Activity #2

What Makes a Plant Invasive?

● ● ● In Advance *Collecting Weeds*

- Have students bring to class examples of plants they think of as weeds. Challenge students to look for plants that seem particularly invasive (capable of rapidly taking over large areas and inhibiting the growth of other plants).

● ● ● Class Period One *Characteristics of Invaders*

Materials & Setup

For each student

- Student Page "Invasive Plants in Hawai'i" (pp. 22-30)
- Student Page "Invasive Plants in Hawai'i: Questions on the Reading" (pp. 31-34)

Instructions

1) Have students display their plants in front of the class. As the class observes the plants, ask whether there seem to be any similarities among them. (If they need ideas, prompt students to look at characteristics such as leaf size, flower size and structure, the form in which plants grow, root shape and size, and so forth.)

2) Divide the class into groups of four to five students. Tell students that there are eleven characteristics that make some plants highly successful invaders. Have student teams work together to identify as many of these as they can, using the plants on display for ideas. Each group should make a list of the characteristics it identifies and explain their reasoning for each one.

3) Now tell students that there are seven main "dispersal mechanisms" that spread invasive plants into the Haleakalā rain forest. A dispersal mechanism is a means by which plant seeds are spread around, which enables the plant to become established in a new area. Challenge student teams to think of as many of the seven dispersal mechanisms as they can, write down their ideas, and explain their reasoning.

4) Give each student a copy of the Student Page "Invasive Plants in Hawai'i." Have students read pages 22-25, stopping before the subsection entitled "Six Invaders of Concern." When students have finished reading, have groups go back to their lists and use the information in the reading to determine the characteristics and dispersal mechanisms they missed. Groups should note these on their lists and place check marks by the ones they identified correctly.

5) As a class, discuss the similarities and differences between student lists and the ones given in the reading.

6) As homework, assign the rest of the Student Page "Invasive Plants in Hawai'i" as well as "Invasive Plants in Hawai'i: Questions on the Reading."

● ● ● Class Period Two *Invasives Identification Quiz*

Materials & Setup

- "Correct Responses for Invasive Plant Identification Quiz" acetate (master, p. 21)
- Overhead projector and screen

For each student

- Student Page "Invasive Plant Identification Quiz" (pp. 35-36)

Instructions

1) Hand out the Student Page "Invasive Plant Identification Quiz," and have students complete it.

2) Go over correct answers, using the acetate of correct responses. Discuss student questions.

3) Optional: Discuss the homework assignment with the class, using the questions on the Student Page "Invasive Plants in Hawai'i: Questions on the Reading" as a guide.

Journal Ideas

- How would you define a "weed"? Does invasiveness potential have anything to do with your definition? How about whether the plant is native?
- When talking about nonnative plants in Hawai'i, people often distinguish between "Polynesian introductions" brought here by early Polynesian settlers, and nonnative plants that were introduced later, after European contact. Does this division make sense to you? Why or why not?

Assessment Tools

- Participation in group work and class discussion
- Student Page "Invasive Plants in Hawai'i: Questions on the Reading" (teacher version, pp. 17-20)
- Student Page "Invasive Plant Identification Quiz" (teacher version, p. 21)
- Journal entries

Teacher Version

Invasive Plants in Hawai'i: Questions on the Reading

1) From the reading, select three of the characteristics that invasive plants may possess, and explain why each one could give these plants an advantage over native plants.

Characteristic	Advantage
• Quick growth to reproductive maturity	Rapidly maturing plants would start producing seed or reproducing vegetatively more quickly than slower native species, thus adding more plants to their populations more quickly.
• Profuse reproduction by seeds and/or vegetative structures such as root runners	Crowding out more slowly reproducing native plants
• Long seed life in the soil	The ability to build up a massive number of seeds in the soil from which new plants can continuously sprout puts native plants with shorter-lived seeds at a disadvantage.
• Seeds that can lie dormant through unfavorable conditions and sprout when conditions are ideal for rapid growth	Dormancy adds to the number of seeds in the soil from which new plants may sprout under favorable conditions. Not sprouting during unfavorable conditions means that these plants may have a reduced risk of seedling mortality compared to native plants that do not have this characteristic.
• Seeds that are adapted to be easily spread by wind, animals, water, and/or humans	The ability to establish new populations in areas that are not directly adjacent to existing ones may give invasive plants an edge in colonizing new areas.
• Production of "biological toxins," substances that suppress the growth of other plants	A form of direct competition which may suppress the growth of nearby native plants
• Spines, thorns, and other structures that cause physical injury and repel animals	Most native Hawaiian plants have evolved without these mechanisms which can be an important protection against introduced predators such as goats, pigs, and cattle.

Characteristic	Advantage
• The ability to "parasitize" or live on other plants.	Parasitic plants can weaken native plants by using nutrients and energy from the host plant.
• Roots or "rhizomes" (underground plant stems that sprout roots below and plant stems above) containing large food reserves	Large food reserves may enable invasive plants to survive longer through drought and other adverse environmental conditions than native plants.
• Survival and seed production under adverse environmental conditions	May enable invasive plants to thrive where and when more sensitive native plants die back or lose vigor
• High photosynthetic rates or large leaves that allow them to tolerate low-light conditions and to grow quickly	May enable invasive plants to become established in shady areas where many native plants cannot live and give juveniles of an invasive species that forms dense thickets an advantage over native species that need more light to survive or thrive

2) If the goal is to control or eliminate invasive plants, why would it be important to identify and remove new populations before they reach reproductive maturity?

Once a population matures, it may rapidly reproduce, growing very quickly in size and density. A smaller population will be easier to treat or remove and have less impact on native vegetation in the area. Also, once an invasion is widespread, there is a much larger area to patrol to find new populations.

3) One job of field crews in protected areas is to look for previously undiscovered populations of invasive plants. If you were in charge of field crews at Waikamoi Preserve or Kīpahulu Valley, which of the plant species covered in the "Matrix of Factors That Influence Invasiveness" would you have field crews look for most frequently? Use the information in the matrix to explain your answer.

Clidemia—this species rapidly reaches reproductive maturity in six months, unlike other species in the matrix that take at least two years.

4) Give two reasons why it would be important for field crews to reinspect areas where they have already manually removed a population of invasive plants and/or treated it with herbicides.

   - To determine whether their treatment worked,
   - To monitor whether any seeds stored in the soil have sprouted into new plants, and
   - To prevent more fruit or seed from being produced by plants that may have survived or been missed in the initial treatment.

5) How long would you have crews return to a treated site to monitor it? Use the information in the matrix to explain your answer.

   Depending upon the species, four to six years, since that's how long seeds can stay viable in the soil. (Responses may also address the fact that seed longevity in the soil is unknown for some plant species. In these cases, students may suggest additional research, long-term monitoring that becomes less frequent over time, and other alternatives.)

6) Imagine that you are in charge of controlling invasive plants in Waikamoi Preserve or Kīpahulu Valley. Use the information provided in the last two columns of the invasiveness matrix ("Vegetative Layers Impacted" and "Potential Displacement of Natives in Layers") to determine the potential threat each plant poses to native rain forest plants. Rank the six plant species in order of the threat they pose to the native rain forest, with "1" indicating the greatest threat and "6" indicating the least threat. (If there is a tie between two species for a given ranking, use other information in the matrix to determine your ranking.) Explain why you ranked the plants the way you did.

   Here is one logical ranking (there may be others, which are acceptable as long as they are based primarily on the information in the last two columns in the matrix and well-reasoned).

   1. Strawberry Guava
      May fully displace all vegetative layers and reaches reproductive maturity more quickly than Miconia
   2. Miconia
      May fully displace all vegetative layers but reaches reproductive maturity more slowly than strawberry guava, so it may be easier to find and control populations before they reproduce
   3. Australian Tree Fern
      May partially to completely displace three of four vegetative layers in the rain forest
   4. *Kāhili* Ginger
      May completely displace the ground and shrub layers
   5. Pampas Grass
      May partially to completely displace the ground and shrub layers
   6. Clidemia
      May partially displace the ground and shrub layers

7) Use the other columns of the invasive matrix to double-check your ranking. Would you change anything based on this additional information? If so, what would you change and why? If not, why not?

Here is one logical response (there may be others, which are acceptable as long as they are based primarily on the additional information in the matrix and well-reasoned).

1) Miconia
May mature more slowly than strawberry guava but is of higher concern because it produces such huge numbers of small seeds that are highly dispersable

2) *Kāhili* Ginger
Its ability to completely displace the ground and shrub layers means that it could disrupt the new growth of any kind of vegetation in the forest. Since pigs are controlled in much of Waikamoi Preserve and Kīpahulu Valley, this plant is a greater threat than strawberry guava, which is primarily spread by pigs.

3) Strawberry Guava
May fully displace all vegetative layers and reproduces quickly

4) Australian Tree Fern
Dispersal by wind is a big concern with this plant since it can be easily spread long distances.

5) Pampas Grass

6) Clidemia

8) How can knowing the potential elevation range help a resource manager plan a control strategy for a particular plant species?

Possible responses include:

For plants that are restricted by elevation, managers can target control efforts to the elevational range in which the plants may be found, rather than spreading efforts to elevations where these plants are unlikely to survive or reproduce.

Also, a broad elevational range can add up to greater destruction because there is a greater amount of habitat that this plant may invade. This potential may increase the priority placed on controlling a given plant.

Frost and cold tolerance means that plants may invade the upper-elevation habitats, which tend to be less altered by human activity, with a more intact native ecosystem. This potential may increase the priority placed on controlling a given plant.

Correct Responses for Invasive Plant Identification Quiz

Photo: The Nature Conservancy

***Kāhili* Ginger**

B. A popular flowering plant in gardens and landscaping

1. Birds are one of the main dispersal mechanisms for this plant, which produces bright red seeds.

Photo: The Nature Conservancy

Miconia

E. Originally brought to the Hawaiian Islands as an ornamental tree because of its dark green and purple leaves

2. Is capable of completely displacing native plants in all vegetative layers of the rain forest

Photo: Steve Anderson

Clidemia

A. A densely branching shrub that is thought to have been introduced to the Hawaiian Islands unintentionally

3. Restricted to elevations below 1300 meters (4264 feet) because it cannot tolerate cooler temperatures or frost

Photo: Steve Anderson

Australian Tree Fern

D. Nurseries sell more of these plants than the native *hāpu'u,* which could serve the same function in landscaping.

4. A dense infestation of this plant in Kīpahulu Valley is thought to have originated from nurseries in the Hāna area, 12 kilometers (7.4 miles) away.

Photo: Kim Martz and Forest Starr

Strawberry Guava

C. Originally introduced to the Hawaiian Islands as a food source because it bears edible purple or yellow fruit

5. Is spread by pigs and can completely displace native plants in all vegetative layers of the rain forest

Photo: Kim Martz and Forest Starr

Pampas Grass

F. A popular ornamental plant with saw-toothed leaves and white to pink flower plumes

6. Is capable of invading many habitats including grasslands, mesic forests, wet forests, shrublands, and bogs