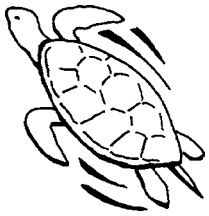


Activity #1

Coastal Inhabitants

● ● ● In Advance *Enlarge Coastal Schematic*

- Have a few students make enlarged coastal schematics for use during the first class period. Tape a large piece of newsprint on the wall and project the Coastal Schematic acetate onto the newsprint. Have students use a marker to trace the image onto the newsprint. Make two for each group of six to ten students. (See class period one materials & setup for materials needed.)

● ● ● Class Period One *Coastal Areas Then and Now*

Materials & Setup

In advance

- "Coastal Schematic" acetate (master, p. 9)
- Several large sheets of newsprint (two for each group of six to ten students)
- Masking tape
- Large marking pens
- Overhead projector

For each group of six to ten students

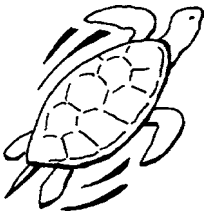
- One blank enlarged "Coastal Schematic" on newsprint
- Colored marking pens or colored pencils
- Cellophane tape
- Set of 44 "Coastal Species Cards" in color (master, pp. 10-32)

Instructions

1) Ask students to brainstorm the plants and animals they have seen in coastal areas. Write their ideas on the board or overhead.

2) Ask students which plants and animals on this list they think are native, and which are not. Note what the majority of students think next to the plant or animal name on the list. After you have gone through a good selection from the list, ask students whether they think most plants and animals in coastal areas are native or nonnative.

3) Tell students that the coastal ecosystem on Maui has been dramatically altered by human use from the time of the original Polynesian settlers through today, and in fact is the most altered ecosystem on the island. Ask students to discuss why that is, brainstorm about questions such as why people would want to live in the coastal zone, and how people use coastal areas. Write student ideas on the board or overhead.



4) Divide the class into groups of six to ten students. Give each group a newsprint version of the "Coastal Schematic," some colored marking pens or pencils, and a set of laminated color species cards.

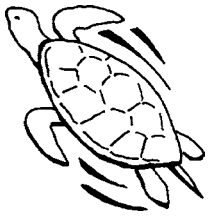
5) Have groups separate native from nonnative species cards. (Note: Be sure students understand that the label, "endemic," signifies species that are endemic to the Hawaiian Islands. Also make sure students know the meaning of the term "indigenous." It refers to a species that is native, but not unique, to an area.) During this process, they should notice whether any of the species they thought were native are actually nonnative, or vice versa.

6) Using the native species cards only, have each group create a representation of what the coastal ecosystem might have looked like before people came to Maui. The cards contain habitat information that will help students place species in the correct parts of the coastal ecosystem. They may tape the species cards onto the newsprint schematic and/or draw the species in the appropriate places on the schematic. Students should fill in the schematic with their own drawings of species, especially those that they think would have been more abundant than taping the species card to the schematic would suggest.

7) Ask students to consider their representations of the native coastal ecosystem in light of the fact that the coastal ecosystem is the most altered ecosystem on Maui. Have students brainstorm what might be missing from their representations, which have been created using only species that still exist today. Summarize the discussion by using the following points:
   - Fossil evidence indicates that large flightless geese and flightless ibis that are now extinct once inhabited the coastal area.
   - The coastal area was once predominently forested. Scientists estimate that it was eighty percent or more forested prior to human settlement. Intensive cultivation in coastal areas led to the demise of these forests.
   - Based on historical accounts and fossil evidence, scientists know that native honeycreepers such as the *ʻapapane* and *ʻamakihi* once inhabited coastal areas. As the native vegetation has been largely removed and replaced by alien plants, these birds no longer inhabit the coastal ecosystem.
   - Human use and development of coastal areas has eliminated many wetlands areas and sand dunes.
   - Scientists acknowledge that they cannot know for certain what the coastal ecosystem was like prior to human settlement because so much has changed.
   - Many plant and animal species that were once abundant in the coastal area are rare today.

8) Allow groups a short time to add to or adjust their coastal ecosystem representations based on the discussion.

9) Have each group briefly present its representation to the rest of the class. (Keep the newsprint representations and the nonnative species cards for the next class period.)



● ● ● Class Period Two *Where Did Coastal Species Come From?*

Materials & Setup

- World Map acetate (master, p. 33)
- Four colors of nonpermanent overhead markers
- Overhead projector and screen

For each group of six to ten students

- Native coastal areas representations and non-native species cards from previous class
- One blank enlarged "Coastal Schematic" on newsprint
- Colored marking pens or colored pencils
- Cellophane tape

Instructions

1) Divide the class into the groups from the previous class period. Each group should have its representation and species cards from the previous class period, along with a blank "Coastal Schematic" on newsprint and colored markers or pencils.

2) Have each group brainstorm a list of everything they can think of that's been introduced into coastal areas on Maui. They may use the species cards to generate ideas and their lists may include living and nonliving things (e.g., roads, hotels, houses, beach access, harbors, dune restoration fences).

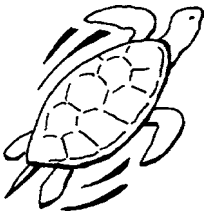
3) Have each group use its list and all the species cards (including those from the previous day's schematic) to create a representation of what the coastal ecosystem on Maui looks like today. They may tape species cards onto the newsprint schematic in addition to drawing other living and nonliving elements found in today's coastal areas.

4) Have each group briefly show its representation to the rest of the class and explain the differences between it and the native coastal ecosystem they represented during the previous class period.

5) Ask students to brainstorm all the different ways coastal plants and animals could have gotten to the Hawaiian Islands. Write student ideas on the board or overhead.

6) Project the "World Map" acetate. Tell students they are going to work with information on the species cards to identify patterns in how species got here, where they came from, and where Hawaiian species are found elsewhere in the world. They will consider five main categories:
   - Indigenous species (these illustrate natural patterns of dispersal),
   - Migratory species,
   - Endemic species,
   - Polynesian introductions, and
   - Species introduced after European contact.

   Assign a different color marker to each of these five categories.



7) Have students review species cards for information about the origins of Hawaiian coastal species and geographic distribution patterns of species found in Hawai'i. As they discover information, call on one student at a time to say the name of the species, where it came from originally, and how it got to Hawai'i. Use the appropriate colored marker to draw a line on the map connecting the place of origin with the Hawaiian Islands. For indigenous species without a clear place of origin, put marks on the map to indicate where else in the world the species are found. For each endemic species, simply draw a dot near the Hawaiian Islands.

8) When the map is filling up or you have covered most of the cards, ask students to identify and explain patterns based on the lines and dots on the map. If students need help, ask them to look for:
   - Regions where many species originate (e.g., tropical Pacific Islands, throughout the tropics worldwide, Indian Ocean),
   - Regions where few species originate (e.g., American continent, Australia, India, Europe),
   - Similarities and differences between the origins or geographic distribution of species that dispersed naturally and those introduced by humans (e.g., most indigenous species are distributed throughout the Pacific islands, throughout the tropical Pacific and Indian Oceans, and more broadly throughout the tropics; human introductions expand the geographic connections of Hawaiian species to include places such as Europe, Australia, India, and the American continent), and
   - The number of endemic species. (Many Hawaiian ecosystems are comprised of a high number of endemic species because the isolation of the islands makes ongoing genetic exchange with other places unlikely. Coastal ecosystems have relatively few endemic species because of the increased likelihood of continuing inflow of genetic material from off-island in areas where many plants are dispersed on ocean currents or carried in the digestive tracts of migratory birds.)

Journal Ideas

- Why is the coastal ecosystem the most human-altered ecosystem type on Maui? Since there is very little native coastal habitat left, what do you think people should do?
- How would you describe how you thought about coastal areas before this activity? What have you learned about the coastal ecosystem? How do you feel about the coastal areas on Maui now?
- If you did the dispersal mapping exercise that you did during class separately for native species and nonnative species, what differences would you expect to see in the maps? Why?

Assessment Tools

- Group representations of native coastal ecosystems and the coastal ecosystems of today
- Group lists of living and nonliving things humans have introduced to coastal areas
- Participation in group work and class discussions
- Journal entries

Coastal Schematic

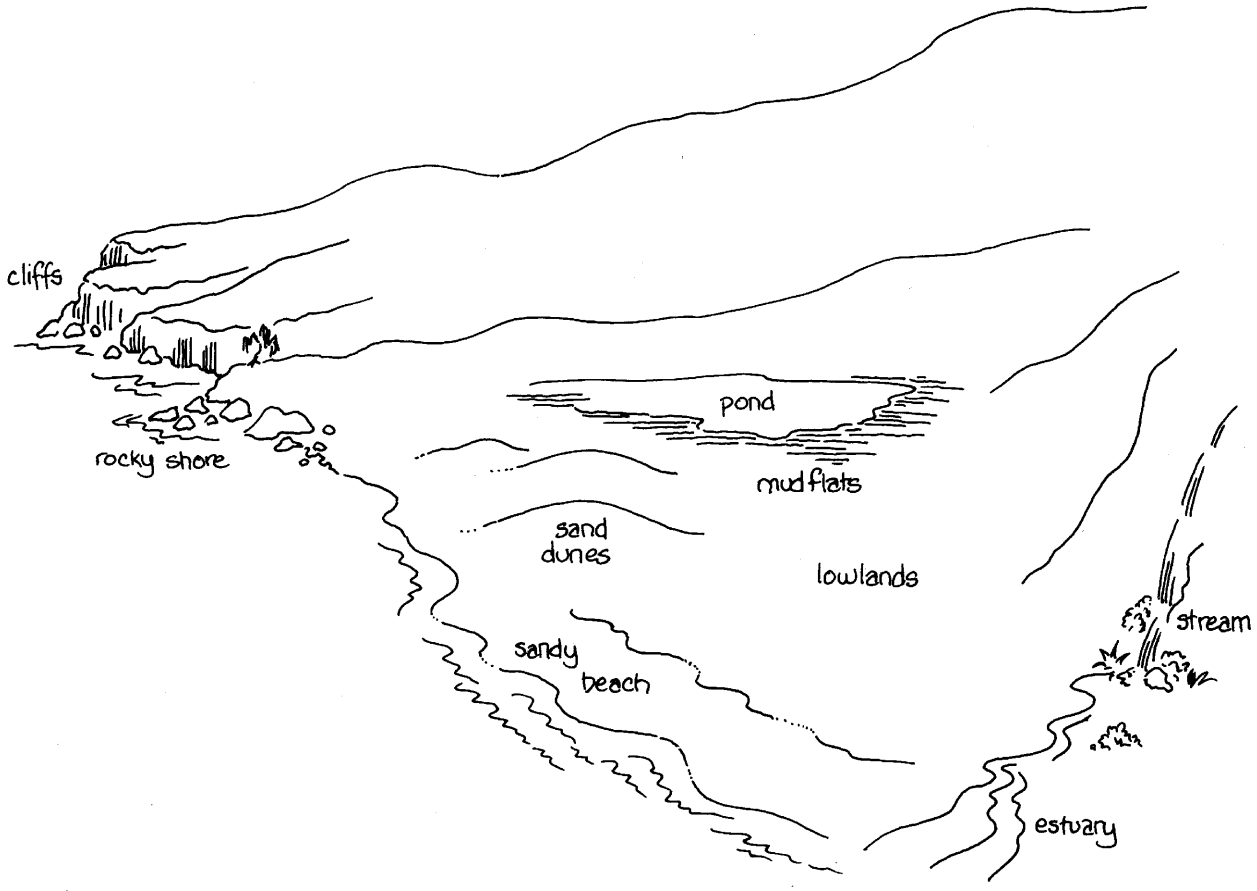


Illustration: Sophie Cayless

Coastal Species Cards

Cut apart along dotted lines.

Photo: Forest Starr and Kim Martz

***Hala* or Screwpine** (*Pandanus tectorius*)

Order Pandanales, Family Pandanaceae

- This indigenous tree is also found along or near the coast of most Pacific islands.
- Although it was propagated by Hawaiians, *hala* is thought to have colonized the Hawaiian Islands naturally. Fossilized *hala* fruit a million years old have been found on Kaua‘i.

Habitat

- This tree is usually found in coastal areas, but it can also grow at elevations up to 610 meters (2000 feet).

Adaptations & Interactions

- Its fruit floats and is easily dispersed through ocean currents.
- Its somewhat fleshy leaves help it retain water.
- Numerous “prop” roots that support a relatively weak main trunk enable this tree to survive in windy coastal areas, even though it grows up to thirty feet tall. Its fibrous leaves also withstand wind.

Human Connections

- Its seeds and parts of the male flower were sometimes eaten, although mostly in times of famine.
- Fresh fruit sections were strung together in *lei*. Dried sections were used to apply dye to *kapa* cloth.
- The *lau hala*, the tree’s long spiny leaves, were stripped of their spines and woven into mats, baskets, canoe sails, and other objects. Where *pili* grass was unavailable, the *lau hala* were used to thatch houses.

Photo: Forest Starr and Kim Martz

Naupaka Kahakai or Beach Naupaka (*Scaevola sericea)*

Order Campanulales, Family Goodeniaceae

- This indigenous shrub is also found elsewhere throughout the tropical and subtropical regions of the Pacific and Indian Oceans.
- It is a common plant in coastal shrublands in windward and leeward areas, on sand or rock, and often along with other native vines and shrubs. It can be low-lying, or grow to twelve feet tall.

Habitat

- This highly salt-tolerant shrub grows in the coastal or beach strand, an environment affected by salt spray and seawater.

Adaptations & Interactions

- Its round, white fruits float and tolerate saltwater. It can germinate when washed ashore after a year at sea.
- Its succulent leaves help it retain water.
- Its fruits are eaten by pigeons and seabirds, especially in places where there are few other fruits available.

Human Connections

- In Hawaiian legend the "half flower" of the *naupaka* is from a flower torn in half by the heartbroken princess Naupaka who was not allowed to marry her love. She went to live in the mountains and her half of the flower became the *naupaka kuahiwi*. At the seashore, her lover's half of the flower became *naupaka kahakai*.
- The bark of this shrub has been used in traditional Hawaiian medicine, and fruits were occasionally eaten.

ʻŌhelo Kai (*Lycium sandwicense)*

Order Solanales, Family Solanaceae

Photo: Forest Starr and Kim Martz

- This indigenous shrub is endemic to Polynesia, where it is found on scattered islands in areas such as Tonga and Rapa.
- It grows low to the ground.

Habitat

- *ʻŌhelo kai* normally grows on arid, rocky shorelines within reach of the salt spray.

Adaptations & Interactions

- Its succulent leaves help it retain water.
- Livestock may graze on this plant during dry times.

Human Connections

- Its bright red, juicy fruits are sometimes eaten, although the flesh is salty and not too tasty.

Pōhinahina or Beach Vitex

(*Vitex rotundifolia)*

Order Lamiales, Family Verbenaceae

Photo: Forest Starr and Kim Martz

- This indigenous shrub is also native to parts of India, southern Japan, and many tropical Pacific islands.
- It grows low to the ground.

Habitat

- It grows on sand dunes, sandy beaches, and rocky shores.
- As beaches and coastal areas are developed, this plant is becoming increasingly rare.

Adaptations & Interactions

- *Pōhinahina* rarely reaches more than two feet high, a growth form that helps protect it from the wind and salt spray.
- Its silvery or grayish leaves help reflect the harsh and direct sunlight.

Human Connections

- This plant is sometimes used in traditional Hawaiian medicine.
- Its Hawaiian name refers to the light green leaves of the *pōhinahina*, which can look silvery or grayish.

ʻŪlei or Hawaiian Rose

(*Osteomeles anthyllidifolia*)

Order Rosales, Family Rosaceae

Photo: Forest Starr and Kim Martz

- This indigenous woody vine or shrub also occurs in the South Pacific on the Cook Islands and Tonga.

Habitat

- *ʻŪlei* grows from sea level up to at least 1829 meters (6000 feet) on arid parts of the Hawaiian Islands.

Adaptations & Interactions

- It is sometimes overgrown by the parasitic *kauna'oa* plant, which absorbs nutrients from it.

Human Connections

- *ʻŪlei* wood was used for making fish spears. It was also used to make a musical instrument called the *ʻūkēkē*. This bowed piece of wood was fitted with two or three strings that were strummed. The supple, viny branches were used for weaving fish traps and baskets.

‘Ilima (*Sida fallax*)

Order Malvales, Family Malvaceae

Photo: Forest Starr and Kim Martz

- This indigneous shrub is also found along arid coastlines of many other tropical Pacific islands and as far west as China.
- *‘Ilima* grows low to the ground in small clumps.

Habitat

- It is found just behind the open, outer beach strand in sandy or rocky spots or high above the ocean on cliffs. Inland, it can grow as an upright shrub.

Adaptations & Interactions

- The hairy leaves help keep salt off the surface of the leaf, preventing damage from salt spray. Their silvery color helps reflect sunlight.

Human Connections

- Its beautiful yellow-orange flowers are prized for making *lei*.
- In traditional Hawaiian medicine, *‘ilima* flowers were used as a general tonic. Juice from the pressed flowers, or chewed flowers, was given to children and pregnant women as a mild laxative.

Pōhuehue or Beach Morning Glory (*Ipomoea pes-caprae* subsp. *brasiliensis*)

Order Solanales, Family Convolvulaceae

Photo: Forest Starr and Kim Martz

- This common indigenous vine is also found extensively throughout the tropics.
- It is a low-growing, trailing, woody vine with pinkish-red, bell-shaped flowers.

Habitat

- Its thirty- to one hundred-foot creeping stems typically grow right up to the water’s edge on sandy beaches. It is also found on rocky shorelines.

Adaptations & Interactions

- *Pōhuehue* seeds float well and are salt water-tolerant.
- The smooth, thick leaves with waxy surfaces help retain water and protect from salt spray.

Human Connections

- In ancient Hawai‘i, the long roots were cooked and eaten, despite the fact that they can be poisonous.
- *Pōhuehue* stems were sometimes used by ancient Hawaiian surfers to induce the surf to come up. Slapping the stems on the water was accompanied by special chants.

Pā‘ū o Hi‘iaka or Small Blue Morning Glory (*Jacquemontia ovalifolia* subsp. *sandwicensis*)

Order Solanales, Family Convolvulaceae

Photo: Forest Starr and Kim Martz

- This common vine is found from west Africa to the Pacific Islands, but the Hawaiian Islands are the only Polynesian islands on which the species is found. The *pā‘ū o Hi‘iaka* is an endemic subspecies.
- It is a low-growing plant with vines up to ten feet long.

Habitat

- It sprawls over shorelines of bare rock and sand, often with *‘ilima*, and sunny inland spots to 457 m (1500 ft) in elevation.

Adaptations & Interactions

- *Pā‘ū o Hi‘iaka* plants usually have leaves covered with many whitish hairs that reflect sunlight and help protect the plant from saltwater damage.

Human Connections

- In Hawaiian legend, the fire goddess Pele named this plant when she came back from a morning of fishing. She had left her baby sister, Hi‘iaka, on the beach and the trailing vines of the plant had grown over the child, protecting her from the sun. The name means “skirt of Hi‘iaka.”
- In ancient Hawai‘i, its roots and leaves were served as food.

Kauna’oa Kahakai, or Hawaiian Dodder (*Cuscuta sandwichiana*)

Order Solanales, Family Cuscutaceae

Photo: Forest Starr and Kim Martz

- This endemic vine is found on all of the main islands except Kaua‘i.

Habitat

- It grows on plants found in the coastal or beach strand, an environment affected by salt spray and seawater, as well as plants found behind the beach strand.

Adaptations & Interactions

- This parasitic plant lacks chlorophyll. Its yellow stems grow over other beach plants, absorbing nutrients from these hosts.
- Common host plants include *naupaka kahakai, ‘ilima,* and *pōhuehue*.

Human Connections

- Strands of *kauna‘oa* were used in braiding *haku lei*. *Kauna‘oa* is the lei flower of Lāna‘i.

ʻĀkulikuli or Sea Purslane

(*Sesuvium portulacastrum*)

Order Caryophyllales, Family Aizoaceae

Photo: Forest Starr and Kim Martz

- This indigenous vine is native to many tropical coastal areas.

Habitat

- *ʻĀkulikuli* is one of the most salt-tolerant plant species, growing in areas that are splashed by waves and in and around salt marshes and other saline zones. Its habitats include sandy and rocky beaches and surrounding sandy lagoons.

Adaptations & Interactions

- This low-growing plant has narrow, succulent leaves that help retain water.

Human Connections

- Sea purslane is an edible herb—although salty—and may be eaten raw or cooked.

ʻAkiʻaki or Beach Dropseed

(*Sporobolus virginicus*)

Order Cyperales, Family Poaceae

Photo: Forest Starr and Kim Martz

- This indigenous grass is native to tropical and subtropical areas worldwide.
- *ʻAkiʻaki* is a wiry grass that sends up a flower spike that can be up to 20 inches tall.

Habitat

- It grows near the high tide line.

Adaptations & Interactions

- *ʻAkiʻaki* plays an important role in stabilizing sand dunes. It spreads by means of an underground root structure, creating a dense, interconnected web of roots that help hold sand in place.

Ma‘u ‘Aki‘aki or Button Sedge
(*Fimbristylis cymosa*)
Order Cyperales, Family Cyperaceae


Photo: Philip Thomas

- This indigenous sedge is distributed throughout the Pacific from Malaysia to tropical America.

Habitat
- It is often the dominant species—sometimes the only one—on rocky and sandy coasts.
- *Ma‘u ‘aki‘aki* rarely grows far from shore.

Human Connections
- The *ma‘u ‘aki‘aki* stem was used as an ear cleaner.

Niu or Coconut Palm (*Cocos nucifera*)
Order Arecales, Family Arecaceae


Photo: Forest Starr and Kim Martz

- This Polynesian-introduced tree is distributed throughout the tropics.

Habitat
- Like other seashore trees, *niu* grows behind beaches. At higher elevations and around old village sites, the presence of *niu* offers evidence of the widespread planting of this tree from early Hawaiian times to the present.

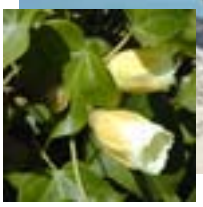
Adaptations & Interactions
- The coconut (the fruit of the coconut palm) floats and can survive in the ocean for about four months. So, although it was first introduced to Hawai‘i by Polynesians, it could spread from island to island on the currents.
- *Niu* can grow taller than 100 feet, carrying its sturdy, fleshy leaves only at the top of the trunk.

Human Connections
- *Niu* is a useful plant in traditional Hawaiian society. The nut provided food, oil, and material for making utensils. The husks provided fiber for cordage, and the leaves were used as thatch and to make baskets. The trunks were used as structural posts.

Milo or Portia Tree

(*Thespesia populnea*)

Order Malvales, Family Malvaceae



Photos: Forest Starr and Kim Martz

- This Polynesian-introduced tree is found throughout the tropics.
- It varies in size from a shrub to an upright tree over 20 feet tall.

Habitat

- *Milo* forms part of the understory of what is sometimes called the "beach forest," the area behind the beach where the taller trees and shrubs tend to grow. Highly salt tolerant, this tree often grows in exposed coastal areas, mixed with *hau* and *hala*. Its form is often sculpted by strong coastal breezes.

Adaptations & Interactions

- In winter, *milo* trees may lose many leaves due to salt spray from high surf. But the leaves grow back in summer.
- *Milo* seeds are buoyant and salt water-resistant.
- The shiny, waxy leaf surfaces provide protection from salt spray and water loss.

Human Connections

- *Milo* wood is used by carvers, especially for beautiful wood bowls. The wood was traditionally used for canoe hulls. Parts of the tree were used to make dye, and the young leaves are edible either raw or cooked.
- In traditional Hawaiian medicine, *milo* seeds are taken as a laxative.

Hau (*Hibiscus tiliaceus*)

Order Malvales, Family Malvaceae

Illustration: Joan M. Yoshioka

- This Polynesian-introduced shrub/tree grows up to 12 feet tall. It is common along many tropical Pacific beaches.
- It is considered by some to be an indigenous species, although Polynesians probably brought *hau* cuttings to Hawai'i with them.

Habitat

- Salt-resistant, it grows most often near the coast, although it was also cultivated further inland.

Adaptations & Interactions

- The fleshy leaves help retain water.

Human Connections

- *Hau* was a valuable plant in traditional Hawaiian society. Its light, buoyant wood was used for canoe outriggers, net floats, and adz handles. Its fiber was used to make cordage and fishing nets. *Hau* fiber is still used in making *haku* and *wili lei.*
- *Hau* was a popular shade tree around homes.
- In traditional Hawaiian medicine, sap yielded from the bark and branches was used as a mild laxative. Buds of the *hau* flower were chewed and swallowed to relieve dry throats, and the bark was used to make a medicine for chest congestion and childbirth.

Kou (*Cordia subcordata*)

Order Lamiales, Family Boraginaceae

Photos: Forest Starr and Kim Martz

- This Polynesian-introduced tree is native to southeast Asia and many western Pacific islands.
- It is a small tree that rarely gets taller than thirty feet.

Habitat

- *Kou* grows in dry, scrubby lowland areas including arid seashores.

Human Connections

- *Kou* was a favored shade tree among Hawaiians, and its light, strong wood was made into utensils and religious statues.
- The flowers were used in *lei,* and the leaves were used to make a light tan dye for *kapa* and to color fishing lines.
- The seeds were sometimes eaten.

Noni **or Indian Mulberry** (*Morinda citrifolia*)

Order Rubiales, Family Rubiaceae

Illustration: Joan M. Yoshioka

- This Polynesian-introduced shrub/tree is found on many South Pacific islands.
- It is a short evergreen tree or shrub.

Habitat

- *Noni* grows wild in many places along the rocky coasts of Hawai‘i. It has naturalized in moist and arid areas from sea level to about 400 meters (1312 feet).

Adaptations & Interactions

- *Noni* has thick, glossy leaves.

Human Connections

- *Noni* has many uses in traditional Hawaiian medicine and is considered a natural cure-all. Leaves were crushed and applied to bruises, sores, and wounds. The bark was used to treat cuts, and juice from the roots was used for skin problems. The green fruits were mashed and used over broken bones and to treat concussions.
- The bad-smelling fruits are edible, but in early Hawai‘i were eaten only during times of famine.
- Yellow and red dyes for *kapa* were made from the root.

***Kiawe* or Mesquite** (*Prosopis pallida)*

Order Fabales, Family Fabaceae

Photos: Forest Starr and Kim Martz

- This nonnative tree is a native of tropical South America (Peru, Colombia, Ecuador).
- It can grow to heights of over 50 feet.

Habitat

- *Kiawe* dominates the landscape in lowland dry areas, especially disturbed sites. It is common near sandy shores as well.

Adaptations & Interactions

- Its deep roots allow it to tap ground water in dry areas, possibly lowering the water table in coastal zones.
- It is well known for its long, piercing thorns. This is the only tree in the coastal dry forest that can form a canopy (continuous covering of tree branches).

Human Connections

- The first *kiawe* tree was planted in Hawai'i in 1828.
- This tree is now very useful in Hawai'i. It is cut for firewood, its flowers yield delicious honey, and its pods are used to feed pigs and cattle. It is sometimes planted to reforest dry lowlands.

Koa Haole (*Leucaena leucocephala*)

Order Fabales, Family Fabaceae

Photo: Forest Starr and Kim Martz

- This nonnative shrub/small tree is native to tropical America. It has been spread by humans to many tropical areas around the world.
- *Koa haole* can reach 30 feet in height.

Habitat

- This plant is now abundant and widespread in Hawai'i, where it has successfully invaded extensive areas of the coast and dry lowlands, especially disturbed sites.

Adaptations & Interactions

- Its long tap roots give it access to ground water and can make it difficult to remove from areas in which it is established.

Human Connections

- This shrub provides cattle feed and firewood. It is used for erosion control, to improve the soil (by attracting nitrogen-fixing bacteria to its root system), and to provide shade for natural regeneration of native species.
- Seeds from *koa haole* are strung to make *lei*.

Indian Pluchea or Indian Fleabane
(*Pluchea indica*)
Order Asterales, Family Asteraceae

Photo: Forest Starr and Kim Martz

- This nonnative shrub is native to southern Asia. Its name is pronounced *ploo-key-a*.

Habitat
- It grows on marshy shorelines and muddy areas around ponds.

Adaptations & Interactions
- It bears clusters of dull purple flowers. The seeds are wind-borne, and when they blow away, they leave behind what looks like fuzzy dry flowers that make Indian pluchea distinguishable from a distance.

Human Connections
- In traditional Hawaiian medicine, this plant was used internally to treat fevers and externally for poultices.

ʻĀkulikuli Kai or Pickleweed (*Batis maritima*)
Order Batales, Family Bataceae

Photo: Forest Starr and Kim Martz

- This nonnative shrub is native to tropical and subtropical America.

Habitat
- Introduced to Hawaiʻi by 1859, it now grows in dense stands and large clumps in marshy coastal areas, around ponds, and in estuaries.

Adaptations & Interactions
- The smooth, fleshy, cylindrical leaves help the plant retain water.

Human Connections
- The leaves are edible and taste salty. They are said to have medicinal value.

Paina or Common Ironwood
(*Casuarina equisetifolia*)
Order Casuarinales, Family Casuarinaceae


Photo: Michele Archie

- This nonnative tree is native to northern Australia.
- It is a rapidly growing tree that may grow to 80 feet in ten years.

Habitat
- Introduced within the last 200 years, it is now widespread throughout the islands, especially in dry environments with poor soil. It ranges from sea level to about 915 meters (3000 feet).

Adaptations & Interactions
- In many areas, it grows in thick stands that choke out virtually all other plant life.

Human Connections
- The inner bark is used to soothe sore throats and other illnesses.
- It is planted as a windbreak, to hold soil or sand in place, or to enrich soil with nitrogen.

'Iwa or Great Frigatebird
(*Fregata minor palmerstoni*)
Order Pelecaniformes, Family Fregatidae


Photo: Forest Starr and Kim Martz

- This indigenous seabird is widespread throughout the tropical Pacific.

Habitat
- It is often seen in flight around the main Hawaiian Islands, but nests primarily on the Northwestern Hawaiian Islands.

Adaptations & Interactions
- Its Hawaiian name means "thief." The *'iwa* can often be seen harassing boobies and shearwaters until they drop the prey they are carrying. The *'iwa* then catches the food in midair and flies off with it.

Human Connections
- In Hawaiian, the saying "*kikaha ka 'iwa he la makani*" refers to a well-dressed person. Literally, it means, "The *'iwa* bird soars over the cliffs."

Koa'e Kea or White-Tailed Tropicbird

(*Phaethon lepturus dorotheae*)

Order Pelecaniformes, Family Phaethontidae

Photo: Forest Starr and Kim Martz

- This indigenous seabird can be found nesting throughout most mountainous Pacific island groups.

Habitat

- It is often seen along windward coasts and inland valleys of all of the main Hawaiian Islands. It nests in inaccessible rock crevices and cliff faces on these islands.

Adaptations & Interactions

- The *koa'e kea* feeds by making plunging dives into the ocean to catch fish and squid.

Human Connections

- Like the related *koa'e 'ula* (red-tailed tropicbird), *koa'e kea* feathers were used in traditional Hawaiian featherwork.

Noio or Black Noddy

(*Anous minutus melanogenys*)

Order Charadriiformes, Family Laridae, Subfamily Sterninae

Illustration: Joan M. Yoshioka

- The *noio* is an endemic seabird. This subspecies is a year-round resident throughout the Hawaiian Islands. The species breeds on islands in the tropical Atlantic and Pacific.

Habitat

- On the main Hawaiian Islands, it is found most frequently in rocky coastal areas.
- On the main islands, *noio* nest in caves or on rocky cliff ledges. In the Northwestern Hawaiian Islands, they often build nests in ironwood trees or *naupaka*.

Adaptations & Interactions

- It uses its long, sharp beak to feed on small fish near the surface of the ocean, as well as on hatchling hawksbill sea turtles making the journey across beaches from nest to ocean.

Human Connections

- Even today, traditional Polynesian voyagers look for *noio* as a sign that they are close to islands.
- The name, "noddy," comes from the nodding or bobbing of males feeding fish to females before egg laying.

ʻUaʻu Kani or Wedge-Tailed Shearwater

(*Puffinus pacificus*)

Order Procellariiformes, Family Procellariidae

Photo: Forest Starr and Kim Martz

- This indigenous seabird is found throughout the tropical and subtropical Pacific and Indian Oceans.
- *ʻUaʻu kani* is the most common seabird seen around the main islands.

Habitat

- It nests throughout the Northwestern Hawaiian Islands and along the coasts and offshore islets of the main islands.

Adaptations & Interactions

- *ʻUaʻu kani* nest in colonies, digging burrows with their feet or nesting in natural crevices.

Human Connections

- Young birds leaving their colonies are often stranded on beaches and disoriented by urban lights. They can be hit by cars or killed by cats and dogs.

Kōlea or Pacific Golden Plover

(*Pluvialis fulva*)

Order Charadriiformes, Family Charadriidae

Photo: Eric Nishibayashi

- This indigenous shore bird is the most abundant migratory winter visitor to Hawaiʻi.
- *Kōlea* nest in the arctic and return here in August. Most birds fly north again by early May. A few oversummer here, often first-year birds.

Habitat

- They are found on mudflats, lawns, fields, and grassy mountain slopes from sea level to above 3050 meters (10,000 feet). *Kōlea* are highly territorial and return to the same area year after year.

Adaptations & Interactions

- *Kōlea* feed by running in short spurts, then stopping to search for insects and other invertebrates.
- Plant seeds from the digestive tracts of *kōlea* and other shore birds remain viable and able to sprout upon arrival in Hawaiʻi. Seeds may also be transported stuck to feathers or mud-encrusted feet.

Human Connections

- Its Hawaiian name has come to mean "boaster."
- In Hawaiian legend, *kōlea* and tree snails have a mutually beneficial relationship. *Kōlea* bring the snails nectar and in return the snails sing for the birds.

ʻŪlili or Wandering Tattler

(*Heteroscelus incanus*)

Order Charadriiformes, Family Scolopacidae

Photo: Eric Nishibayashi

- This indigenous shore bird is a common migratory winter visitor to Hawai‘i.
- *ʻŪlili* nest in Alaska and arrive here in August. Most birds fly north again by late April or early May.

Habitat

- These birds are most often found in mud flats, on sandy beaches, rocky coastlines, and rocky streams inland.

Adaptations & Interactions

- *ʻŪlili* bob up and down as they probe into the mud or under rocks searching for mollusks and other invertebrates.

Human Connections

- Its Hawaiian name mimics the call of the *ʻūlili*.

Hunakai or Sanderling (*Calidris alba*)

Order Charadriiformes, Family Scolopacidae

Photo: Eric Nishibayashi

- This indigenous shore bird is a common migratory winter visitor to Hawai‘i.
- *Hunakai* arrive in Hawai‘i by August and fly north to their arctic breeding grounds in April.

Habitat

- They are commonly seen on mud flats and sandy beaches, often with plovers and turnstones.

Adaptations & Interactions

- *Hunakai* feed by picking at the surface of the mud flat or in shallow water for invertebrates. They also search for exposed prey by chasing receding waves.

Human Connections

- In Hawaiian, its name means “sea foam.”

ʻAkekeke or Ruddy Turnstone

(*Arenaria interpres*)

Order Charadriiformes, Family Scolopacidae

Photo: Eric Nishibayashi

- This indigenous shore bird is a very common migratory winter visitor to Hawaiʻi.
- *ʻAkekeke* nest in the Arctic, leaving Hawaiʻi in April or May and returning in August. A few over-summer here.

Habitat

- They are commonly found along shorelines and mud flats as well as in fields and lawns.

Adaptations & Interactions

- In their search for insects and crustaceans, they turn over stones with their bills. They sometimes break open and eat seabird eggs.
- They often join small flocks of other shore birds.

Human Connections

- The Hawaiian name means "talkative."

Aeʻo or Hawaiian Stilt or Black-Necked Stilt

(*Himantopus mexicanus knudseni*)

Order Charadriiformes, Family Recurvirostridae

Photo: Eric Nishibayashi

- This endemic race of water bird is a year-round resident on all of the main Hawaiian Islands, and is endangered.

Habitat

- *Aeʻo* nest in wetlands, including Kanahā and Keālia ponds on Maui. Nesting sites are adjacent to or on low islands in fresh, brackish, or salt water.
- They spend time in open mud flats, pickleweed mats, and open pastureland, where visibility is good and predator pressure is low.

Adaptations & Interactions

- Their nests are usually shallow depressions lined with stones and twigs.
- Hawaiian stilts feed in shallow water, where they find a variety of invertebrates and other aquatic organisms.

Human Connections

- The stilt's Hawaiian name means "one standing tall."

ʻAlae Keʻokeʻo or Hawaiian Coot

(*Fulica americana alai*)

Order Gruiformes, Family Rallidae

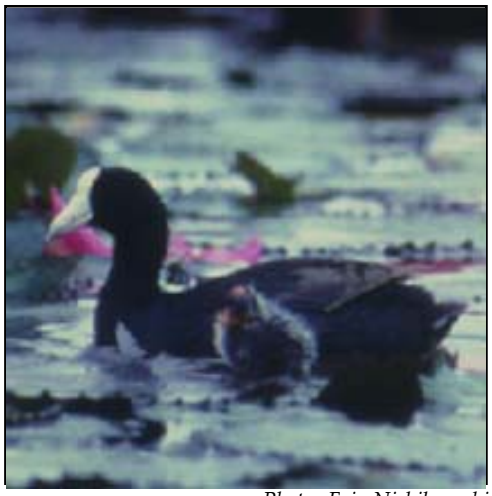


Photo: Eric Nishibayashi

- This endemic water bird is found on all the main Hawaiian Islands. It is an endangered species.

Habitat

- *ʻAlae keʻokeʻo* are found in fresh and saltwater marshes and ponds. They build floating nests in aquatic vegetation.

Adaptations & Interactions

- When ponds dry up, coots fly long distances looking for suitable habitat, sometimes flying between islands.
- *ʻAlae keʻokeʻo* eat seeds and leaves of aquatic plants, insects, tadpoles, and small fish.

Human Connections

- In Hawaiian, *ʻalae keʻokeʻo* means "white forehead."

ʻAukuʻu or Black-Crowned Night-Heron

(*Nycticorax nycticorax hoactli*)

Order Ciconiiformes, Family Ardeidae

Photo: Eric Nishibayashi

- This indigenous water bird is resident on all the main Hawaiian Islands and is also found on the American continent.

Habitat

- *ʻAukuʻu* build nests made of sticks, off the ground in trees.
- These herons are often seen flying between roosting sites and feeding areas in ponds, streams, marshes, lagoons, exposed reefs, and tide pools.

Adaptations & Interactions

- *ʻAukuʻu* stand still in the water, waiting for their prey to appear. They strike with lightning quickness, catching fish, crustaceans, and frogs. They also eat mice, insects, and the chicks of other birds.

Human Connections

- The Hawaiian saying *"ʻaukuʻu hapapa ka haʻi loko"* literally means "heron groping in somebody else's fish pond." In common usage it means "a man groping for someone else's woman."

***Koloa* or Hawaiian Duck** (*Anas wyvilliana*)

Order Anseriformes, Family Anatidae

- This endemic water bird was once found on all of the main islands except Lāna‘i and Kaho‘olawe. There are now small populations on Kaua‘i, Maui, O‘ahu, and Hawai‘i. It is an endangered species.

Habitat

- These ducks are found in lowland wetlands, river valleys, and mountain streams.

Adaptations & Interactions

- *Koloa* build their nests on the ground, lining them with down and feathers.
- They feed on freshwater vegetation, mollusks, and insects.
- Many *koloa* have hybridized (crossbred) with mallard ducks, meaning that there are fewer of this endangered species than there may appear to be.

Human Connections

- In Hawaiian, *koloa* means “duck.” This species is sometimes called *koloa maoli* or “native *koloa*,” to distinguish it from migratory or introduced ducks, also called *koloa*.

Cattle Egret (*Bubulcus ibis*)

Order Ciconiiformes, Family Ardeidae

Photo: Eric Nishibayashi

- This nonnative bird is native to the Old World.

Habitat

- Cattle egrets are common on most of the main Hawaiian Islands. On Maui, they breed at Kanahā and Keālia ponds.
- Cattle egrets can be found in a variety of habitats including cattle pens and pastures, garbage dumps, watercress ponds, and taro patches.

Adaptations & Interactions

- They nest in large colonies (or “heronries”), often in trees.
- They feed on flies, grasshoppers, other insects, and crayfish.
- This species may pose a threat to native species by competing for nesting sites and food, and by preying on young birds.

Human Connections

- The cattle egret was introduced in 1959 to help control pest insects on cattle ranches.

Common Myna (*Acridotheres tristis*)

Order Passeriformes, Family Sturnidae

Illustration: Joan M. Yoshioka

- This nonnative bird is native to India.

Habitat

- Mynas are common on all of the main islands, usually at elevations below 2500 meters (8200 feet). They have recently become established on Midway Atoll.

Adaptations & Interactions

- Mynas share communal roosting trees. They nest in tree hollows, cavities in buildings, or in dense foliage.
- Mynas prey on the eggs and nestlings of other birds.

Human Connections

- Mynas were introduced in 1865 to help control army worms.
- They help clean up after humans, eating garbage or animals killed by cars along roadsides.

***Pinao* or Big Blue Darner** (*Anax strenuus*)

Order Odonata, Family Aeshidae

Photo: Eric Nishibayashi

- This endemic insect's ancestors probably colonized the Hawaiian Islands by flight.
- It is the largest native Hawaiian insect, with a wingspan of up to six inches, which also makes it the largest insect in the United States.

Habitat

- *Pinao* are widespread on all the islands and probably move from island to island.

Adaptations & Interactions

- The large compound eyes, moveable head, biting mouthparts, long gripping legs, and four independently moving wings are all adaptations for catching insects in flight.

Pinao ʻUla or Orange-Black Damselfly

(*Megalagrion xanthomeles*)

Order Odonata, Family Coenagrionidae

Photo: Hawai'i Biological Survey

- This endemic insect's ancestors probably colonized the Hawaiian Islands by flight.
- It was once found on all the main islands, but is now extirpated on Kauaʻi and nearly so on Oʻahu. On Maui this species is rare and potentially threatened, with highly localized populations.

Habitat

- It is a small damselfly with red and black males and brown females.
- It is found in the lowlands in a variety of habitats, most commonly occuring in coastal wetlands.
- On Maui, the *pinao ʻula* known to breed in "brackish" (somewhat salty, but not as salty as ocean water) ponds near the La Perouse lighthouse.

Adaptations & Interactions

- The "naiads" (larvae) are eaten by mosquito fish and possibly long-legged ants.

Seashore Splash-Zone Cricket

(*Caconemobius* spp.)

Order Orthoptera, Family Gryllidae

Illustration: Joan M. Yoshioka

- This endemic insect is found on all the main Hawaiian Islands.

Habitat

- It is found only in wet rock habitats in the ocean splash zone.

Adaptations & Interactions

- This salt water-tolerant species may have originally "rafted" here on floating debris or vegetation from a far-off place.
- It feeds on flotsam in rocky areas.
- Active mainly at night, it is sometimes the most abundant animal on wet boulders.
- This is one of the "crickless" Hawaiian crickets. Unlike many other cricket species, the seashore splash-zone cricket is wingless and does not rub body parts together to make the characteristic cricket chirp.

Big-Headed Ant (*Pheidole megacephala*)

Order Hymenoptera, Family Formicidae

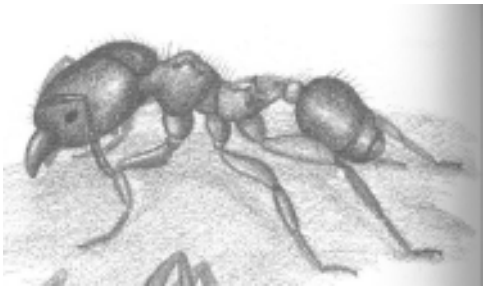


Illustration: Joan M. Yoshioka

- This nonnative arthropod is thought to be a native of southern Africa. It is now widespread throughout the tropical and subtropical regions of the world. It was first recorded in Hawai'i in 1886. Hawai'i has no native ant species.

Habitat

- The big-headed ant is found from sea level to about 750 meters (2460 feet). It has been recorded in *'ōhi'a* canopies as well as on the ground. Nests are generally underground or beneath an object.
- It is not tolerant to cold nor to extremely low or high humidity.

Adaptations & Interactions

- The big-headed ant is believed to be largely responsible for the disappearance of most native insects and spiders, and perhaps some native bird species, in lowland areas in Hawai'i.
- During the mating season, winged males and reproductive females fly from the nest to mate and begin new colonies.

Large Centipede (*Scolopendra subspinipes*)

Order Chilopeda, Family Scolopendridae

Illustration: Joan M. Yoshioka

- This nonnative arthropod has been introduced throughout the world and is abundant on tropical islands. Its native region is unknown.
- This is the largest of 24 species of centipedes in Hawai'i. It can reach over 15 centimeters (six inches) in length, with 20 pairs of walking legs.

Habitat

- It is found largely in lowland areas.

Adaptations & Interactions

- Chewing mouthparts and a pair of poisonous claws allow these arthropods to prey on various insects, including cockroaches, and earthworms.

Human Connections

- In humans, centipede bites can lead to localized pain, swelling, vomiting, dizziness, headaches, and an irregular pulse.

Mo'o Niho 'Awa or Lesser Brown Scorpion (*Isometrus maculatus*)

Order Scorpiones, Family Buthidae

Illustration: Joan M. Yoshioka

- This nonnative arthropod is found in tropical areas all over the world. Its native region is unknown.
- It is related to insects and spiders and resembles a small lobster, with claws and a long tail that ends in a poisonous stinger.

Habitat

- It is widely distributed in lowland areas of the Hawaiian Islands.

Adaptations & Interactions

- It feeds on spiders and insects at night, grasping the prey with its pincers and paralyzing the prey with its stinger.

Human Connections

- This scorpion may sting humans in self-defense, but its venom is not dangerous.

Honu or Green Sea Turtle (*Chelonia mydas*)

Order Chelonia, Family Cheloniidae

Photo: Forest Starr and Kim Martz

- This indigenous reptile is federally listed as a threatened species. It is likely that fewer than 200,000 mature females remain, where tens of millions of these turtles once populated the oceans.
- These large sea turtles weigh from 150 to 400 pounds.

Habitat

- *Honu* are found in offshore waters and coastal beaches.
- They nest mostly in the summer on Northwestern Hawaiian Islands beaches. Other times, they are found near the main islands.
- *Honu* migrate up to 800 miles to reach the French Frigate Shoals and other islands in the northwestern part of the Hawaiian chain.

Adaptations & Interactions

- These turtles feed largely on *limu* (algae) growing on coral and rocks.
- The females dig nests in the sand, deposit their eggs, and then cover the nests with sand again.

Human Connections

- Green turtles are a traditional Hawaiian source of meat.
- Fishing crews once killed green turtles in large numbers, and they are still taken illegally despite legal protection. Turtles are also killed when they eat marine debris or are accidentally caught in fishing nets. They are affected by coastal habitat destruction and water pollution, and threatened by a growth of tumors called fibropapilloma, the cause of which is unknown.

Honu 'Ea or Hawksbill Turtle

(*Eretmochelys imbricata*)

Order Chelonia, Family Cheloniidae

Illustration: Joan M. Yoshioka

- This indigenous reptile is federally listed as an endangered species.

Habitat

- This turtle is found in offshore waters and coastal beaches.
- It nests primarily on beaches on the eastern shores of the island of Hawai'i, although it also nests on other islands. Nesting season is from July to November.
- The females dig nests in the sand, deposit their eggs, and then cover the nests with sand again.

Adaptations & Interactions

- The pointed beak may be an adaptation to feeding on sponges.
- During the two-month incubation period, the eggs may be dug up by feral cats, mongooses, dogs, and humans.

Human Connections

- People interfere with nesting hawskbill turtles by activities such as compacting sand and leaving nearby buildings lighted at night, which disorients both nesting females and hatchlings moving to the ocean.

World Map