



Activity #2

Rain Forest Species Research

● ● ● Class Period One Species Cards

Materials & Setup

- Research materials: at minimum the three listed in #3 below, and others that you can gather or check out of the library [See the Student Page “Rain Forest Species Cards” (pp. 36-41) for suggested resources.]

For each student

- Student Page “Rain Forest Species Cards” (pp. 36-40)
- One card from the “Rain Forest Species Assignments” (master, pp. 27-35)

Instructions

- 1) Hand out the Student Page “Rain Forest Species Cards” to each student. Also give each student one Species Assignment card—a different species for each student. There are 36 species total.
- 2) If you have a smaller class, you may select a representative sampling from the species cards, making sure you have a blend of invertebrates, birds, and plant species from the canopy, subcanopy, understory, forest floor, and vines categories. See the teacher background “Rain Forest Species Card Information Summary” for species that fit in each category (pp.15-26).

OR

You may offer extra credit to students who create more than one species card.

- 3) For the rest of this class, as homework, and during the next class period, students will create a card for the species assigned to them. The primary information resources available as part of this curriculum are:

Hawai‘i Audubon Society, *Hawaii’s Birds*, 5th ed., Hawai‘i Audubon Society, Honolulu, 1997.

Medeiros, Arthur C., and Lloyd L. Loope, *Rare Animals and Plants of Haleakalā National Park*, Hawai‘i Natural History Association, Hawai‘i National Park, 1994.

Moanalua Garden Foundation, *Forest Treasures* (CD ROM), 2000.

Stone, Charles P., and Linda W. Pratt, *Hawai‘i’s Plants and Animals; Biological Sketches of Hawaii Volcanoes National Park*. Hawai‘i Natural History Association, National Park Service, and University of Hawai‘i Cooperative National Park Resources Study Unit, Hawai‘i National Park, 1994.

Additional sources of information can be found in the library and on the Internet. A beginning listing of resources is part of the student page.



- 4) Encourage students to create their own images for the species card rather than using the one on the Species Assignment card. Also encourage them to bring to the next class art supplies, reference books they have at home, and species information they photocopy from printed sources or download from the Internet so they can work on their species cards during class.

Note _____

If you have difficulty locating resources for student research or if you do not want students to research the species cards, give each student the relevant information from the teacher background (pp. 15-26). Students can create their species cards using this information.

● ● ● **Class Period Two Rain Forest Species Cards**

Materials & Setup _____

- Research materials (see Class Period One)
- Colored pens, pencils, scissors, glue and other supplies for student use in creating species cards

Instructions _____

- 1) Allow students to finish their species cards during this class period.

Journal Ideas _____

- Make up a chant or a poem about your rain forest species.
- What was the most interesting thing you learned about your species? Why?

Assessment Tools _____

- Rain forest species cards
- Journal entries



Teacher Background

Rain Forest Species Card Information Summary

The following summarizes some of the available information about each species. You may use these summaries to help check students' work. Note: Unless otherwise noted, "endemic" refers to the Hawaiian Islands, denoting species that today are thought to be unique to one or more of the Hawaiian Islands.

NATIVE INVERTEBRATES

Haleakalā flightless lacewing (*Pseudopsectra lobipennis*)

- Endemic to Haleakalā
- It no longer has lace wings. Its hardened and beetle-like front wings cup and protect its body and its rear wings are small and strap-like.
- In spite of alien rodent predators, this rare insect still survives in the dense rain forests of Kīpahulu Valley within the park.
- The adults hunt at night on tree trunks.

Hawaiian crickets

(Family Gryllidae, one indigenous genus [*Paratrigonidium*] and 3 endemic genera [*Leptogryllus*, *Thaumatogryllus*, and *Prognathogryllus*])

- All Hawaiian crickets are brown and flightless.
- Some are loud, strong "singers." A male cricket sings by rubbing his wings together to attract females of his species. Each species has a unique song.
- It lives in 'ōhi'a and koa rain forests up to 1500 meters (4920 feet) in elevation. Within Haleakalā National Park, most are found in the rain forests of Kīpahulu Valley.
- Alien rodents (mice and rats) prey on these rare insects.
- The number of named, endemic Hawaiian crickets is over 200 species, twice the total known for the continental U.S. One species is named *kipahulu* after Kīpahulu Valley.

Hawaiian ground beetles (Family *Carabidae*)

- Ground beetles prey on arthropods and snails.
- Ground beetles are an example of adaptive radiation. The 215 endemic species of ground beetles on the Hawaiian Islands are believed to have evolved from as few as six original immigrants.
- Ground beetles are found in many different natural communities on Haleakalā including high-elevation shrublands, the alpine/aeolian zone, and the rain forest.
- In the late 1980s, scientists discovered and described two new species of ground beetles inside deep lava tubes in Kīpahulu Valley.



Hawaiian long-horned beetles (*Plagithmysus spp.*)

- Endemic genus (There are other genera of Hawaiian Long-Horned Beetles, as well.)
- The larvae of these wood-boring beetles feed within living, often damaged trees. Females lay their eggs in the bark of trees. On hatching, the larvae burrow into the wood, feeding there for a year or more before pupating into adult beetles.
- Most often, one beetle species has only one tree species as its host. *Plagithmysus cheirodendri* is endemic to East Maui and feeds exclusively on the wood of *kōlea* trees. Other long-horned beetles are associated with *koa*.
- Wood-boring beetles are an example of adaptive radiation. Over 136 species are believed to have evolved from a single ancestral species that arrived on the islands millions of years ago, probably from North America.
- Long-horned beetles are found in many different natural communities on Haleakalā. The most common is associated only with the *māmane* tree, some are found only in rain forests, and one species has adapted to feed only on the *ʻāhinahina* in the alpine/aeolian zone.
- The Maui parrotbill, a Hawaiian honeycreeper, uses its bill to tear apart plant stems in search of the pale larvae of these beetles, one of its primary foods. The naturalist R. C. L. Perkins found that the stomachs of the parrotbills he collected in 1894 were filled with long-horned beetle larvae.

Haleakalā weevil (*Oodemas spp.*)

- Endemic genus
- These weevils are also known as snout beetles, for their long snout. They have small (1/4-inch long), shiny, black, rounded bodies that resemble seeds.
- At least 15 species of *Oodemas* are known from Haleakalā, either in the deep rain forests or in native shrublands.
- The 58 species of small, rare *Oodemas* weevils are found only on the Hawaiian Islands. They seem to have no close relatives in the rest of the world.
- These weevils are a favorite food for birds. The adults hide under bark and in mosses and leaf litter during the day. They emerge under cover of darkness to feed on native plants and to mate.

Hawaiian carnivorous inchworm (*Eupithecia spp.*)

- Endemic genus
- The larvae of at least 18 species of Hawaiian moths have abandoned the usual vegetarian diet of caterpillars throughout the world. These caterpillars practice ambush predation, in which they settle on the edges of leaves or on plant stems waiting for a tiny spider or insect to approach.
- These carnivorous species are related to other *Eupithecia* moth species on Haleakalā that feed on flowers, seeds, leaves, and other plant parts.
- The first species of carnivorous inchworms was discovered in 1972.
- These inchworms are about 1.25 centimeters (.5 inch) long.
- There are at least 18 different species using different types of perch sites. They are colored and shaped to blend in with their favored hunting sites. Some that perch on moss-covered tree trunks even look mossy themselves!



Happy-face spider (*Theridion grallator*)

- Endemic
- These spiders are found in many of the rain forests of Hawai‘i, although they may be difficult to spot.
- Happy-face spiders are named for the bright patterns that appear on their abdomens. Some of these patterns resemble smiling faces.
- They are so small that you need a magnifying glass to really appreciate their markings. Including their legs, they are only 1.25-2 centimeters (about .5-.75 inch) long.
- They live under the leaves of rain forest trees and shrubs such as *kanawao* (*Broussaisia arguta*), *kawa‘u* (*Ilex anomala*), and ‘oha wai (*Clermontia* spp.). They spin irregular-shaped webs in which they catch their prey.
- Females lay eggs on the underside of leaves. Once the tiny spiderlings hatch, the mother captures food for them, wrapping it in silken loops.

Pulelehua or Kamehameha butterfly (*Vanessa tameamea*)

- Endemic (One of only two butterflies native to Hawai‘i)
- A striking orange, black, and white butterfly that measures about five centimeters (two inches) across.
- Most commonly found in mesic woodlands and low- to mid-elevation wet forests. Higher-elevation rain forests and dry forests are less favored but still provide habitat for these butterflies.
- Larvae of this butterfly feed on the leaves of the *māmaki* (*Pipturus albidus*) and other native plants that, like *māmaki*, belong to the nettle family (*Urticaceae*). Parts of the caterpillar resemble *māmaki* flower clusters, and the chrysalis looks like a dead, curled-up leaf.
- Adult *pulelehua* feed on nectar from many native plants and are probably important pollinators for those plants.

Picture wing flies (Family Drosophilidae)

- There are more than 800 species of Hawaiian *Drosophila*. They are a premier example of adaptive radiation.
- *Drosophila* species now occupy a range of habitats. Different species feed on different food items, including rotting fruit and leaves, tree sap, and fungi.
- About 100 of the Hawaiian *Drosophila* species are “giant” picture wing flies. With wingspans up to 2.5 centimeters (one inch), these flies have ornate wing and body patterns that enable the different species to recognize each other.
- Male flies set up breeding territories called “leks” and attract females there. Males have evolved a wide array of courtship behaviors that have been recorded by scientists studying the role of sexual selection in the development of new species.
- Like many of the native arthropod species in Hawai‘i, most of these fly species are endemic to single islands, and even to very small areas on specific islands. Since their populations are often small and have a limited range, they are especially sensitive to habitat changes.



Flying earwig Hawaiian damselfly or *Pinao 'ula* (*Megalagrion nesiotes*)

- Endemic to East Maui and Hawai'i
- This species was recently rediscovered on Maui after 75 years with no specimens collected there. Originally known from both East Maui and Hawai'i, this damselfly is likely to be extinct on Hawai'i Island.
- "Flying earwigs" got their name from the pincer-like appendages on the tip of the male fly's tail.
- Adults tend to fly and perch low amidst the tangled vegetation of the rain forest understory. Unlike many other damselfly species, this species tends to live well away from ponds and streams.
- Observations suggest that breeding habitat is probably fern banks, steep and moist slopes, and scattered pockets of water, such as those collected in the leaves of rain forest plants.
- Away from the water, the *pinao 'ula* often makes its home in the *pa'inui* plant.

Tree snails (*Partulina* spp.)

- Endemic
- Tree snails range from one to 7.5 centimeters (1/3 to three inches) in length. Their color ranges from white to brown to black, and many are banded. There is a great deal of variation in size, color, pattern, and shape.
- Graze on microscopic algae or fungi
- Various sources of introduced biota have had a negative impact on the snails and their habitat, among them the "cannibal snail" which was originally introduced to control the African snail. This predator eats the tree snail young and eggs. Rats are another chief predator on native tree snails.
- The "singing" tree snails were famous among European naturalists after early explorers brought specimens back from the Hawaiian Islands. It took about 50 years before crickets were found to be the source of the song!

NATIVE BIRDS

'I'iwi (*Vestiaria coccinea*)

- Endemic
- A member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- The 'i'iwi is about 15 centimeters (six inches) long, scarlet-orange in color, with a deeply curved, orange bill.
- The 'i'iwi prefers nectar but will sometimes eat insects and spiders, and feeds its young on insects. It is often found high in the canopy, feeding in flowering 'ōhi'a trees. It can also be found lower in the rain forest dipping into the long, curved flowers of mints (*Stenogyne* spp.), other native plants, and introduced species.
- Its feathers were prized by Hawaiians for use in making feathered capes for royalty.
- It is not as common on Maui as the 'apapane and the 'amakihi, but is still widespread at upper elevations. (It is very rare or extinct on O'ahu, Moloka'i, and Lāna'i.)
- 'I'iwi build their nests five meters (16 feet) or higher up in trees.



‘Apapane (*Himatione sanguinea*)

- Endemic
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- The red plumage of these 13-centimeter (five-inch) birds matches the color of the red ‘ōhi‘a lehua blossoms perfectly. It is often found in the forest canopy searching for nectar from the ‘ōhi‘a, but it also frequents flowering *koa* and *māmane* trees.
- The ‘apapane forages in the forest canopy for nectar and insects.
- This species often nests in the crowns of ‘ōhi‘a lehua or in tree ferns, but its nests have also been found in lava tube skylights.
- The ‘apapane is among the most common honeycreepers in the state. Its range extends from the rain forests into upper-elevation shrublands and even into planted forests. Unlike many other honeycreepers, it is still found down to sea level in some areas.
- Its feathers were used in some Hawaiian featherwork.

‘Amakihi (*Hemignathus virens*).

Also, Maui ‘Amakihi (*Hemignathus virens wilsoni*) a Maui endemic subspecies

- Endemic
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- This yellow-green bird measures about 11 centimeters (4.5 inches) in length and has a downcurved bill, shorter than that of the ‘i‘iwi.
- The ‘amakihi feeds on nectar, insects, spiders, and fruit from forest trees and plants.
- It generally nests in uppermost tree branches.
- The ‘amakihi is among the most common honeycreepers in the state. Its range extends from the rain forests into upper-elevation shrublands and even into planted forests and higher elevation residential areas such as Kula and Kēōkea.

‘Alauahio or Maui creeper (*Paroreomyza montana*)

- Endemic to Haleakalā (formerly also found on West Maui and Lānai)
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- Found on East Maui only, most commonly in the rain forest but also in the upper-elevation shrublands.
- Females of this small (11-centimeter or 4.5-inch) species of honeycreeper are green, the males yellow-green.
- They forage in pairs or small flocks, usually in the trees and shrubs of the rain forest understory, feeding on insects and spiders. Less often, they will feed on the nectar of ‘ōhelo and ‘ōhi‘a flowers.
- Often, an ‘alauahio will be seen high above the forest floor, gleaning insects from the bark of a *koa* tree.



'Ākohekohe or Crested honeycreeper (*Palmeria dolei*)

- Endemic and endangered
- Once found on both Maui and Moloka'i but now restricted to East Maui
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- This primarily black bird sports a distinctive tuft of head feathers that range in color from light gray to light orange. It is one of the larger honeycreepers at 18 centimeters (seven inches) in length.
- It is an aggressive bird that often drives off other honeycreepers from flowering trees, enforcing the top end of a “pecking order” among nectar-sipping forest birds.
- It builds its nests in tree tops high in the upper canopy.
- It feeds primarily on the nectar of 'ōhi'a blossoms. Its crest probably aids in pollinating the brush-like flowers of the 'ōhi'a. 'Ākohekohe will take nectar from other native plants, and it also eats insects such as caterpillars.

Po'ouli (*Melamprosops phaeosoma*)

- Endemic to Haleakalā (The *po'ouli* is endangered, with a population possibly numbering only three individuals in early 2001.)
- First described in 1973 on the upper northeastern slopes of Haleakalā
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- The name *po'ouli* means “dark-headed,” which is an apt description of this small (14-centimeter or 5.5-inch-long) honeycreeper. Brown above and pale gray below, *po'ouli* wear a dark mask over the face and head.
- It builds its nest of twigs, lichens, mosses, and grasses high up in the 'ōhi'a canopy.
- It forages in understory shrubs and trees tearing at bark, mosses, and lichens on branches looking for invertebrates such as native tree snails and wood-boring larvae.

Maui parrotbill (*Pseudonestor xanthophrys*)

- Endemic to Haleakalā and endangered.
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- Parrotbills are small birds (14 centimeters or 5.5 inches long) that are mostly olive green with yellow and brown markings, a bold eye stripe, and a large bill that resembles a parrot's.
- The Maui parrotbill is a flocking bird. With its low numbers, it is often seen in flocks with 'alauahio.
- It is found in the shrubs and trees of the rain forest understory and subcanopy, foraging for insect larvae in woody branches and stems. It can be found in 'ōhi'a and 'ōhi'a-koa rain forests, as well as in *koa*-dominated forests.
- The Maui parrotbill uses its beak like a can opener to split and crack branches, prying out insect larvae with its tongue and upper mandible.
- There is no known Hawaiian name for this species.



Nukupu'u (Hemignathus lucidus)

Also, Maui *Nukupu'u* (*Hemignathus lucidus affinis*), a Maui endemic subspecies

- Endemic and endangered, possibly extinct. (The last birds were seen in the 1980s.)
- This bird is a member of the Hawaiian honeycreepers, a group that at one time included some 52 species descended from one original finch species. The honeycreepers are an example of adaptive radiation.
- Yellow and olive-green birds range from 11 to 14 centimeters (4.5-5.5 inches) long with a long, curved upper mandible.
- The *nukupu'u* uses its upper bill to search in bark crevices for spiders, caterpillars, *Oodemas* weevils, and other insects.
- Its preferred habitat, the *koa* forest, has been destroyed on a large scale, occupying only a small part of its original range. Now, with the *koa* forests dramatically decreased in size, and the presence of malaria-carrying mosquitoes at lower elevations, the *nukupu'u* is most commonly found in 'ōhi'a-dominated forests above 1500 meters (4,920 feet).

NATIVE PLANTS

Canopy

'Ōhi'a (*Metrosideros polymorpha*)

- Endemic
- *Polymorpha* means “many forms.” This species is found in a variety of forms, both within and outside the rain forest. Geographically speaking, its closest relatives occur in Australia.
- In the rain forest, it may grow straight and tall, reaching a height of 18 m (60 feet) or more. In the cloud forest zone, a part of the rain forest where most moisture comes from a nearly-constant cover of fog and clouds, the tree is smaller, with a gnarled and twisted trunk and leathery leaves. In the extreme wet of mountain bogs, 'ōhi'a stands only a few inches high.
- This is the dominant tree in the wetter rain forests at middle and upper elevations. It forms a nearly continuous canopy in these areas.
- Although its flowers are adapted to wind pollination, native birds feeding on nectar also assist in pollination.
- It may begin its life as an epiphyte—a plant that grows using another plant for support, and taking nutrients from air and rainwater. Wind-blown seeds often lodge and germinate on tree fern trunks.
- 'Ōhi'a wood is important in Hawaiian canoe-making, used for the gunwale (*mo'o*) of the canoe because it is hard enough to take the constant rubbing of the paddle. It was also used for the seats, spreaders, decking, and mast of the canoe, and for the ridgepoles, posts, rafters and thatching poles in houses.
- In Hawaiian tradition, it is believed that picking the blossoms causes rain.



Koa (*Acacia koa*)

- Endemic (Geographically speaking, its closest relatives occur in Australia.)
- *Koa* can reach heights of 30 meters (100 feet), piercing the ‘ōhi‘a lehua canopy in places and towering above the rain forest.
- *Koa* may dominate the canopy in relatively drier parts of the rain forest. Sometimes it shares the canopy with ‘ōhi‘a. In other places, the *koa* will grow taller and can form a distinct upper canopy layer above the ‘ōhi‘a.
- *Koa* forests have been greatly diminished by logging and ranching. These trees are slow-growing and not easily renewable.
- *Koa* is the host to many rain forest insects.
- Its small, fuzzy, yellow flowers are important sources of nectar for native forest birds, although not as important as the red flowers of ‘ōhi‘a lehua.
- *Koa* wood was prized by the Hawaiians, and was used to carve canoes, paddles, surfboards, spears, and calabashes ('umeke la‘au) to hold food, kapa and feathered garments. *Koa* was not used to store *poi*, as it imparted a bitter taste.
- Hulls of single (*kaukahī*) and double (*kaulua*) canoes were carved out of a single *koa* log.
- *Koa* bark was used as a dye for *kapa* and for timbers of grass houses.

Loulu or Fan palm (*Pritchardia* spp.).

Also, (*Pritchardia arecina*), the species found in the Haleakalā rain forest

- Endemic (The members of this genus are the only fan palms native to Hawai‘i. There are 19 endemic species, each of which is unique to a particular island.)
- These palms grow emerge above the canopy singly or in small patches.
- Fossil evidence suggests that *loulu* was more common in ancient times than it is now.
- These fan palms were used in the construction of *heiau loulu*, temporary *heiau* where offerings were made to the gods who presided over fishing.

Subcanopy

Hāpu‘u pulu or Tree fern (*Cibotium glaucum*)

Also *Hāpu‘u i‘i* (*Cibotium chamissoi*)

- Endemic
- These large ferns can grow taller than three meters (ten feet) on a stocky “trunk,” which is actually a network of interwoven aerial roots that absorb moisture.
- They can be very abundant in the shade created by rain forest trees such as ‘ōhi‘a lehua and ‘ōlapa. Where pigs range through the rain forest, however, these ferns are greatly diminished. They are recovering in areas that have been damaged by pigs in the past but are now fenced and patrolled to keep pigs out.
- *Hāpu‘u* are sometimes called “the mother of ‘ōhi‘a” because their trunks make a good place for seedling germination.
- Tree ferns are covered with brown silky hairs called *pulu*. *Pulu* was traditionally used for stuffing pillows, dressing wounds, and embalming the dead.
- During times of famine, the pith of the trunk was cooked and eaten, and the fiddleheads were eaten, as well.



‘Olapa (*Cheirodendron trigynum*)

- Endemic
- This tree ranges in height from five to 15 meters (16 to 50 feet). ‘Olapa is sometimes part of the understory and sometimes part of the canopy.
- In Hawaiian rain forests, ‘olapa often grows intermixed with *hāpu‘u* tree ferns and ‘ōhi‘a.
- This tree bears clusters of small, purplish fruits which are eaten by native birds.
- ‘Olapa is one host plant for native *Drosophila* flies.
- The soft wood of ‘olapa makes good habitat for the burrowing insects on which many birds feed.
- ‘Olapa sticks were used by the *kia manu* (bird catchers). They covered the sticks with *kēpau* (sap) and placed them in the forest. The sap trapped birds that landed on these sticks. The wood burns when it is wet and was used by the *kia manu* for fires in the wet forest.
- In hula, ‘olapa is the name given to dancers who are graceful enough to imitate the motions of ‘olapa leaves fluttering in the breeze.

Māmaki (*Pipturus spp.*)

- Two Kaua‘i endemic species and two Maui endemics (*P. albidus* and *P. forbesii*)
- Māmaki grows as a shrub or small tree two to six meters (six to 20 feet) tall.
- It is in the nettle family. It is unusual because it lacks the stinging hairs associated with most nettle species.
- Birds eat the fruits of the māmaki, helping disperse the seeds.
- Māmaki was used to make a *kapa* similar to that made from *wauke* but coarser in texture.
- Rope and cordage were made from māmaki fibers.
- The leaves of *Pipturus albidus* are the primary food of the larvae of the *pulelehua* or Kamehameha butterfly (*Vanessa tameamea*).
- *Pipturus forbesii* is endemic to Haleakalā, found at upper elevations in the rain forest as well as in subalpine shrubland.

Kanawao or Pū‘ahanui (*Broussaisia arguta*)

- Endemic
- A multibranched shrub 1.5-4.5 meters (five to 15 feet) tall, *kanawao* bears clusters of small flowers that produce small red-maroon fruits that mature to a blue-black color.
- It often grows in association with ‘ōhi‘a lehua and ‘olapa.
- This plant is a favored habitat for the happy-face spider.
- The soft wood of *kanawao* makes good habitat for the burrowing insects on which many birds, such as the Maui parrotbill, feed.
- *Kanawao* fruits were believed to aid conception.
- The cluster of fruits was used to symbolize an expansion in the number of chiefs in traditional Hawai‘i.



Kōlea (*Myrsine* spp.)

- Kōlea is the collective name for most of the 20 endemic species of *Myrsine* found in Hawai‘i. Only some of these species are found in the rain forest (such as *M. lessertiana* and *M. emarginata*).
- The 20 Hawaiian *Myrsine* species are thought to have evolved from one or two ancestral species, making this group an excellent example of adaptive radiation.
- Some kōlea grow as shrubs, while others are trees. Kōlea is a common understory tree.
- Dark-colored fruits are clustered along stems or branches.
- At least one kōlea species, *kōlea lau nui* (*Myrsine lessertiana*), provided wood for early Hawaiian house posts and beams as well as beaters for *kapa*. Red dye was made from the bark, and black dye was derived by burning the plant to make charcoal.

Understory

‘Ohelo (*Vaccinium* spp.)

- Three endemic species (*V. calycinum*, *V. dentatum*, and *V. reticulatum*)
- Related to blueberries and cranberries
- ‘Ohelo grows as a shrub or tree, on the ground, or as an epiphyte using other plants for support. Depending on the species and the habitat, ‘ohelo can range from several centimeters to several meters in height.
- All three ‘ohelo species can be found in rain forest and bog areas on Haleakalā.
- Birds eat the small, usually red, fruits and help disperse seeds. When ‘ohelo is in bloom, nectar-feeding birds favor it.
- The fruits of the ‘ohelo were eaten by Hawaiians traveling to the uplands. They are still eaten by some people. Dried ‘ohelo leaves are still used to make tea.
- ‘Ohelo is considered to be sacred to Pele, the Hawaiian volcano goddess. Visitors to Kilauea would customarily offer a branch bearing berries to Pele before eating themselves. This tradition lives on today when people offer a berry or two to Pele before eating. (Breaking branches off the plants is illegal in Haleakalā National Park.)

‘Ohā and Hāhā (and others), or Hawaiian lobelias (*Lobelia*, *Cyanea*, and *Clermontia* spp.)

- Four endemic Hawaiian genera and many endemic species are represented among Hawaiian lobelias. (*Lobelia* is not an endemic genus. *Clermontia* and *Cyanea* are among the four endemic genera.)
- Rats and pigs can cause serious damage to these flowering plants, although pigs can be—and are—excluded from parts of the rain forest.
- The four endemic genera (totaling nearly 100 species) all evolved from a single common ancestral species that arrived in Hawai‘i millions of years ago. Among Hawaiian plants, this is the most prolific example of adaptive radiation.
- Hawaiian lobelias are shrubby species. Many of them have a characteristic lobeliad “rosette” growth form, in which leaves in circular formation grow at the end of single vertical stems (like palm trees). Others have branched trunks or vertical branches.
- The nectar of many lobelias is attractive to native honeycreepers. The flower shapes coevolved with the honeycreepers, so there is a correspondence between beak shape and flower shape.



Vines and Climbing Shrubs

‘Ie‘ie or Climbing screwpine (*Freycinetia arborea*)

- Indigenous
- This woody, climbing plant is found in the rain forest at lower and middle elevations up to about 1400 meters (4592 feet).
- Sometimes ‘ie‘ie sprawls across the forest floor. It often wraps around and climbs the trunks of taller trees such as *koa* and *‘ohi‘a*. It produces many aerial roots (‘ie) that attach the plant to the host tree.
- ‘Ie‘ie used to be pollinated by native honeycreeper species that are now extinct. Introduced birds such as the Japanese white-eye (*Zosterops japonicus*) now do the job.
- This plant was greatly diminished by pig damage. Rats are also major threats to ‘ie‘ie. It is now rare to find flowers that have not been eaten by rats. Rat predation on flowers impairs reproduction.
- The fibers in the stem were used to make cordage to tie together house rafters and bind the outrigger (*ama*) to the canoe (*wa‘a*).
- Aerial roots were woven into very fine and durable baskets and funnel-shaped traps to catch freshwater shrimp and fish as well as helmets (*mahiōle*) which were worn by chiefs going into battle.
- ‘Ie‘ie was sacred to early Hawaiians. The plant was dedicated to the forest god, Kū. In a *hālau hula*, ‘ie‘ie represented the demigoddess Lauka‘ie‘ie.

Maile (*Alyxia oliviformis*)

- Endemic
- A climbing shrub or vine with glossy, leathery leaves, tubular yellow flowers, and purple-black fruits shaped like olives
- There are many varieties of *maile*, distinguished by differences such as leaf size and shape, and scent. Different Hawaiian names reflect these differences (e.g., *maile ha‘i wale* or brittle *maile*, and *maile pākaha* or blunt-leaved *maile*) and illustrate ancient Hawaiians’ acute observation skills.
- *Maile* is woven into a fragrant, open-ended lei that symbolizes respect for the wearer.
- *Maile* is dedicated to the *hula* goddess, Laka. It has inspired many songs, chants, and dances.

Hawaiian mints (*Stenogyne* spp.)

- Endemic
- Of eight *Stenogyne* species known from East Maui, five are thought to be extinct. Unlike most other mint species found elsewhere in the world, Hawaiian mints are “mintless”—they do not have aromatic foliage that deters browsing, because they evolved in an environment in which there were no browsing animals. So they are vulnerable to grazing by introduced cattle, pigs, and goats.
- Rat predation is a significant problem for these plants.
- *Stenogyne kamehamehae*, with its clusters of long, curved red or white flowers, is found in rain forests on both Moloka‘i and Maui. *Stenogyne rotundifolia* is a Maui endemic that still survives in the upper reaches of Haleakalā rain forests in areas not disturbed by feral pigs.
- Deep, curved *Stenogyne* flowers attract native nectar-sipping bird species whose beak shapes co-evolved with the mint flower shapes. These birds pollinate the flowers.



Forest Floor and Epiphytes

Uluhe or False staghorn fern (*Dicranopteris linearis*)

- Indigenous
- A shrubby, vining fern that forms densely tangled mats on the rain forest floor
- Thickets of *uluhe* can quickly take over when openings are created in the forest canopy, but they do not do well in deep shade. This dense growth can overtake other vegetation and prevent the growth of other plants, including most alien weed species. *Uluhe* can form vegetative mats as much as six meters or 20 feet deep!
- *Uluhe* is often found growing in association with ‘ōhi‘a lehua.
- In traditional Hawaiian medicine, the bitter juice of this plant was taken as a laxative or emetic.

‘Ala‘ala wainui (*Peperomia* spp.)

- ‘Ala‘ala wainui is the Hawaiian name for all the plants in this genus, most of which are endemic.
- These plants, which are members of the pepper family, are succulent herbs that range in height from seven or eight centimeters (three inches) to just over a meter.
- ‘Ala‘ala wainui may grow on the ground or as epiphytes, perched on trees or rocks.
- This plant is extremely susceptible to pig damage, as its fragile stems are easily trampled.
- The sticky fruit are probably dispersed on birds’ feet and feathers.
- Many plants in this group were used to make medicines for a variety of health problems and to produce a gray dye for *kapa*.

Pa‘iniu (*Astelia* spp.) or *Kaluaha* (*Astelia menziesiana*)

- Endemic
- The long, silvery leaves of *pa‘iniu* form rosettes from the center of which grow flowering stalks that bear a cluster of small, bright-orange fruits.
- It is an herbaceous plant that may grow as an epiphyte, using native tree trunks or branches for support, or it may be rooted in the ground.
- This species is used as an indicator of the presence or absence of pigs. If you find *pa‘iniu* growing on the ground, you know there have not been pigs in the area.
- This is a favored home for *pinao ‘ula*, the Hawaiian Damselfly.
- Birds eat the *pa‘iniu* fruit, assisting in seed dispersal.
- The silvery skins of the leaves were woven into flower garlands called *lei pa‘iniu*.

Limu or Mosses and Liverworts

- *Limu* refers to many forms of algae, as well as mosses, lichens, and liverworts.
- Numerous species of mosses (*limu kele*) and liverworts live in the rain forests. They form a spongy, blanket-like cover on some native trees, rocks, and other surfaces.
- These fragile plants are easily destroyed by browsing and trampling pigs, goats, and deer.
- The “sponge” of *limu* absorbs water, providing a source of additional moisture during dry spells and helping prevent erosion caused by rapid runoff.



Rain Forest Species Assignments

Cut along dashed lines

Invertebrate

Haleakalā flightless lacewing

(*Pseudopsectra lobipennis*)

Order Neuroptera,
Family Hemerobiidae

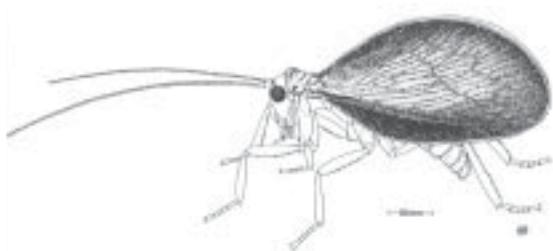


Illustration: Nanci Sidaras

Invertebrate

Tree snails

(*Partulina spp.*)

Order Pulmonata,
Family Achatinellinae



Illustration: Joan Yoshioka

Invertebrate

Hawaiian crickets

(One indigenous genus [*Paratrigonidium*] and 3 endemic genera [*Leptogryllus*, *Thaumatogryllus*, and *Prognathogryllus*])

Order Orthoptera, Family Gryllidae
(*Paratrigonidium* and *Leptogryllus* are most common on East Maui.)

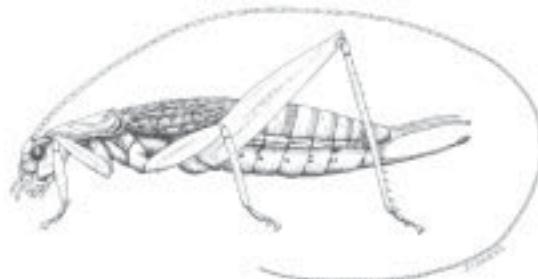


Illustration: Nanci Sidaras

Invertebrate

Hawaiian ground beetles

(Family Carabidae)

Order Coleoptera

(The genus *Mecyclothorax* is most common on East Maui.)

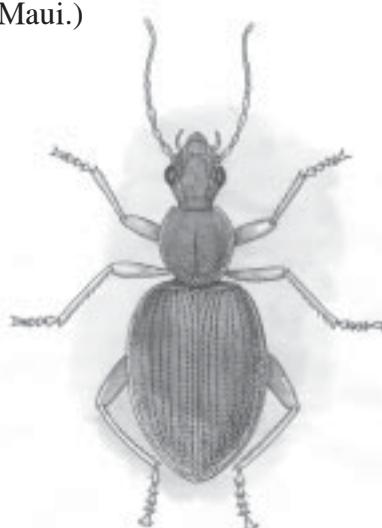


Illustration: Nanci Sidaras



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Invertebrate

Hawaiian long-horned beetles

(*Megopis reflexa* and

Plagithmysus spp.)

Order Coleoptera,

Family Cerambycidae

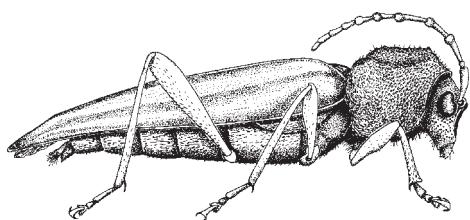


Illustration: Nanci Sidaras

Invertebrate

Haleakalā weevil

(*Oodemas* spp.)

Order Coleoptera,

Family Curculionidae

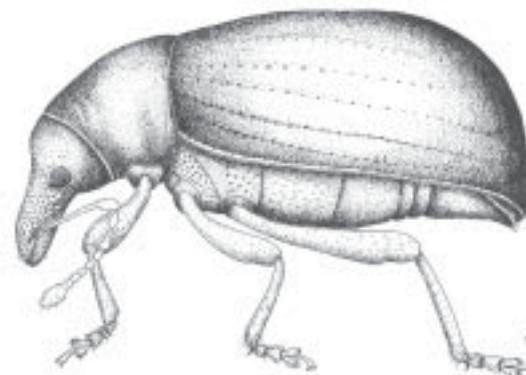


Illustration: Nanci Sidaras

Invertebrate

Hawaiian carnivorous inch-worm (*Eupithecia* spp.)

Order Lepidoptera,

Family Geometridae

(The green grappler, *Eupithecia orichloris*, is a common East Maui species.)



Illustration: Nanci Sidaras

Invertebrate

Happy-face spider

(*Theridion grallator*)

Order Araneae, Family Theridiidae



Illustration: Nanci Sidaras



Cut along dashed lines

Invertebrate

Pulelehua or Kamehameha butterfly
(*Vanessa tameamea*)
Order Lepidoptera,
Family Nymphalidae

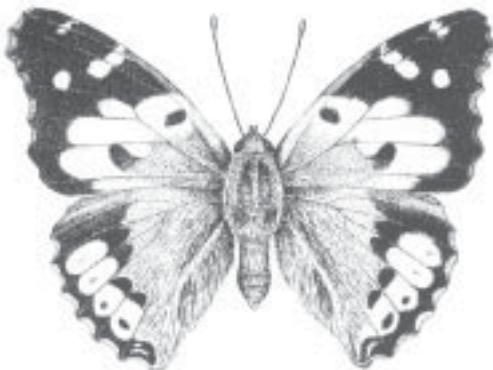


Illustration: Nanci Sidaras

Invertebrate

Flying earwig, Hawaiian damselfly or Pinao 'ula
(*Megalagrion nesiotes*)
Order Odonata,
Family Coenagrionidae



Illustration: Joan Yoshioka

Invertebrate

Picture wing flies
(Family Drosophilidae)
Order Diptera



Illustration: Joan Yoshioka

Bird

Nukupu'u
(*Hemignathus lucidus*)
Order Passeriformes, Family
Fringillidae, Subfamily Drepanidinae

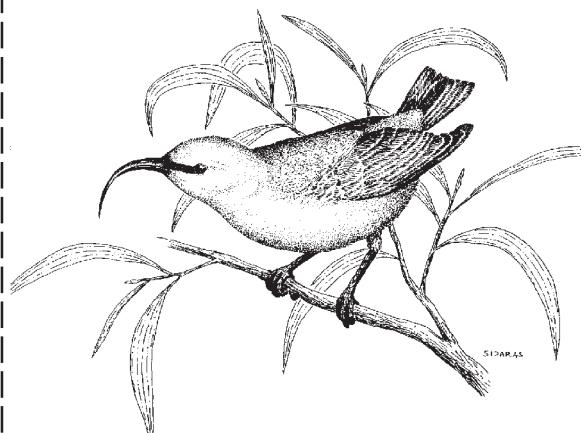


Illustration: Nancy Sidaras



Cut along dashed lines

Bird

'Iwi (*Vestiaria coccinea*)

Order Passeriformes,
Family Fringillidae,
Subfamily Drepanidinae



Photo: Eric Nishibayashi

Bird

'Apapane (*Himatione sanguinea*)

Order Passeriformes,
Family Fringillidae,
Subfamily Drepanidinae



Photo: Eric Nishibayashi

Bird

'Amakihi (*Hemignathus virens*)

Order Passeriformes,
Family Fringillidae,
Subfamily Drepanidinae



Photo: Eric Nishibayashi

Bird

Maui 'Alauahio or Maui creeper

(*Paroreomyza montana*)

Order Passeriformes,
Family Fringillidae,
Subfamily Drepanidinae



Photo: Eric Nishibayashi



Cut along dashed lines

Bird

'Ākohekohe or Crested honeycreeper (*Palmeria dolei*)
Order Passeriformes, Family Fringillidae, Subfamily Drepanidinae



Photo: Eric Nishibayashi

Bird

Po'ouli
(*Melamprosops phaeosoma*)
Order Passeriformes, Family Fringillidae, Subfamily Drepanidinae



Photo: Paul Baker, Maui Forest Bird Recovery Project

Bird

Maui parrotbill
(*Pseudonestor xanthophrys*)
Order Passeriformes, Family Fringillidae, Subfamily Drepanidinae



Photo: Eric Nishibayashi

Plant

Limu or Mosses and Liverworts
Class Musci (Mosses),
Class Hepaticae (Liverworts)



Limu growing on tree trunks (Photo: Steve Anderson)



Cut along dashed lines

Plant

'Ōhi'a lehua

(*Metrosideros polymorpha*)

Order Myrtales, Family Myrtaceae



Illustration: Joan Yoshioka

Plant

Koa (*Acacia koa*)

Order Fabales, Family Fabaceae



Koa (*Acacia koa*)

Illustration: Joan Yoshioka

Plant

Loulu or Fan palm

(*Pritchardia spp.*)

Order Arecales, Family Arecaceae

(*Pritchardia arecina* is a common East Maui species.)



Illustration: Joan Yoshioka

Plant

Hāpu'u pulu or Tree fern

(*Cibotium glaucum*)

Also **Hāpu'u i'i**

(*Cibotium chamissoi*)

Order Filicales, Family Dicksoniaceae



Illustration: Joan Yoshioka



Cut along dashed lines

Plant

'Olapa

(*Cheirodendron trigynum*)
Order Apiales, Family Araliaceae



Illustration: Joan Yoshioka

Plant

'Ohelo (*Vaccinium* spp.)

Order Ericales, Family Ericaceae
(*Vaccinium calycinum* is a common East Maui species.)



Illustration: Joan Yoshioka

Plant

Māmaki (*Pipturus* spp.)

Order Urticales, Family Urticaceae



Illustration: Joan Yoshioka

Plant

'Ohā and Hāhā (and others) or Hawaiian lobelias (*Lobelia*, *Cyanea*, and *Clermontia* spp.)

Order Campanulales,
Family Campanulaceae,
Subfamily Lobelioideae
(Common East Maui species include *Lobelia grayana*, *Cyanea hamatiflora*, and *Clermontia arborescens*.)



'Ohā (*Clermontia parviflora*) (Illustration: Joan Yoshioka)



Cut along dashed lines

Plant

Kanawao or Pū'ahanui

(*Broussaisia arguta*)

Order Rosales, Family Hydrangeaceae



Photo: Steve Anderson

Plant

Kōlea (Myrsine spp.)

Order Primulales, Family Myrsinaceae

(*Myrsine lessertiana* is a common East Maui species.)



Illustration: Joan Yoshioka

Plant

'Ie'ie or Climbing screwpine

(*Freycinetia arborea*)

Order Pandanales,

Family Pandanaceae



Photo: Carol Gentz

Plant

Maile (*Alyxia oliviformis*)

Order Gentianales,

Family Apocynaceae



Illustration: Joan Yoshioka



Cut along dashed lines

Plant

Hawaiian mints (*Stenogyne* spp.)

Order Lamiales, Family Lamiaceae

(*Stenogyne rotundifolia* is a common East Maui species.)



Illustration: Nanci Sidaras

Plant

Uluhe or False staghorn fern

(*Dicranopteris linearis*)

Order Filicales, Family Gleicheniaceae



Illustration: Joan Yoshioka

Plant

'Ala'ala wainui

(*Peperomia* spp.)

Order Piperales, Family Piperaceae

(*Peperomia cookiana*, *lilifolia*, and

waikamoiana are common East Maui species.)



Photo: Kim Martz and Forest Starr

Plant

Pa'iniu (*Astelia* spp.) or

Kaluaha (*Astelia menziesiana*)

Order Liliales, Family Liliaceae



Illustration: Joan Yoshioka