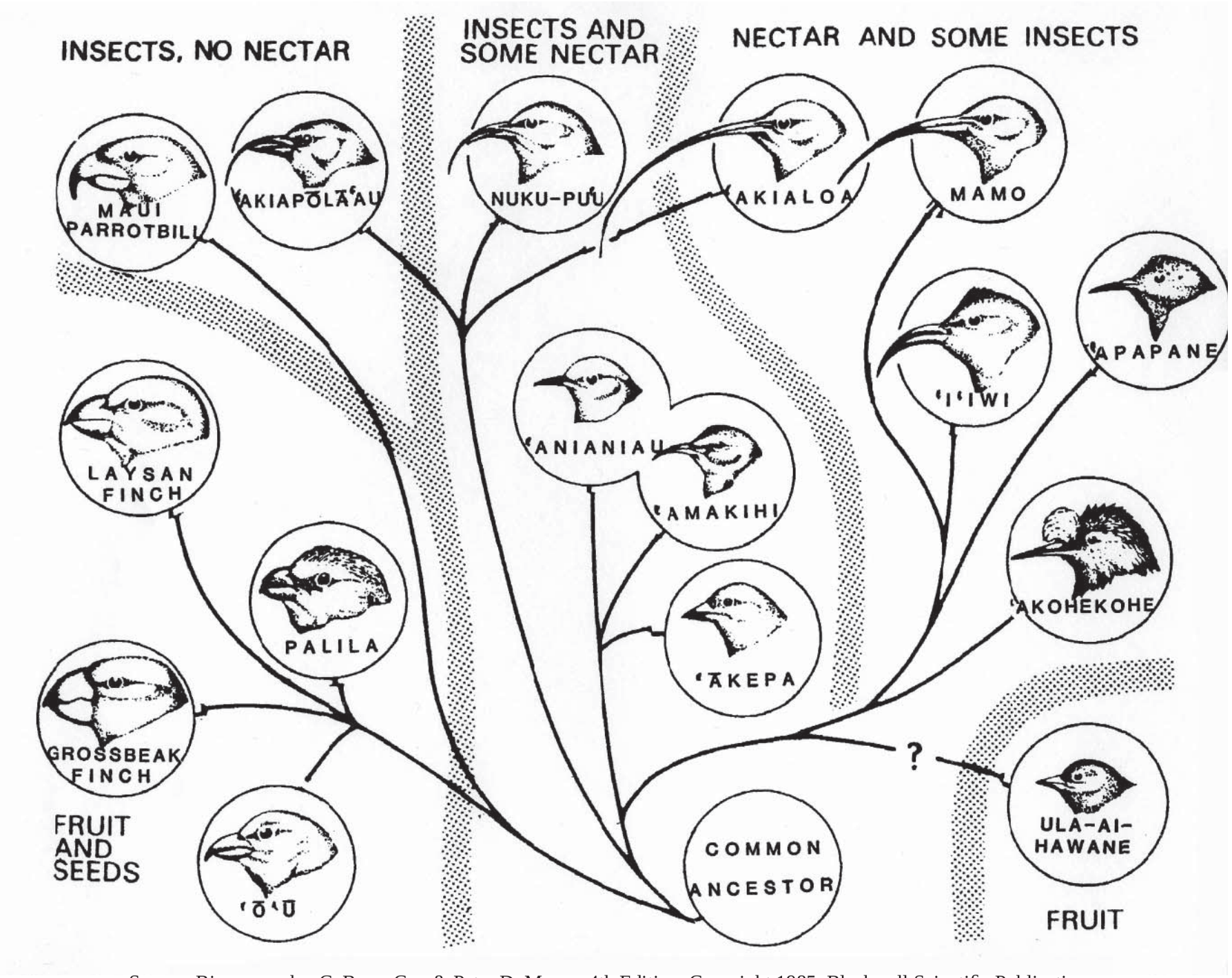
A pair of birds like the one pictured here just arrived on an island that is 2500 miles from the nearest continent. This pioneer species eats insects and nectar. There are no mammals on the island, but there are insects and tiny tree snails.



When the population of this species grows quite large, the birds will compete for foods. How will the birds survive without running out of food? Many more niches in the koa-'ōhi'a forest are available. But the pioneer species cannot efficiently reach or handle all of these foods.

Design a new bird, similar to the common ancestor, to occupy one or more of the following niches: (see numbered circles)

1) Eating pilo berries
2) Eating thick-coated koa seeds
3) Probing under thick masses of moss for insects
4) Crunching open branches for insects
5) Pecking through thick bark for insect larvae
6) Eating tree snails
7) Taking nectar from the base of long, tubular flowers



Source: Biogeography, C. Barry Cox & Peter D. Moore, 4th Edition, Copyright 1985, Blackwell Scientific Publications

ENDEMIC HAWAIIAN BIRDS

The following bird illustrations accompany the “Endemic Birds: Riddles and Research” activity on page 10. Use these illustrations along with others in this booklet and the companion posters: “Forest Birds of Hawai‘i” and “Open Country and Wetland Birds of Hawai‘i” and as a reference for endemic birds.

LIST OF INDIGENOUS AND ENDEMIC BIRDS OF HAWAI'I

Forest Birds

Kaua'i

Kaua'i 'elepaio (*Chasiempis sandwichensis sclateri*)
Kaua'i 'amakihi (*Hemignathus kauaiensis*)
Anianiau (lesser 'amakihi- *Hemignathus parvus*)
Akeke'e (Kaua'i 'ākepa- *Loxops caeruleirostris*)
Puaiohi (small Kaua'i thrush- *Myadestes palmeri*) E
Kama'o (Large Kaua'i thrush- *Myadestes myadestinus*) E
'Akikiki (Kaua'i creeper- *Oreomystis bairdi*)
Kaua'i nukupu'u (*Hemignathus lucidus hanapepe*) E
Kaua'i 'Ō'ō (*Moho braccatus*) E, *extinct*
Kaua'i 'akialoa (*Hemignathus procerus)* E, *extinct*

O'ahu

O'ahu 'elepaio (*Chasiempis sandwichensis ibidis*)
O'ahu 'amakihi (*Hemignathus flavus*)
'Alauahio (O'ahu creeper- *Paroreomyza maculata*) E

Moloka'i

Oloma'o (Moloka'i thrush- *Myadestes lanaiensis*) E
Kakawahie (Moloka'i creeper- *Paroreomyza flammea*) E, *possibly extinct*
Bishop's 'ō'ō (*Moho bishopi*) *extinct*

Maui

Maui 'ākepa (*Loxops coccineus ochraceus*) E
Maui 'alauahio (Maui creeper- *Paroreomyza montana*)
Maui nukupu'u (*Hemignathus lucidus affinis*) E
Po'ouli (*Melamprosops phaeosoma*) E
Maui parrotbill (*Pseudonestor xanthophrys*) E
'Ākohekohe (crested honeycreeper- *Palmeria dolei*) E

Hawai'i

Hawai'i 'elepaio (*Chasiempis sandwichensis sandwichensis*)
Hawai'i 'amakihi (*Hemignathus virens*)
Hawai'i 'ākepa (*Loxops coccineus coccineus*) E
'Oma'o (Hawai'i thrush- *Myadestes obscurus*)
Hawai'i creeper (*Oreomystis mana*) E
'Akiapōlā'au (*Hemignathus munroi*) E
Palila (*Loxioides bailleui*) E
'Alalā (Hawaiian crow- *Corvus hawaiiensis*) E

More than one island

'Apapane (*Himatione sanguinea*)
'I'iwi (*Vestiaria coccinea*)
'O'u (*Psittirostra psittacea*) E

Raptors

'Io (Hawaiian hawk- *Buteo solitarius*)
Pueo (Hawaiian short-eared owl- *Asio flammeus sandwichensis*)

Waterbird

Koloa maoli (Hawaiian duck- *Anas wyvilliana*) E
'Alae 'ula (Hawaiian common moorhen- *Gallinula chloropus sandvicensis*) E
'Alae ke'o ke'o (Hawaiian coot- *Fulica alai*) E
Nēnē (Hawaiian goose-*Branta sandvicensis*) E
Ae'o (Hawaiian stilt- *Himantopus mexicanus knudseni*) E
Auku'u (Black-crowned Night-heron- *Nycticorax nycticorax hoactli*)

Migratory Birds

Kōlea (Pacific Golden Plover- *Pluvialis fulva*)
'Akekeke (Ruddy Turnstone- *Arenaria interpres*)
Koloa mapu (Northern Pintail- *Anas acuta*)
Koloa moha (Northern Shoveler- *Anas clypeata*)
Lesser Scaup (*Aythya affinis*)
Hunakai (Sanderling- *Calidris alba*)
'Ūlili (Wandering Tattler- *Heteroscelus incanus*)
American Wigeon (*Anas americana*)
Kioea (Bristle-thighed Curlew- *Numenius tahitiensis*)

Seabirds

Mōlī (Laysan Albatross- *Phoebastria immutabilis*)
Ka'upu (Black-footed Albatross- *Phoebastria nigripes*) T
Koa'e kea (White-tailed Tropicbird- *Phaethon lepturus*)
Koa'e 'ula (Red-tailed Tropicbird- *Phaethon rubricauda*)
'Ou (Bulwer's Petrel- *Bulweria bulwerii*)
Bonin Petrel (*Pterodroma hypoleuca*)
'Ua'u (Hawaiian Petrel- *Pterodroma sandwichensis*) E
'Ake'ake (Band-rumped Storm Petrel- *Oceanodroma castro*) E (state listing)
Tristram's (Sooty) Storm Petrel (*Oceanodroma tristrami*)
'Ua'u kani (Wedge-tailed Shearwater- *Puffinus pacificus*)
'A'o (Newell's Shearwater-*Puffinus auricularis newelli*) T
Christmas Shearwater (*Puffinus nativitatis*)
Manu-o-Kū (White (Fairy)Tern- *Gygis alba*) T (state)
'Ewa'ewa (Sooty Tern- *Sterna fuscata*)
Pākalakala (Gray-backed Tern- *Sterna lunata*)
Noio (Hawaiian Black Noddy- *Anous minutus*)
Noio-kōhā (Brown Noddy- *Anous stolidus*)
Blue-gray Noddy (*Procelsterna cerulean*)
'Ā (Masked (blue-faced) Booby- *Sula dactylatra*)
'Ā (Brown Booby- *Sula leucogaster*)
'Ā (Red-footed Booby- *Sula sula*)
'Iwa (Great Frigatebird- *Fregata minor*)
Short-tailed Albatross (*Phoebastria albatrus*) E *Migratory*

E: Listed as *endangered* by the State and/or Federal Government.
T: Listed as *threatened* by the State and/or Federal Government.

SOURCES OF INFORMATION

Atlas of Hawai'i (Third Edition, 1999). The University of Hawai'i Press.

A Teacher's Guide to Nēnē: Hawai'i's Endangered State Bird (2005). *Published by DLNR, Division of Forestry & Wildlife and is available as a free resource to teacher's from all local offices.*

Division of Forestry and Wildlife Website: *Visit www.dofaw.net for more information about Hawai'i's birds, education materials, other educational activities, and individual fact sheets. To view fact sheets for species of greatest conservation need, please visit the Comprehensive Wildlife Conservation Strategy page.*

Hawai'i- A Natural History, (Re-issued Edition, 1994), Sherwin Cariquist, SB Printers, Inc., Honolulu. *Provides additional background information for the teacher on adaptive radiation and Hawai'i's birds.*

Hawai'i. An Island Community, Science in Hawai'i ETV series. *This video explores what happens to the flora and fauna, with a special look at birds, on our isolated islands in the vast Pacific.*

Hawaiian Bird Life (Second Edition, 1981). Andrew J. Berger, The University of Hawai'i Press.

Hawai'i's Birds (Sixth Edition, 2005). Hawai'i Audubon Society. *This small and inexpensive guide is available at most bookstores and will provide an easy-to-read and well-illustrated reference for students.*

Hawai'i's Comprehensive Wildlife Conservation Strategy (2005). Hawai'i department of Land and Natural Resources. http://www.state.hi.us/dlnr/dofaw/cwcs/index.html

Hō'ike o Haleakalā. *Hō'ike o Haleakalā is a multi-disciplinary, science-based environmental education curriculum designed to help sustain the native Hawaiian landscape and culture by helping students establish and deepen connections to the land and the culture it supports. The Hoike curriculum supports State of Hawai'i high school educational standards, particularly in the science disciplines. Each activity is correlated to state science standards, offering educators a way to fulfill educational requirements using local ecosystems and issues as a context. Available at: www.hear.org/hoike/*

Seabirds of Hawai'i (1990). Craig S. Harrison, Cornell University Press. *This book is a detailed guide to the history of birds in Hawai'i. For each species, there is a detailed photo, a short summary of each species, and a map of the species' habitat range.*

Seabirds of the World: A Photographic Guide (1996). Peter Harrison, Princeton University Press.

Treasures of the Rainforest. *This small booklet was written for children. It contains age appropriate information and vivid photos.*

The following posters are available from the Division of Forestry and Wildlife free to teachers as an accompaniment to this teacher's guide and for a small fee to the general public: Forest Birds of Hawai'i, Open Country and Wetland Birds of Hawai'i. Other resources are also available at www.dofaw.net

Agencies to contact for further information:

Department of Land & Natural Resources
Division of Forestry & Wildlife
1151 Punchbowl Street Rm. 325
Honolulu, HI 96813

Keauhou Bird Conservation Center
P.O. Box 39
Volcano, HI 96785

The U.S. Fish and Wildlife Service
300 Ala Moana Blvd
Honolulu, HI 96813
(808) 792-9400

To request additional copies of this booklet please contact the Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife: (808) 587-0166 (Honolulu); (808) 984-8100 (Maui); (808) 974-4221 (Big Island); (808) 274-3433 (Kaua'i).

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