# Choose your weapon!

**Summary**
Students investigate and choose a biocontrol agent for a fictitious weed.

**Learning Objectives**
Students will be able to:
- Explain how scientists find potential biocontrol agents.
- List 4 criteria for choosing biocontrol agents.
- Explain why careful selection of biocontrol agents is important.

**Suggested prior lessons**
What is a weed?
Cultivating weeds

**Curriculum Connections**
Science, levels 2-6

**Vocabulary/Concepts**
Biocontrol, biological control, biocontrol agent, ecology, organism, family, genus, parasitic, endangered, endemic, native

**Time**
1 – 1 ½ hours

**Materials**
- copies of The Scenario, Rules for Selecting Biocontrol Agents, Biocontrol agent clue cards, and Choose Your Weapon record sheet
- Video—Heather Beetle: a born killer (http://www.youtube.com/watch?v=scWnyjweApw&feature=results_video)

## Background information

Biological control, or biocontrol, is using one organism to get rid of another. In order to successfully use biocontrol to manage weeds, we need to understand the ecology of the weed—how it interacts with its environment and the other living things around it—and of the potential biocontrol agents we want to use against it.

## Activity

(adapted from *Pests Have Enemies Too* by M. Jeffords and A. Hodgins, Illinois Natural History Survey, 1995)

Watch the video LINK about how heather beetle was chosen as a biocontrol agent for heather. Using think, pair, share, ask students to recount some of the criteria scientists used to choose a biocontrol agent. How did they test their choice of agent?

Explain to the students that they are going to become scientists searching for a biocontrol agent for a ficticious weed—the purpleface waterleaf.

*Please note that the scenario used in this activity is completely fictitious. The plants and biocontrol agents in the scenario don't actually exist.*

Have students read the Scenario and the Rules for Selecting Biocontrol Agents, and discuss these as a class to ensure students understand their task. Divide the class into groups of 3 or 4 and give each group a set of clue cards and a Choose your Weapon! sheet. Groups should divide the clue cards among them and take turns reading out each clue and discussing it among themselves. As they

go, they should note possible biocontrol agents on the record sheet, and any important facts they think will help them make their decision. Once they've read all the clues, they should discuss each possible agent and decide whether they think it would make a good biocontrol agent or not. Explain that there may be agents they just don't have enough information about, and they should note this on their sheet.

When they're finished, have groups present their decisions to the class. They should explain what they decided to about each possible agent and why.

## Extension/discussion:

1. Have students research the introduction of stoats and ferrets for rabbit control as an example of what can happen when you don't choose a biocontrol agent carefully.

## Curriculum Connections

Science—Nature of Science
Level 2:

Understanding about science

- Appreciate that scientists ask questions about our world that lead to investigations and that openmindedness is important because there may be more than one explanation.

Levels 3 & 4:

Understanding about science

- Appreciate that science is a way of explaining the world and that science knowledge changes over time.
- Understanding about science: Identify ways in which scientists work together and provide evidence to support their ideas.

Investigating in science

- Build on prior experiences, working together to share and examine their own and others' knowledge.
- Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.

Communicating in science

- Begin to use a range of scientific symbols, conventions, and vocabulary.

Participating and contributing

- Explore various aspects of an issue and make decisions about possible actions.

Science—Living world
Level 2:

Life processes

- Recognise that all living things have certain requirements so they can stay alive.

Ecology
- Recognise that living things are suited to their particular habitat.

Evolution
- Recognise that there are lots of different living things in the world and that they can be grouped in different ways.

Levels 3 & 4:

Ecology
- Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

Evolution
- Begin to group plants, animals, and other living things into science-based classifications.
- Explore how the groups of living things we have in the world have changed over long periods of time and appreciate that some living things in New Zealand are quite different from living things in other areas of the world.

Level 5:

Ecology
- Investigate the interdependence of living things (including humans) in an ecosystem.

Level 6:

Ecology
- Investigate the impact of natural events and human actions on a New Zealand ecosystem.

## Vocabulary/concepts

**Biocontrol or biological control** – the use of a living organism to control a weed or other pest.

**Biocontrol agent** – a living organism used to control a weed or pest.

**Ecology** – the study of the relationships among living things.

**Endangered** – rare or in danger of becoming extinct.

**Endemic** – found only in New Zealand

**Family** – one of the groups scientists use to classify living things. Organisms in the same family have some similar features, and may share some diseases and natural enemies.

**Genus** – one of the groups scientists use to classify living things. Organisms in the same genus are very closely related to one another, and often share diseases and natural enemies.

**Organism** – a living thing

**Parasitic** – living on or in a host organism. Parasitic organisms are called parasites. They often weaken or kill their host.

**Native** – Found naturally in New Zealand. Not introduced by people.

# The Scenario

Purpleface waterleaf was accidentally introduced to New Zealand in the mid-1980s. It most likely arrived in mud on the soles of a tramper's boots. It was first noticed growing along the Abel Tasman Coastal Track, and has since spread widely in the upper half of the South Island and throughout the North Island. It grows in wetlands from sea level to alpine areas and crowds out native wetland plants. Its small seeds have tufts of hair on them and are spread widely by the wind. Because of its rapid spread, control of purpleface waterleaf has failed. It now threatens several endangered endemic wetland plants.

Purpleface waterleaf is native to Europe. You travel to its native range to look for potential biocontrol agents to bring back to New Zealand.

Use the clues to decide which agent might be a good candidate for biocontrol of purpleface waterleaf.

# Rules for Selecting Biocontrol Agents

The rules below are used by scientists when choosing organisms for biocontrol. Follow these rules as you search for biocontrol agents for purpleface waterleaf.

**An organism that is to be introduced for biocontrol must…**

1. feed only on the target weed. It should not harm native plants or crops.

2. ideally be easy to capture and raise in large numbers for release.

3. be able to reproduce successfully in its new home so that its numbers will increase rapidly after release.

4. have little or no effect on other organisms in the environment and must not become a pest itself.

## Clue #1:

In Bulgaria, you find a small wetland with a few purpleface waterleaf plants growing near the edge. The leaves of one plant are full of insect feeding holes. The plant appears to be nearly dead and has failed to bloom. You collect several hundred beetles from around the plant. You later identify them as the **waterleaf beetle.**

## Clue #2:

The **waterleaf beetle** feeds on several different kinds of closely related waterleafs, has two generations per year, and can be raised in captivity on potted waterleaf plants. Female beetles lay 100-400 eggs per generation.

## Clue #3:

In Germany, you find a small population of very stunted purpleface waterleaf with wrinkled, curly leaves. You collect a sample of leaves and test them for disease. The test reveals that the plants are infected with a **virus** unknown to science. Nothing is known about this new virus.

## Clue #4:

In Poland, you collect last year's seeds from several plants and bring them into the laboratory. Overnight, a large number of tiny, white maggot-like creatures with dark heads emerge from the seeds. You rear the creatures to adulthood and discover they are seed weevils. The weevils are identified as the **miniature forb weevil**.

## Clue #5:

The **miniature forb weevil** eats seeds of a certain size, but is not picky about the kind of seed it attacks. It is easy to raise in captivity. In cool, wet years it can become a pest on clover in pastures.

## Clue #6:

In Italy, you notice purpleface waterleaf growing in a marsh. In one place, you find several large **caterpillars** eating young plants. You try to rear the caterpillars to adulthood so they can be identified, but all the caterpillars sprout fuzzy-looking cocoons. Tiny parasitic wasps that have been eating the caterpillars alive emerge from these cocoons, and the caterpillars die before becoming adults. You are not able to identify the caterpillars.

## Clue #7:

In Latvia, you find wilting and dying purpleface waterleaf plants. These plants are covered with tiny insects called aphids that suck the sap from the plant. The aphids are identified as the **purpleface waterleaf aphid**.

## Clue #8:

The **purpleface waterleaf aphid** has a complex life cycle. It spends the winter as eggs on oak trees. When it hatches in spring, it spends a few weeks feeding on new oak leaves, then moves to purpleface waterleaf plants. After feeding and reproducing on purpleface waterleaf all summer, the aphid produces winged offspring that fly back to oak and spend a few weeks feeding before laying eggs on the trees.

## Clue #9:

In Austria, you discover a small patch of purpleface waterleaf covered with what looks like a hairy white powder. You find out that the plants are infected with a **powdery mildew fungus** that is almost always fatal to the plant.

## Clue #10:

The **powdery mildew fungus** attacks all members of the plant family to which purpleface waterleaf belongs. It occurs only in extremely wet summers with high heat and humidity. In dry cool years, the disease does not harm the plants.

## Clue #11:

Three native New Zealand plants are in the same family as purpleface waterleaf. All three are endemic (found nowhere else). One is widely spread across the country, and the other two are found only in alpine wetlands in Canterbury and Otago.

## Clue #12:

The New Zealand plants in the same family as purpleface waterleaf are all in their own genus. This genus is not found anywhere else in the world, and is considered quite distinct from other members of the family.

# Choose your weapon!

As you read the clues, list the possible biocontrol agents for purpleface waterleaf and decide if you think it is a good biocontrol agent or not.

| Possible agent | Important information | Should we use it? | | |
|---|---|---|---|---|
| | | Yes | No | Maybe, but we need to know more about it |
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