

Activity #4

# Web of Life Game

## ● ● ● Class Period One *Web of Life Game*

### Materials & Setup

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- Alpine/Aeolian Connections Game Cards (master, pp. 30-45)  
(If there are not enough cards to go around, have students share a card.)
- A matching game card black and white photocopy for each student to take home

### For each student

- Student Page “Web of Life Game” (pp. 46-47)
- Student Page “How Does Your Species Fit?” (p. 48)

### Instructions

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- 1) Begin the class by writing these words next to each other on the board or overhead: “similarities” and “relationships.” Ask students to think of some similarities among students in the class and write some examples in a column beneath the word, “similarities.” Next ask students to think of some relationships among students in the class and again write examples in a column below the word, “relationships.” Explain to students that they will be looking for both similarities and relationships among species in the alpine/aeolian ecosystem during the game they will be playing.
- 2) Hand out the Student Page “Web of Life Game.” Conduct Part One of the game using the game cards provided with the curriculum and following the game instructions (pp. 28-29).
- 3) Assign the Student Page “How Does Your Species Fit?” as homework.

## ● ● ● Class Period Two *Web of Life Game, Continued*

### Materials & Set Up

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- Large pieces of paper and colored pencils or marking pens

### Instructions

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- 1) Conclude the “Web of Life Game” by completing Part Two.

### Journal Ideas

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- Answer the “Think About It . . .” question on your species game card.
- What have you learned about this ecosystem by studying the relationships among species?

### Assessment Tools

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- Student Page “Web of Life Game”
- Student Page “How Does Your Species Fit?”
- Journal entries



## Teacher Background

# Playing the Web of Life Game

## Part One

- 1) Pass out one game card and one copy of the Student Page “Web of Life Game” to each student. Take a few minutes for students to look at their cards.
- 2) Tell students the object of this game is to fill in their sheets with as many connections to other species in the alpine/aeolian zone as they can by talking with other classmates and comparing notes about their species.

Review the student activity sheet with students. It describes three kinds of links that students might be looking for:

- a) Characteristics that a species shares with another species,
- b) Similar kinds of adaptations to the alpine/aeolian environment, and
- c) Ways in which a species interacts with other species.

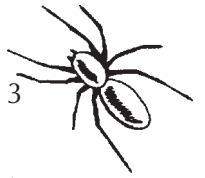
Students may find other kinds of links, too, which may include similar habitat or use of habitat (e.g. petrels and wolf spiders both dig protective burrows).

- 3) **BE PREPARED FOR A SOMEWHAT CHAOTIC SCENE AS STUDENTS SORT OUT THEIR STRATEGIES AND LOOK FOR LINKS!**
- 4) If things quiet down too much, encourage students to study their cards for details that they might have missed or to look around the classroom for someone they haven’t talked to yet.
- 5) When the end of class is near, have students return to their seats. Assign the Student Page “How Does Your Species Fit?” as homework.

Also hand out black and white photocopies of game cards for students to take home. Each student should have the photocopy that corresponds to the game card he or she used during class. Students need the information on the game card as well as the completed game activity sheet to do this assignment.

## Part Two

- 1) Spend a few minutes with students reviewing some of the basic links within natural communities. Ideas you may want to cover include:
  - Dependent relationships and independence,
  - Presence or absence of a central species in a natural community,
  - Predator/prey relationships,
  - Parasitism,
  - Mutualistic relationships in which both organisms benefit, and
  - Food webs.
  - Ask students to identify others.
- 2) Divide students into small groups of four or five students each, and give them about 20 minutes to draw a picture representing relationships of species to each other in the alpine/aeolian zone. They do not have to cover every species in this drawing, but they should study their lists of links from the previous class to include as many species as they can.
- 3) After about 20 minutes have passed, have students create one collaborative drawing, with you or one of the students acting as scribe. During this time, direct the action, asking questions that help students consider key relationships using the following discussion questions:



## Discussion Questions

- 1) What did students learn about their species and about the alpine/aeolian ecosystem?
- 2) What might happen to the whole community if different species were removed? (Pick a range of individual species to focus on one at a time.)
- 3) What kinds of things might cause some of the relationships to be cut off?
- 4) Ask students to discuss and/or illustrate the possible effects of the introduced species (Argentine ant and Western yellowjacket) on the native web of life.

## Activity Option

### Materials & Setup

- Lengths of string or yarn in several different colors
- Scotch tape

### Instructions

Instead of, or in addition to, having students make drawings that represent species relationships in the alpine/aeolian ecosystem, try this:

- 1) After you go through the review of basic links within natural communities (Part Two, #1), work with students to assign different colors of string to different kinds of relationships.

For example, colors may be assigned to represent:

- Predator/prey relationships,
  - Parasitism,
  - Mutualistic relationships in which both organisms benefit, and
  - Others that students identify.
- 2) Have students whose species are related in each of these ways tape either end of the appropriately colored string to their laminated species cards as a way of visually emphasizing the connections.
  - 3) Go through the types of relationships one at a time at first. Then create a “web of life” for the alpine/aeolian zone by adding all of the relationships/string colors together.
  - 4) Follow up with the discussion questions, showing effects of removing species or cutting off relationships by cutting or removing the strings held by the student representing different species.
  - 5) Illustrate the importance of the silversword in the ecosystem by cutting all of the strings that connect the silversword to anything else. Ask students to explain how each of the connected species would be affected if the silversword were removed from the web.



# Web of Life Game Cards

## 'Āhinahina, Haleakalā Silversword (*Argyroxiphium sandwicense* subsp. *macrocephalum*) Family Asteraceae

**Status** Endemic to Haleakalā. Threatened.

**Habitat** Found only on the upper slopes of Haleakalā.

### Characteristics

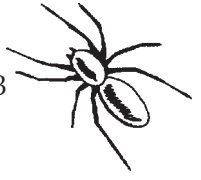
- Cannot produce fertile seeds without cross-pollination. Depends on insect pollinators for survival.
- About a dozen endemic species of moths, beetles, and other insects are found only with silverswords.
- Leaves are covered with silvery-colored hairs that reflect sunlight and help to hold in heat.
- "Monocarpic"—meaning it flowers only once and then dies.
- Stiff, succulent leaves in a rosette form shelter the interior of the plant from excessive heat or cold. The leaves of the often-spherically shaped plants may help shade the dark cinders below them, protecting shallow roots from too much heat.

**Think about it:** How might invasions by non-native Argentine ants and Western yellowjackets threaten the 'āhinahina?

**Did you know?** The 'āhinahina is a part of a group of plants called the silversword alliance. These plants descended from a single ancestor species of tarweed that probably came originally from California. The 28 endemic Hawaiian species in the silversword alliance are in three genera: *Argyroxiphium*, *Dubautia*, and *Wilkesia*.



Photo: R.C. Zink, Haleakalā National Park



## Carabid Beetle (or Ground Beetle) (*Mauna frigida*)

Order Coleoptera, Family Carabidae

**Status** Endemic to Haleakalā. Of ten carabid beetle species recorded within the alpine/aeolian zone, nine are endemic to Haleakalā.

**Habitat** Five of the endemic carabid beetle species, including *Mauna frigida* have been found only on the upper 150 meters (492 feet) of the mountain's summit.

### Characteristics

- These five species are flightless scavenger-predators.
- Thick outer or exoskeletons protect them from water loss and extreme cold.

**Think about it:** These five species are extremely rare. Little is known about their current status or biology. Some of them may be extinct. How would you go about trying to find out?

**Did you know?** The 215 Hawaiian endemic carabid beetle species probably evolved from as few as six original immigrants.

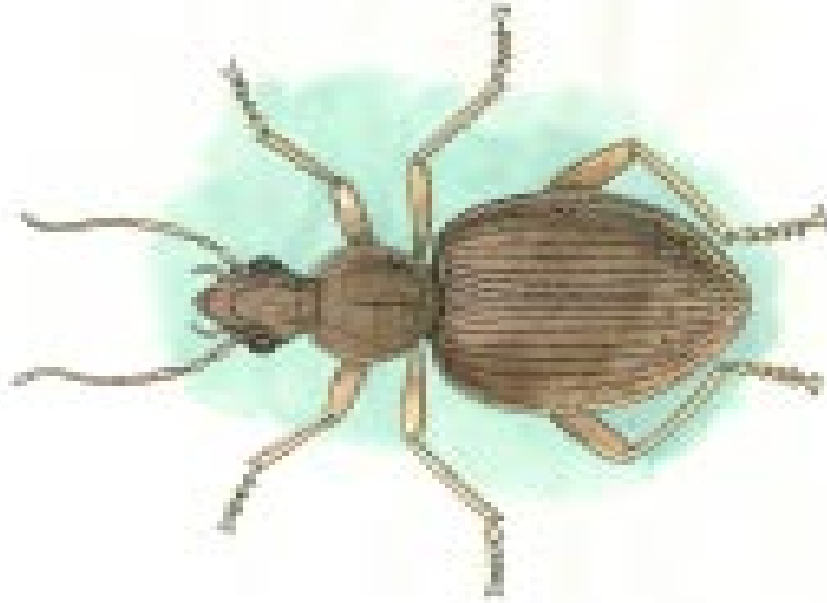


Image: Nancy Sidasaras



### Hawaiian Noctuid Moth (*Agrotis arenivolans*) Order Lepidoptera, Family Noctuidae

**Status** Endemic to Hawai'i.

**Habitat** • Larvae have been seen feeding on the leaves of the native shrubs *pūkiawe* and *na'ena'e*. They also feed on the seeds of the *āhinahina*.  
• Caterpillars burrow in cinders during the day and feed at night.

#### Characteristics

- Adults have a layer of long, thick hairs on their wings and bodies that help keep them warm, reflect sunlight, and prevent water loss.
- Adult noctuid moths visit flowers at night, probably acting as pollinators for native plants.

**Think about it:** Noctuid larvae are abundant in the alpine/aeolian zone. But wherever the Argentine ant is established, very few of these caterpillars can be found. What do you think is happening?

**Did you know?** The larvae (caterpillars) of most Lepidoptera species around the world feed on plants. But the larvae of at least one Hawaiian noctuid moth species in the alpine/aeolian zone feed on other insects as well as on the leaves of the few plants that occur in the area. Their arthropod prey is either dead or in a stupor from the cold night air.

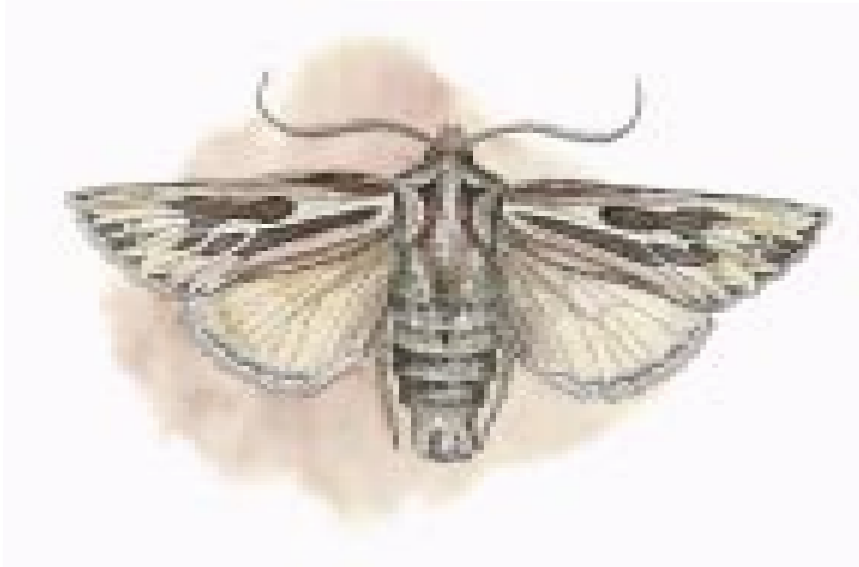
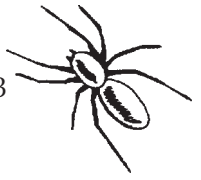


Image: Nancy Sidas





**Wolf Spider (*Lycosa hawaiiensis*)**  
Order Araneae, Family Lycosidae

**Status** Endemic to Haleakalā.

**Habitat** •Lives only at or near the mountain's summit.

- Makes shallow burrows under rocks by cementing windblown leaves and other detritus together with silk. The burrows protect them from the cold, dry climate.

**Characteristics**

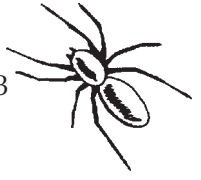
- Normally dark in color, turns silver when hunting among the 'āhinahina rosettes.
- A predator-scavenger that hunts on the ground rather than building webs.
- A large spider, measuring between 3.5-5 cm (1.4-2 in) in length.

**Think about it:** How might a dark-colored body and long legs help a wolf spider survive in the cold temperatures of the alpine/aeolian zone?

**Did you know?** Mother wolf spiders carry silk egg sacs (larger than their own bodies) beneath them. As the young hatch, they ride on their mother's back while she hunts.



Photo: Haleakalā National Park



**Haleakalā Flightless Moth**  
**(*Hodegia [Thyrocopa] apatela*)**  
Order Lepidoptera, Family Gelechiidae

**Status** Endemic to Haleakalā.

**Habitat** • Found only on the upper slopes of Haleakalā.

• Seen most often on warm days in rocky areas but also attracted to lights at night.

**Characteristics**

- 1 1/4 cm (.5 in) long, silver-grey color.
- Has dagger-shaped wings but cannot fly. Instead, it walks and hops along the ground.
- Larvae live in silken tubes woven in with dried *na 'ena'e* leaves and bits of cinder.
- Larvae are covered with a thick layer of hair.

**Think about it:** What weather conditions in the alpine/aeolian zone might make it an advantage to walk instead of fly?

**Did you know?** Western yellowjackets prey on this moth. Researchers believe Argentine ants, too, would pose a threat if they became established in the moth's very small range.

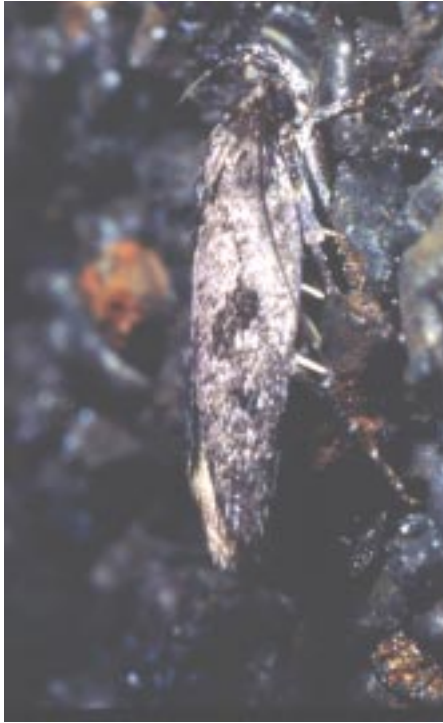


Photo: Eric Nishibayashi

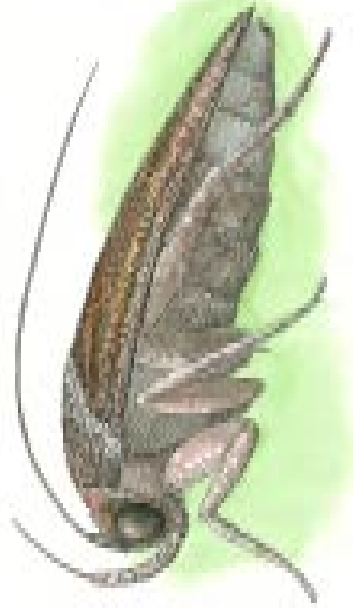
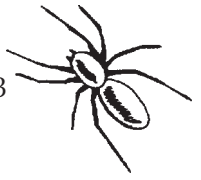


Image: Nancy Sidasaras





**Argentine Ant (*Linepithema humile*)**  
(formerly *Iridomyrmex humilis*)  
Order Hymenoptera, Family Formicidae

**Status** Alien (probably native to Argentina and Brazil).

**Habitat** Have established a population near the edge of the alpine/aeolian zone.

**Characteristics**

- On Haleakalā, areas occupied by Argentine ants show reduced numbers of many native insect species, including Lepidoptera larvae, carabid beetles, ground-nesting bees and wasps, and others.
- Noctuid moth caterpillars have been found among its prey.

**Think about it:** Researchers believe this species has the potential to eliminate most native arthropod species, including those that pollinate the *‘āhihina* and other plants. How do you think this would change the ecology of the alpine/aeolian zone?

**Did you know?** Argentine ants are "eusocial" (truly social) insects. Biologists believe that social behavior gives insects a competitive edge over more solitary insects.



Image: Nancy Sidas



**Western Yellowjacket (*Vespula pensylvanica*)**  
Order Hymenoptera, Family Vespidae

**Status** Alien (native to western North America).

**Habitat** On warm summer days, very common on the mountain's summit, even where there is little plant cover.

**Characteristics**

- After dry winters, large numbers of worker wasps emerge in the late summer. They prey intensely on other arthropods.
- Haleakalā flightless moths have been found among their prey.

**Think about it:** Yellowjackets often prey on rare species with small ranges, native plant pollinators and flightless species. What effects do you think intense predation would have on the ecosystem?

**Did you know?** Western yellowjackets are "eusocial" (meaning truly social). Biologists believe that social behavior gives insects a competitive edge over more solitary insects.



Image: Nancy Sidas



**Plant Hopper (*Nesosydne argroxiphii*)**  
Order Homoptera, Family Delphacidae

**Status** Endemic to Haleakalā.

**Habitat** Found only on *'āhinahina*.

**Characteristics**

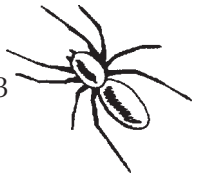
- Silver colored, like the silversword.
- Sucks sap from the leaves of the silversword, but does no serious damage.
- Very tiny (1-2 mm or .04-.08 in).

**Think about it:** What advantage would a silver color be for an insect that lives exclusively on *'āhinahina* plants?

**Did you know?** Plant hoppers tap at different pitches to attract a mate. Each species has a different pattern of tapping.



Photo: Kim Martz and Forest Starr



## Hawaiian Long-Horned Beetle (*Plagithmysus terryi*)

Order Coleoptera, Family Cerambycidae

**Status** Endemic to Haleakalā.

**Habitat** Larvae bore into lower stems and roots of flowering ‘*āhinahina* plants.

### Characteristics

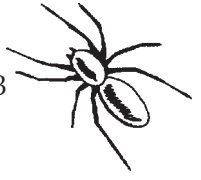
- Larvae feed on the woody tissue of the ‘*āhinahina* until they transform into adults.
- Mates and lays eggs in May and June when winter rains diminish, days are warm, and the silverswords begin to flower.

**Think about it:** The ‘*āhinahina* is the only known host plant for this beetle. How does this help explain the fact that, while an occasional plant will be so weakened that it topples over, most of the time the larvae cause no apparent damage?

**Did you know?** Over 136 species in the endemic genus *Plagithmysus* are believed to have evolved from a single ancestral species.



Image: Nancy Sidas



**Seed Bug (*Nysius communis*)**  
Order Heteroptera, Family Lygaeidae

**Status** Endemic to the Hawaiian Islands.

**Habitat** • Found in the summit area, as well as in other habitats on the mountain.

- Commonly seen on *‘āhinahina* and *na‘ena‘e* in the alpine/aeolian zone.
- In other ecosystems, found on other host plants such as *koa* and *‘ōhi‘a lehua*.

**Characteristics**

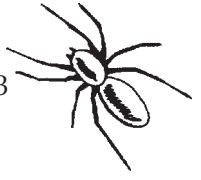
- Swarms are often seen in the summit area.
- Feeds on plant juices.

**Think about it:** How would piercing and sucking mouth parts help these insects obtain food?

**Did you know?** In the 1960s, swarms of various species of *Nysius* bugs sometimes interfered with visibility from the observatories on Haleakalā. Bushes surrounding the observatories were treated with the insecticide DDT to keep the insects out of the area.



Photo: Kim Martz  
and Forest Starr



**Tephritid Fly (*Trupanea cratericola*)**  
Order Diptera, Family Tephritidae

**Status** Endemic to Haleakalā.

**Habitat** Found only in association with ‘āhinahina (Haleakalā silversword).

**Characteristics**

- Females lay eggs in the buds of ‘āhinahina flowers. The eggs hatch as the flower develops.
- Larvae feed on seeds from ‘āhinahina.
- Wings are patterned.

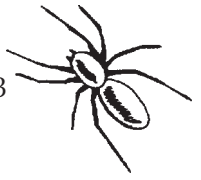
**Think about it:** Females have a long ovipositor, the body part through which they lay eggs. Why would this characteristic be important for the survival of eggs and larvae?

**Did you know?** Nobody knows where these flies spend the winters.



Photo: Kim Martz and Forest Starr





**Hawaiian Yellow-Faced Bee**  
**(*Nesoprosopis [Hylaeus] volcanicus*)**  
Order Hymenoptera, Family Colletidae

**Status** Endemic to Haleakalā.

**Habitat** Lays eggs in a winding, silken tube nest, usually under a rock.

**Characteristics**

- Solitary, unlike the social honeybee that lives in cooperation with other bees.
- Visits flowers to gather pollen and nectar to feed its young.
- Small—only 6-12mm (.024-.048 in) long.

**Think about it:** Why would these small bees be so critical to the pollination of many native plants including *pūkiawe* and the *‘āhinahina*?

**Did you know?** Another species of Hawaiian yellow-faced bee (*N. volatilis*) found in the alpine/aeolian zone is a nest parasite. It lays its eggs in the nest of the bee species *N. volcanicus* or the related *N. nivalis*. It may visit flowers, as well, but only to gather nectar to feed itself.

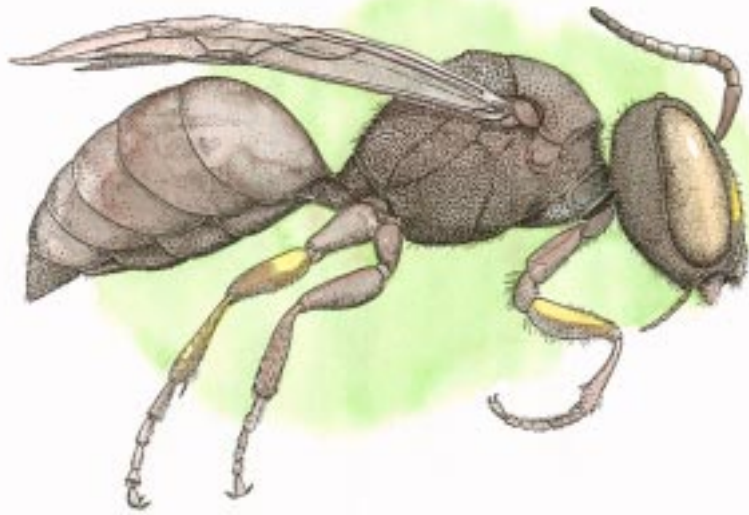


Image: Nancy Sitaras



**Na'ena'e or Kūpaoa (*Dubautia menziesii*)**  
Family Asteraceae

**Status** Endemic to Maui.

**Habitat** A common shrub in the alpine/aeolian zone.

**Characteristics**

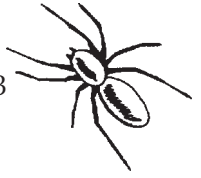
- Stiff, succulent, concave leaves similar to those on a silversword.
- Leaves grow along the stem in crowded ranks.
- From mid-June through November, yellow flowers are borne at the ends of branches.

**Think about it:** Why would bearing flowers at the ends of branches be an advantage for plants that rely on insects for pollination?

**Did you know?** Although it bears little resemblance to the 'āhinahina, the na'ena'e can hybridize with the 'āhinahina. Both belong to a group of plants called the silversword alliance. These plants descended from a single ancestor species of tarweed that probably came originally from California. The 28 endemic Hawaiian species in the silversword alliance are in three genera: *Argyroxiphium*, *Dubautia*, and *Wilkesia*.



Photo: Haleakalā National Park



***Pūkiawe (Styphelia tameiameia)***

Family Epacridaceae

**Status** Indigenous.

**Habitat** One of the most common shrubs in the alpine/aeolian ecosystem on Haleakalā.

**Characteristics**

- Tiny stiff, succulent leaves grow all around the stem. The leaves store water.
- Tiny white flowers and inedible, dry berries that may be red, pink, or white.

**Think about it...** *Pūkiawe* leaves are used in traditional Hawaiian medicine to treat colds and headaches. Lei-makers often use *pūkiawe* in elaborate *lei haku*. Should people be allowed to collect *pūkiawe* for these traditional uses within Haleakalā National Park, where plants and animals are protected from collection and hunting?

**Did you know?** The tiny Hawaiian yellow-faced bees are an important pollinator of this plant.



*Photo: Michele Archie*



**Tetramolopium**  
(*Tetramolopium humile* subsp. *haleakalae*)  
Family Asteraceae

**Status** Endemic to Haleakalā.

**Habitat** • Found only in the alpine/aeolian zone.

• Often grows sheltered by chunks of lava, large boulders, or crevices of lava flows.

**Characteristics**

• Small, narrow, hairy leaves.

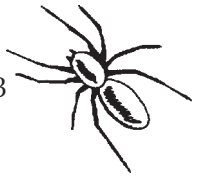
• Grows in a compact form low to the ground, like a dense cushion of leaves.

**Think about it:** How would small, hairy leaves and a cushion-like shape help this plant conserve water?

**Did you know?** Tetramolopium is a relative of the daisy and aster; two flowers that are common in home gardens and flower shops.



*Photo: Haleakalā National Park*



**'Ua'u, Hawaiian Dark-Rumped Petrel**  
**(*Pterodroma phaeopygia sandwichensis*)**  
Family Procellariidae

- Status**
- Endemic to the Hawaiian Islands.
  - Formerly known from all of the larger Hawaiian Islands.
  - Endangered.

- Habitat**
- Seabird that uses the alpine/aeolian zone only for nesting.
  - Most often nests in crevices or deep burrows dug in cinder along cliffs.

**Characteristics**

- Spends winters on the open ocean and return to nest on Haleakalā.
- Parent birds forage for squid and other food at sea, returning to tend and feed their young at night.

**Think about it:** How would introduced predators such as rats and mongoose pose a threat to the 'ua'u?

**Did you know?** Haleakalā is the only protected habitat for the 'ua'u. Ninety percent of the world's known population is found there.



Photo: Eric Nishibayashi





# Web of Life Game

## Instructions

This game has you looking for links between the species that is on your game card and other species in the alpine/aeolian zone. These links might be:

- Characteristics that your species shares with another species.
- Similar kinds of adaptations to the alpine/aeolian environment.
- Ways that your species interacts with other species.
- Other kinds of links. Be creative!

This is easy! Simply talk with your classmates who are holding cards for different species. Fill the name of the species in the table on the next page in the “Species” column. If you find a link, write that down in the other column. If you don’t find a link with that species, make a note about that, too.

## Strategy Hints

See how your species “fits” in the alpine/aeolian ecosystem. In order to do that, you’ll want to know about all the other species, being thorough in comparing notes with the holder of that species card.

Pay attention to the details on your card so you don’t miss any links. It’s not the number of “links” that counts—it’s that you learn how your species is related to other species in the alpine/aeolian zone.





Write the name of your species here:

Species	Links



# How Does Your Species Fit?

Using your game card and completed table of links with other species as background information, describe how your species relates to the other species in the alpine/aeolian ecosystem. Think about questions such as the following in writing your answer:

- What characteristics does your species share with other species (for example, food sources, coloration, shape, or behavior)?
- Do any of these characteristics seem to represent similar kinds of adaptations to the alpine/aeolian environment? Which environmental characteristics might they be adaptations to?
- How does your species interact with other species? Are there other species it depends upon?
- Are there any patterns that would help you describe how your species fits in the alpine/aeolian zone?

Write your answer in the space below, and use the other side of the sheet if you need more space: