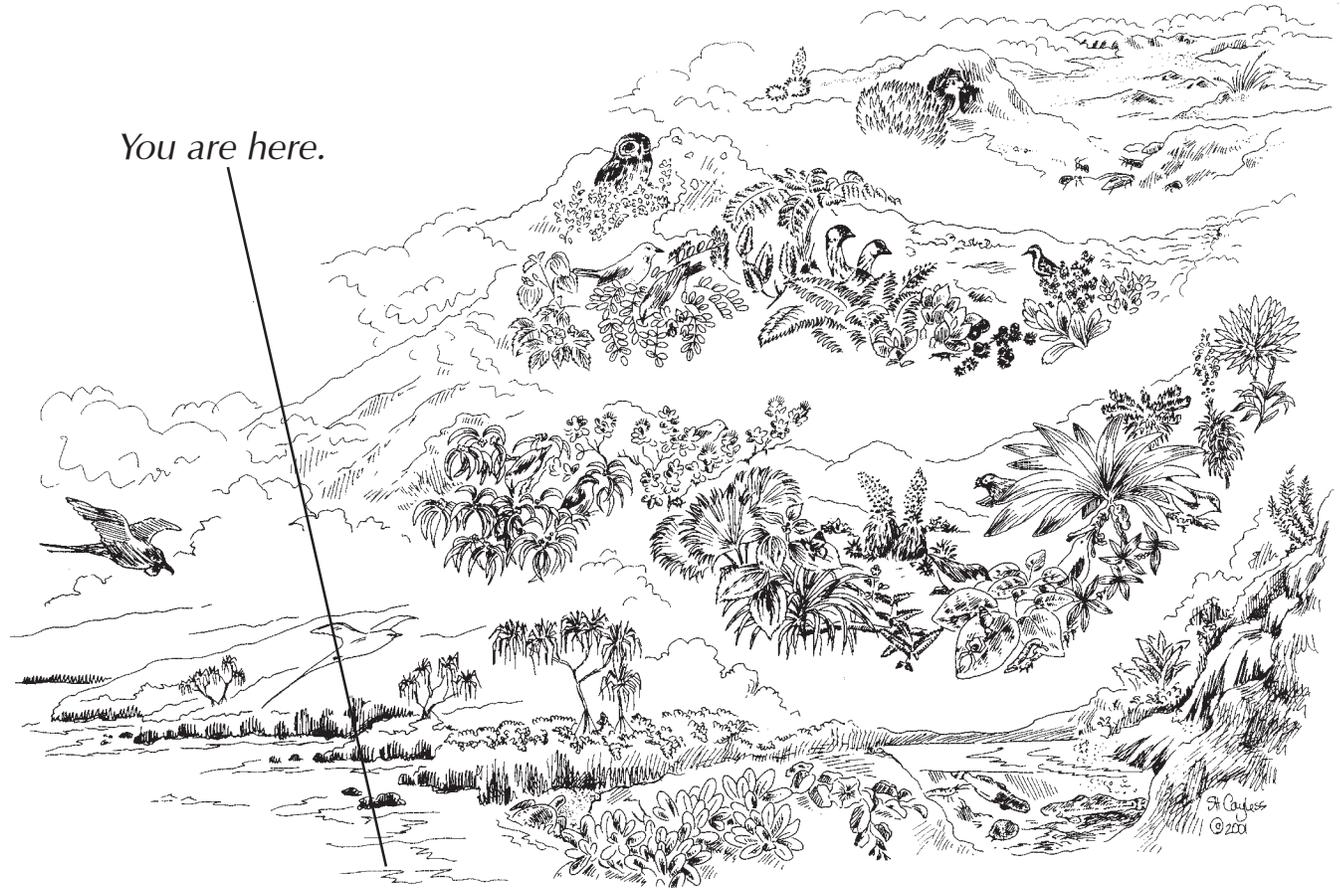




Marine Module



● ● ● What Does the Marine Zone Mean to You?

These reflections are offered by individuals involved in studying and protecting the native ecosystems of Haleakalā.

From the sea we have ventured and to the sea we glimpse our future. From the shallow sands that skirt Haleakalā to the depths of her foundation three miles below, the sea sustains Haleakalā, holding her high, forever reaching to the sun.

—Eric Andersen

I think of the gardens of coral and how people are screwing it up. I think of people overfishing, overusing the resources. I think of people looking for immediate satisfaction and not worried about tomorrow.

—Kalei Tsuha

Surfing, diving, fishing
Looking up at the mountain from the ocean
Watching fish watching me

—Kim Martz and Forest Starr



Illustration: John Dawson

*Ku mai! Ku mai!
Ka nalu nui mai Kahiki mai.
'Alo po'i pu!
Ku mai i ka pohuehue
Hu! Kaiko'o loa!*

*Arise! Arise!
Great surfs from Kahiki.
Waves break together!
Rise with the pohuehue
Well up, raging surf!*

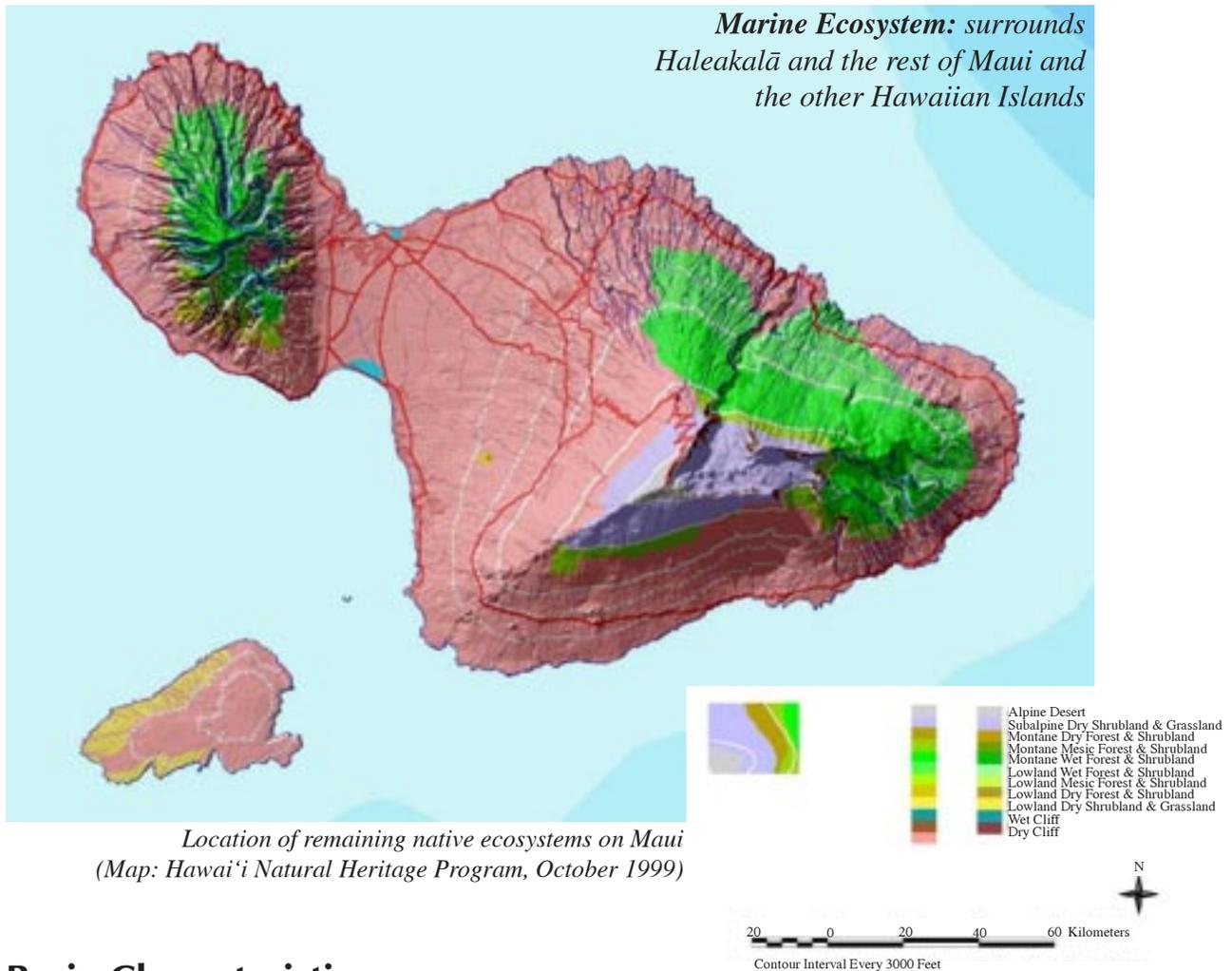
*Jane Gutmanis, Na Pule Kahiko: Ancient Hawaiian Prayers,
Editions Limited, Honolulu, Hawai'i, 1983, p. 101.*



● ● ● Ecosystem Summary

Where on Haleakalā?

Marine ecosystems surround Haleakalā, from the shallow waters often found near shore to deeper waters further offshore. The intertidal area between high- and low-tide lines is also considered a part of the marine environment because of its exposure to ocean water and the marine organisms that live there.



Basic Characteristics

The marine ecosystem is characterized by constant or regular inundation by salt water. Marine plants and animals are distributed in more or less distinct zones which are distinguished by the island's age, the amount of reef growth, exposure to wave action (determined in part by geographic orientation), light and temperature (functions of depth), and latitude.

Marine habitats include coral reefs of various types, boulder fields, sandy bottoms, areas where the reef drops steeply to great depths, and caves, caverns, and lava tubes. An incredible array of plants and animals live in these habitats, many of which are commonly encountered by snorkelers and divers. These plants and animals display a wide range of adaptations to different marine environments, from the tube feet with which sea stars move and attach themselves to stable surfaces to the hardened "beak" with which parrotfish feed on algae from the surface of dead coral, turning the coral structure into sand in the process.



Did You Know?

Compared to many other western Pacific island groups, the oceans surrounding Hawai‘i are relatively species-poor. Looking at shallow-water species of corals, mollusks, echinoderms, and fish is illustrative:

Corals	Hawai‘i: 17 genera and subgenera Marshall Islands: 59 Line Islands: 59
Marine Mollusks	Hawai‘i: 1000 species Ryukyu Islands: 2500
Echinoderms (e.g. sea urchins, sea stars)	Hawai‘i: 90 species Philippines: 345
Reef and Shore Fish	Hawai‘i: 700 species Marshall Islands: 1000

This *attenuation*, or lessening, of species diversity in Hawai‘i as compared to other island groups in the western Pacific can be explained in large part by geographic isolation. Hawai‘i is far away from continents and other major islands and reef systems, separated by distances that do not favor species with short larval stages. The west coast of North America is 3900 kilometers (2400 miles) away, and Japan is 6100 kilometers (3800 miles) away. The Society Islands lie some 4400 kilometers (2750 miles) to the south in the South Pacific Ocean. Like other Pacific island groups that are rich in marine life, the Society Islands are separated from Hawai‘i by ocean currents that do not favor the dispersal of marine life. In addition, Hawaiian waters are cooler in the winter, and nearshore habitats are exposed to destructive storm waves from both the Arctic and Antarctica. In this harsh, mostly subtropical marine environment, fewer species can exist than in the equatorial and tropical western Pacific.

Status and Threats

Hawaiian marine ecosystems are relatively healthy in comparison to many other places around the world. But human pressures still degrade these ecosystems, particularly the near-shore environment. Long-term fishing catch trends suggest a dramatic decline in the nearshore fishing stocks during the 20th century, perhaps as much as 80 percent. Three factors are probably responsible for this decline:

- Overfishing,
- Inability to enforce existing regulations and implement new fishing restrictions,
- Habitat degradation caused by coastal development and pollution.

Other threats to marine ecosystems include alien species (including fish and algae), heavy recreational use of beach and reef areas, shoreline modifications such as seawalls, land uses that contribute to sediment runoff, sewage and industrial pollution, and harassment or feeding of marine animals.

● ● ● Traditional Hawaiian Significance

In the traditional system of dividing the Hawaiian Islands into political regions, the *ahupua‘a* was the most important land division. *Ahupua‘a* usually extended from the mountains to the outer edge of the reef in the ocean, cutting through all of the major environmental zones along the way. Each



ahupua'a encompassed most of the resources Hawaiians required for survival, from fresh water to wild and cultivated plants, to land and sea creatures. Because of their dependence on the land's resources, the Hawaiians developed a complex system of resource management and conservation that could sustain those resources over time.

In traditional Hawaiian society, the ocean and marine life were as familiar as landforms and terrestrial life. The ocean was a source of food and other resources needed for living, as well as a "highway" between shoreline locations and between islands. Living in such close association with the ocean, early Hawaiians were skilled in swimming, navigating, fishing, and aquaculture.

Early Hawaiians were equally at home on land and in the sea. In their cultural traditions, most of the important land creatures had ocean-dwelling counterparts. A counterpart of the humpback whale, for example, was the sandalwood tree. In some cases, Hawaiian *kāhuna* could accept the ocean counterpart for an offering to the gods if the land creature could not be offered.

Like many land animals, certain marine animals could become *'aumākua* or personal gods that were regularly fed and recognized as individuals. Sharks and turtles were common *'aumākua*.

Hawaiians knew that the ocean was a great reservoir of food for them, and fishing, collecting shellfish, tending fish ponds, and gathering *limu* were constant, necessary occupations. Conserving the supply of the ocean's important resources was also a necessary part of Hawaiian culture and society. In traditional Hawaiian society, the ocean was treated like an icebox. Hawaiians took only what was needed at a specific time, knowing that what they needed in the future would be there then. Conservation was based on the understanding that greediness or waste would displease the gods, and on a knowledge of the life cycles and behaviors of each marine species.

The *kapu* system, which regulated all aspects of society, applied to fishing as well. Certain activities were prohibited or restricted to particular locations or seasons. For example, fishing for certain species during their spawning season was prohibited. Since different fish species spawned in different seasons, there was always food available and the reproducing fish were protected. Other *kapu* applied to fishing in specific inshore areas to allow populations of fish, shellfish, and *limu* to rebound. There was also a rule that ensured that all of the fish would not be removed from any given feeding area (or *ko'a*).

● ● ● Journal Ideas

Use some or all of the following topics for student journal entries:

- Listen to the chant. How would you describe the feeling of the chant? What did it make you think about?
- Listen to the English translation of the chant. Do you have different thoughts and feelings now that you know what this chant means in English?
- What comes to mind when you think of the ocean? What are your favorite areas and memories?
- Do you fish or gather sea life? Or do you know someone who does? What have you learned about the ocean from this person or this activity?

● ● ● To Get a Feel for the Marine Zone

If you are not doing Marine Unit 2, Activity #1 "Adaptation Concentration," you may use the Waikiki Aquarium video *Far from the Cradle* (included with this curriculum) to provide an overview of the Hawaiian marine environment for any of the units. Another overview video is the Island Heritage production *The Underwater World of Hawai'i* (available from Island Heritage, Aiea, Hawai'i, telephone (808) 487-7299, website at <www.islandheritage.com>).



● ● ● Marine Units at a Glance

Unit 1

Riding the Currents

Subjects

Dispersal of marine life

Oceanic currents in the Pacific Ocean

Endemism

Importance

As the Hawaiian Islands formed, marine life arrived here from other parts of the Pacific Ocean to become what we know as the native marine life of the islands. The ongoing dispersal of marine life depends upon ocean currents and the life cycle of marine organisms.

Activities in this unit

- **Navigating the Currents**
Students plan a trip and course for a hypothetical Polynesian canoe voyage to learn some of the primary oceanic currents and wind patterns in the Pacific Ocean.
- **Dispersing on the Currents**
Students learn about marine life reproduction and dispersal, and apply that knowledge to explain the dispersal of marine animals to Hawai‘i.



Unit 2

Marine Relationships

Subjects

Marine species
Adaptations
Trophic levels and food webs
Cultural significance of marine organisms

Importance

Marine organisms exist in specific environments or habitats to which they are well adapted. Understanding relationships among organisms, between organisms and their environment, and between people and marine life is one key to understanding the marine ecosystem.

Activities in this unit

- **Adaptation Concentration**
Students watch a video and play a game to learn about native Hawaiian marine animals and how they are adapted to the marine environment.
- **Marine Food Webs**
Students create food webs using native Hawaiian marine organisms and examine the effect of bioaccumulation on the flow of toxic organisms through these webs.
- **Marine Life Scrapbooks**
Students assemble scrapbooks about the natural history and cultural significance of native Hawaiian marine species.



Unit 3

On the Edge: Living in the Intertidal Zone

Subjects

Intertidal habitats

Zonation

Marine species

Adaptations

Importance

The intertidal zone is a small part of the marine environment of Haleakalā, but one that many students may be familiar with because of its cultural significance. Environmental conditions vary dramatically in the intertidal zone. Studying the conditions and organisms of this zone helps students understand the concept of zonation and provides a complement to the focus on sandy beaches in Coastal Unit 1 “Beach Today, Gone Tomorrow?”

Activities in this unit

- **Intertidal Zonation**
Students work in groups to understand environmental conditions within the five subzones represented in intertidal areas, and how Hawaiian marine organisms are adapted to survive in these conditions.
- **A Day in the Neighborhood: Skits About the Intertidal Zone**
Student groups develop and perform skits to teach the class about environmental conditions, organisms, and adaptations within an intertidal subzone.



Unit 4

Keeping an Eye on Coral Reefs

Subjects

Coral reef ecology

Coral reef study and monitoring techniques

Importance

Hawaiian coral reefs may generally be in better shape than reefs in many other parts of the world. Still, people are putting pressure on Hawaiian coral reefs, and the extent of our impact is not always known. That is why studying and monitoring coral reefs is so important.

Activities in this unit

- **Coral Reef Monitoring Simulations**
Through simulated exercises, students learn some fundamental skills and techniques used in monitoring coral reefs.
- **Protecting Coral Reefs**
Students perform Internet research on one of the main threats to coral reefs in Hawai'i and around the world.



Unit 5

Marine Management

Subjects

Science-based management
Conservation
Current issues in marine management

Importance

Since the time of the early Hawaiians, people have been making rules governing the use of the ocean and marine life. This unit helps students explore the types of rules used for conserving marine species and habitats as well as how science can contribute to making these rules.

Activities in this unit

- “Weren’t There More of Us?” Game
Students play a game to learn about Hawaiian reef animals and regulations intended to protect them.
- Impact of Aquarium Fish Collecting on Coral Reefs
Students read a study of the impact of aquarium fish collecting and interpret data from that study.
- Design a Monitoring Study
Using research design principles learned from the aquarium fish-collecting study, students design their own marine-monitoring study.
- Marine-Management Research Projects
Students undertake research projects on marine-management topics of their choosing.



● ● ● Optional Field Activities

Getting students out in the field puts them in direct contact with the ecosystem and gives them a context for learning. These are excellent supplements to the classroom-based activities of the marine module, giving students the excitement and challenge of hands-on experiences. Here is a listing of resources for field trips and other extensions.

Field Trips

Maui Ocean Center

Description

Self-guided tour with naturalist presentations

A naturalist greets every student group and makes an initial presentation at one of three main stations in the center. Students then tour the facility in small groups, seeing all of the exhibit areas including the Discovery Pool, Open Ocean, and Stingray Cove. Naturalists make formal presentations on a regular basis throughout the morning.

You will receive a curriculum packet in advance of your field trip that will help you link your classroom activities to the field trip.

Field Trip Time

Two hours for the self-guided tour, plus 1/2 hour for lunch

School groups may visit the Maui Ocean Center Tuesdays and Fridays from 9 a.m. to 12 p.m.

What to Bring

- Have students bring their own lunch or add lunch from the Maui Ocean Center for an additional per-student fee.

Group Size Limits

None

Contact

Call the Education Department at 270-7000 Ext. 119 at least two weeks in advance to make arrangements.

Fees

Per-student fee of \$5, one chaperone per 8 students is admitted free.

Getting There

The Maui Ocean Center is located at 192 Mā'alaea Road, about seven miles from Wailuku.



Pacific Whale Foundation

Description

Several standard programs are available, as well as custom-tailored programs for your class.

- *Ocean Van* brings the foundation's educators to your school. Presentations include a multi-media presentation, lecture, and time for student questions. Specific objectives are prearranged with teachers.
- *Whalewatch* excursions involve high school students in basic whale research techniques, available January through April.
- *Marine Debris Beach Survey* involves students in surveying a local beach to analyze the marine debris problem.
- *Tide Pool Exploration* involves students in identifying and observing common Hawaiian reef species, practicing sound field techniques, collecting data on marine debris, and learning about factors determining beach formation.

Pacific Whale Foundation programs can also be combined with a visit to Maui Ocean Center.

Field Trip Time

- *Ocean Van* visits involve up to two presentations that last one class period each.
- *Whalewatch* excursions are 1 1/2 hours long, not including travel time.
- *Marine Debris Beach Survey* takes two hours spent at each of one or more survey locations.
- *Tide Pool Exploration* takes one or more hours, dependent on tides and additional activities selected.

What to Bring

- Requirements depend upon the program selected. Check with the Education Department for details.

Group Size Limits

- Two presentations per *Ocean Van* visit, with each accommodating up to 40 students
- *Whalewatch* excursions, 100-125 (includes students and adults)
- *Marine Debris Beach Survey*, 15-30 students per survey site
- *Tide Pool Exploration*, maximum 60 students

**Contact**

Call the Education Department at 879-8860 to request an Ocean Outreach Programs brochure, which covers all of the foundation's class presentations and field excursions, or to develop a custom-tailored program for your class.

Fees

Ocean Van visits cost \$30.00 per visit (for up to two presentations). Some field trips (e.g., the whalewatch excursion) involve per-student fees, while most are free of charge.

Getting There

Location depends upon the field excursion chosen

Hawaiian Islands Humpback Whale National Marine Sanctuary

Description

Sanctuary staff generally offer field trips for grade school groups but will work with high school teachers to design an educational experience appropriate to the class and learning objectives. Educational resources include humpback whale exhibits and specialists, a traditional Hawaiian fishing pond and an on-staff Hawaiian culture expert, a *lānai* that offers excellent whale viewing from December through April, and populations of many native coastal plants. Adjacent beach parks offer opportunities to explore sand dune ecology or sea turtle nesting, or collect *limu* as a focal point for learning about its uses.

Field Trip Time

Flexible, depending upon the schedule you arrange with Sanctuary staff

What to Bring

Depends upon specific field trip plans

Group Size Limits

None

Larger classes may be divided into smaller groups to rotate through several learning stations.

Contact

Call the education coordinator at 879-2818.

Fees

None

Getting There

The Hawaiian Islands Humpback Whale National Marine Sanctuary office is located at 726 S. Kihei Road, approximately 13 miles from Wailuku.



Connecting Your Field Trip to the Marine Module

Here are some ideas for student assignments that link the field trip to the classroom activities of the marine module:

- During the field trip, have students identify and make a list of species they see that they learned about in Marine Unit 2 (all activities); Unit 3, Activity #1 “Intertidal Zonation”; and Unit 4, Activity #1 “Coral Reef Monitoring Simulations.”
- Have students take notes about or make a visual representation of marine relationships they learned about on the field trip.
- Have students make journal entries about reproductive strategies used by different marine organisms, how marine species are adapted to live in different environments, or major threats to the marine environment.

Extensions

- Maui Ocean Center offers volunteer opportunities. Beach clean-up and other service projects may be arranged by calling the Education Director at 270-7000 Ext. 128.
- The Pacific Whale Foundation makes available two programs for individual students or pairs of high school students. Contact the Education Department at 879-8860 for details.
 - *Student Naturalists* involves students in independent research on a marine science topic of their choosing. A marine biologist reviews this research before students present it to the public on board the foundation’s regular public educational cruises.
 - *Career Shadowing* involves students in half-day “shadowing” interactions with a charter boat captain, field research marine science naturalist, public information liaison, or retail associate. Students learn about the training required and daily responsibilities of individuals in these occupations.
- Project S.E.A.-Link offers a *High School Naturalists* program in which students are trained to share information about the marine environment with customers on snorkel boats. Call Project S.E.A.-Link at 669-9062 for details or e-mail info@projectsealink.org.
- Reef Environmental Education Foundation (REEF) carries out its mission to educate and enlist divers in the conservation of marine habitats primarily through its *Fish Survey Project*. REEF surveys are conducted as part of a diver’s regular diving activities, anytime they are in the water. For more information, see REEF’s website at www.reef.org.