

Reflection Section Answer Guide

Treasure Islands

Introduction

- **Why do you think the scientists were interested in learning about the habitat of native and nonnative bird species in Hawai‘i? If you need a hint, reread “Thinking About the Environment.”** *Out of 113 species endemic to Hawai‘i, only 42 exist today. Of the 42, only 11 are not endangered. If the endemic and native bird species of Hawai‘i are to continue into the future, scientists must learn about their preferred habitats and any threats posed by nonnative bird species.*
- **State the hypothesis in the form of a question.** *Do larger kīpuka with a greater variety of vegetation and taller vegetation have a greater number and variety of native and nonnative bird species? Another possibility is: Is there a relationship between the variety and height of kīpuka vegetation and the number and variety of native and nonnative bird species?*

Methods

- **How did the large area of forest serve as a control?** *The large area of forest was never isolated as a forested island by volcanic lava. Therefore, it would serve as a setting where, if the volcano had not erupted, the number of native and nonnative bird species would not be dependent on a limited habitat patch size.*
- **Why did the scientists record the type of vegetation and trees found in each kīpuka?** *If the vegetation was different for each or even some kīpuka, any differences in the number of bird species found could be because*

of the vegetation. The scientists would not know whether any differences were related to the type of vegetation or the size of the kīpuka.

Findings

- **Based on the findings, do you think the ‘apapane is likely to be one of the endangered bird species? Why or why not?** *Students may have individual answers to this question. They should, however, suspect that the ‘apapane is not likely to be an endangered species because it can successfully live in a wide variety of kīpuka habitats as well as the large forest.*
- **Read the next-to-the-last sentence in “Findings” and examine table 1. What can you say about the kīpuka and the future of native bird species?** *From this finding, it appears that the smaller kīpuka had fewer nonnative species in them. From table 1, it appears that nonnative species may not often use smaller kīpuka. Therefore, students might conclude that smaller kīpuka appear to provide better habitat for native birds than for nonnative birds. Smaller kīpuka appear to provide a measure of protection for native birds.*
- **Looking over table 1 and figure 14, what can you say about the height of trees in different size kīpuka?** *Students should conclude that the larger the kīpuka size in hectares, the taller the trees.*

Discussion

- **What is one advantage of restoring small forest patches?** *Students will have individual answers, but they should realize that it would cost less to restore small forest patches than larger patches. In addition, smaller patches are less attractive to nonnative species.*

- **What is one disadvantage of restoring only small forest patches?** (Hint: Think about the ‘io or Hawaiian hawk.) *The Hawaiian hawk is endangered, and it was found only in the largest kīpuka. If only small patches of forest are restored, the Hawaiian hawk would be restricted to current areas of large forest.*
- **Why might it be important to begin now to restore patches of native forest at higher elevations?** *Students should realize that trees take years to grow. The tallest trees are often the oldest trees. Because tree height is related to the number of bird species living in a kīpuka, it would make sense to begin restoring small areas of native forest now. This restoration would give the trees a chance to grow. By the time the climate changes enough for mosquitoes to reach the middle elevations, native bird species could move to the higher elevation forest patches.*

lot of side branches, the timber will have a lot of knots. Lumber with knots is not as strong or attractive as lumber without knots.

- **Why did the scientists want to study the three obstacles to koa crop tree growth?** *These obstacles are slowing the growth of koa crop trees. Demand for koa wood, which relies on koa crop trees, is rising. If the scientists could discover ways to overcome these three obstacles, landowners could grow koa crop trees faster now and into the future.*
- **Look at figure 5. Do you see any non-crop koa trees in the photo? How do you know?** *Students should realize that the trees to the left and right of the crop tree are noncrop koa trees because they have crooked trunks. Encourage students to examine this photo so that they understand the differences between crop trees and noncrop trees.*

BIG Questions

- **Why should humans care about endemic and endangered species? Should the scientists’ recommendation be followed?** *These questions were posed at the beginning of this article. Students should be able to draw on their experience and knowledge, as well as the information presented in this article, to discuss the pros and cons of protecting endemic and endangered species.*

Koa Constrictors

Introduction

- **Explain in your own words why crop trees are needed for products such as surfboards, body boards, furniture, and guitars.** *If the trunk of a tree is bent or twisted, its wood will not be straight enough for boards to be cut from it. If the trunk has a*

Methods

- **Explain in your own words why scientists use a control in which no treatment is applied.** *Students will have individual answers to this question. They should, however, recognize that without a control with which to compare the treatments, it would be hard to say what effect the treatments have.*
- **Why did the scientists measure the DBH of the koa crop trees before and after the treatments?** *Students should realize that to identify which treatments, if any, seemed to encourage the growth of koa crop trees, scientists would need measurements both before and after the treatments.*

Findings

- **If you were one of the scientists doing this research, what would you recommend to managers wanting to**

increase the growth rate of koa crop trees? Students should realize that thinning, herbicide use, and the application of phosphorus should be recommended to managers wanting to increase the growth rate of koa crop trees.

- **Is phosphorus important to the growth of koa trees? How do you know?** Students should conclude that phosphorus is important to the growth of koa trees because when phosphorus was added to the soil, the trees more than doubled in diameter. The scientists were so sure about the effects of phosphorus on koa tree growth that they called the growth significant.

Discussion

- **How are koa wood guitars and phosphorus related?** Students should be able to describe how the fertilizer phosphorus, when used in conjunction with herbicide and thinning, encourages the growth of koa crop trees in Hawai'i. Some of these crop trees are used to make koa wood guitars.
- **Why would thinning alone be best done when the trees are young?** When forests are thinned, openings are created that allow more sunlight to reach the remaining trees. Older trees, however, take more than 3 years to respond to the increase in sunlight after thinning. Young trees, because they grow faster, would respond more quickly to an increase in sunlight. If thinning were the only treatment used, therefore, it would be better to do it when the trees were young.

Mangrove Mania

Introduction

- **Mangrove forests provide homes for fish and other wildlife. How could this help support the island's economy?** Locals catch and sell the fish whose habitat is the mangrove forests, thus supporting the island's

economy. Fish and wildlife viewing attracts tourists to the island and helps the economy.

- **What did the scientists want to learn in this study?** The scientists wanted to know how sedimentation and sea-level rise affect mangrove forests.

Methods

- **Why do you think the scientists chose two different islands to study?** Because the scientists could compare their findings and see if there are similarities and differences between the mangrove forest areas.
- **Why do you think scientists measured the islands for 5 to 7 years instead of just 1 or 2 years?** Measuring for 5 to 7 years enabled scientists to measure short-term compared with longer term trends in sedimentation and sea-level changes.

Findings

- **Why do you think harvesting of overstory trees may have affected the soil elevation?** It is possible that, after trees were killed, their roots were no longer able to help stabilize the soil. It is also possible that the loss of the tree canopies, which deflect and slow down the rain, allowed hard rains to fall directly on the soil and created more soil erosion.
- **Why do you think fringe areas generally lost soil elevation over the time period studied?** The fringe areas are subject to more wave action and, therefore, may lose more sediment and soil.

Discussion

- **Why is it important for tropical land managers to learn how best to manage the land around mangrove forests?** Mangrove forests help protect the island from

waves and sea-level rise. The mangrove forests are important to the ecology and economy of the island.

- **Why is it important for people living on the islands to be concerned about rising sea levels?** *Rising sea levels can have an enormous impact on the island. For example, fringe areas could be completely under water. The water would impact the mangrove forests that provide many benefits to the islanders. (Reread the “Introduction” section that lists the ways mangrove forests are beneficial.)*

Beam Me Down, Scotty!

Introduction

- **Why did the scientists study Hawai‘i?** *Because the scientists were testing a method of carbon estimation, it would be most helpful to test the method with different types of land use and ecosystems. Hawai‘i was a perfect place to study because it is a large area, it has a clear boundary, and it has a variety of land cover and ecosystems.*
- **What was the problem the scientists were trying to solve?** *The scientists needed to be able to estimate the amount of carbon being stored across large land areas and in different types of land cover. This method for estimating needed to be cost effective and fairly accurate. The problem was that scientists had not yet tested effective methods for estimating carbon storage across large and diverse areas.*

Methods

- **How was the old method of estimating carbon in person combined with new technologies?** *The scientists sampled a wide variety of ecosystems and land covers in person and estimated the amount of carbon contained in those areas. Then, they used the advantage*

of LiDAR to calculate the height of trees to relate the amount of carbon in an area. The scientists compared the more accurate in-person method with LiDAR’s ability to sample large areas.

- **What if the scientists wanted to map the carbon contained in the State of West Virginia? Should they use the same estimate of carbon related to the vertical center as they did in Hawai‘i? Why or why not?** *Students will have individual answers to this question. They should realize, however, that because some of the ecosystems in West Virginia might be different than those in Hawai‘i, the scientists should follow the same four steps to make sure that their estimates are accurate. They should not simply take the estimates made in Hawai‘i and apply them to West Virginia without testing them first.*

Findings

- **Why would areas with old soils contain more carbon than areas with young soils?** *Students will have individual answers to this question. They may realize, however, that young Hawaiian soils are created from lava flow, which only over time become more able to support vegetation and trees as organic matter is accumulated. Areas with recent lava flow have little to no soil and do not support vegetation.*
- **Why do you think the amount of carbon was related to the amount of rainfall in different areas of Hawai‘i?** *Students will have individual answers to this question. They should realize, however, that rainfall is necessary for plant growth. Higher rainfall leads to more vegetation. More vegetation means more carbon storage.*

Discussion

- **Would you say that the scientists' test of their new method to estimate the amount of carbon in Hawai'i was successful? Why or why not?** *Students should conclude that the test of this new method was successful. They should come to this conclusion because scientists were able to create an accurate carbon map of the entire island of Hawai'i using their method that combines the in-person calculations with new technology.*
- **Do you think that this method could be used for other large areas of forest and other land cover? Why?** *Students should realize that this method could be used for any defined area of land to estimate carbon storage as long as land cover maps or Landsat photographs, DBH-carbon equations, and LiDAR measurements were available or could be obtained.*

Don't Litter the Stream!

Introduction

- **State what the scientists wanted to know in the form of a question.** *Are organisms living in some Hawaiian streams eating albizia leaf litter instead of algae? Or, has albizia leaf litter replaced algae as the base of the food web in some Hawaiian streams?*
- **Review "Thinking About Science."** **How do you think the scientists might have answered their question?** *Students will have individual answers, but they should realize that the scientists would use technology to help them understand how much nitrogen was in the organisms that might be eating albizia leaf litter. Students should also realize that the scientists would have to compare*

this amount with the amount of nitrogen in organisms in streams with no albizia growing nearby.

Methods

- **Why did the scientists have to find streams that were alike in every way except for the albizia trees growing nearby?** *If there were other differences between the streams, then the scientists would not know if any observed differences in the diets of the aquatic consumers were because of the albizia or something else.*
- **Finding higher-than-normal levels of nitrogen in the tissues of consumers might lead the scientists to what conclusion about albizia leaves as a food source?** *That albizia, whose leaves contain a lot of nitrogen, was being used as a food source for aquatic consumers.*
- **Reading the captions of figures 6-10, what might you include about the aquatic organisms in this stream?** *Students may have other observations, but one that stands out is that only one of the aquatic organisms is native to Hawai'i.*

Findings

- **Look at the way the numbers occupy the cells in tables 1 and 2. Both show a pattern from left to right. Why do the cells increase from left to right?** *Students should realize that these tables are showing a food web that includes more consumers being consumed as one goes up the food chain. The consumers on the right are at a higher level. Educators may want to introduce the idea of trophic levels to the class at this time.*

- **Compare the first row in tables 1 and 2. What does this row reveal about albizia as a food source?** *This row indicates that albizia is a major food source for amphipods and caddisflies where albizia is growing.*

Discussion

- **If the stream food webs change across Hawai'i because of albizia, do you think the food webs that exist on the land beside streams could change as well? Why or why not?** *Because some land-based animals eat aquatic animals, the increase in nitrogen may be passed to animal species living near the streams.*
- **An increase in nitrogen in Hawaiian streams may cause more algae to grow. If more algae grow, how might the stream be further changed by albizia?** *Students will have individual answers to this question. Students may realize that if albizia trees continue to be the preferred food, too much algae could grow in the stream because of the increased nitrogen and fewer consumers would be eating it. Too much algae in the stream could become a problem.*

Left High and Dry?

Introduction

- **Why do you think it is important to save native ecosystems?** *Students will have individual answers to this question. They should, however, back up their reasons with logic. Some possible answers are to preserve the habitat of native birds, mammals, and insects; to save the few remaining trees or plants of a particularly endangered species; to stop the spread of invasive species; and to preserve the cultural values of native ecosystems.*
- **What is one way to restore a native forest?** *Students will have individual answers to this question. They should, however, back up their reasons with logic. Some possible answers are to plant seeds of native plant and tree species; to plant small native trees and other native plants; to remove the invasive plants; and to exclude any animal species that are destroying the native plants and trees.*
- **What question did the scientists want to answer? What things were done that created success in the restoration of the dry tropical forest? What did the scientists want to do after they answered their question?** *They wanted to develop recommendations for others interested in restoring dry tropical forests, anywhere they are found.*

Methods

- **Why do you think the scientists wanted to keep track of each plant species and the date of planting?** *Students will have individual responses, however, they should back up their answers with logic. Students should realize that it would be impossible to calculate how many plants and trees of each species had died without the tags, and that the age of the plant was needed to determine how long the plants and trees had survived.*
- **From this method, could the scientists determine whether it was necessary to kill the grass with a chemical after they had cut it? Why or why not?** *Students should realize that the scientists could not say whether they needed to kill the grass with a chemical. They could not say this because they killed all of the grass. If the scientists had left some areas of grass alive after cutting it, they could have compared the areas of cut grass with areas of grass that had been cut and had the chemical applied.*

Findings

- **How is the effect of the drought from 1999 to 2003 reflected in figure 10?** *The numbers in parentheses indicate the percentage of surviving plants. With the exception of 1999, the last 2 years of the drought had the lowest percentage of surviving plants. How is the year of high rainfall reflected in figure 10?* *The percentage of surviving plants increased from 27 percent in 2003 to 52 percent in 2005 following the high rainfall in 2004.*
- **Examine figures 10 and 11. Would you say the planting effort was a success? Why or why not?** *The overall survival rate of 30 percent was not high, indicating that the planting effort may not have been successful. The percentage increase in endangered plant and tree populations, however, ranged from 3 percent to 9,733 percent. This could be considered a big success, especially for the koki'o, which is now considered extinct in the wild.*

Discussion

- **State in your own words what the most important finding is from this study.** *The steps people should take in the future if they want to restore native dry tropical forests. How did the scientists determine this finding?* *They learned from their mistakes.*
- **How can you apply this finding to your own life?** *Students will have individual answers to this question, but they should understand that success should sometimes be measured not by the outcome of an action, but by our future action in response to it. If we learn from our mistakes, we can consider our effort a success.*