Clark's Nutcracker and Whitebark Pine Forests

Overview
Students will identify adaptations of the life history of Clark's Nutcracker and its role in the ecosystem.

California Science Standards
Grade 3: 3a.b L.S.
Grade 4: 5e. I&E
Grade 6: 5e. I&E

Oregon Science Standards
Grade 2: 3S.1
Grade 4: 2L.1
Grade 5: 2L.1, 3S.1
Grade 6: 2L.2

National Standards
Content Standard C: Life Sciences

Materials Included
- Stop Watch
- 900 food items (poker chips)

Materials Needed
- Cones or boundary markers

Activity Time
Preparation: 10 min.
Activity Time: 40 min.

Best Season
Fall and Spring

Vocabulary
- Life history
- Cache
- Clutch
- Carrying Capacity

Grade Level: 2nd-8th (O.S.S. 2nd, 4th-6th) (C.S.S. 3rd-4th, 6th)

Learner Objectives

Student will:

- Understand "habitat" in a biological context
- Learn the life history of Clark's Nutcracker
- Understand and define carrying capacity

Background Information

Clark's Nutcracker was first documented on August 22, 1805, by William Clark and was one of the three new bird species described from the historic Lewis and Clark expedition (1803-1806), along with Lewis' Woodpecker and Clark's Grebe. Clark's Nutcrackers are found in the high montane whitebark pine conifer forests of western North America from Canada and into the Cascades and Rockies. In Oregon, Clark's Nutcrackers are seen above 4,000 feet in the Cascade, Siskiyou, Blue and Wallowa Mountains, and are commonly viewed along the rim at Crater Lake National Park.

A highly specialized member of the corvid family (Jays, Crows, Ravens), Clark's Nutcrackers are adapted for life in subalpine conifer forests. A large, strong, multipurpose bill enables Clark's Nutcrackers to hammer and pry open whitebark pine cones to get at both ripe and unripe seeds – the staple diet of the bird. To survive long winters of the subalpine environment, Clark's Nutcracker caches (or stores) whitebark pine seeds by burying the seeds on southern slopes where less snow accumulation occurs. They cache seeds in cracks, holes, tree bark, logs, and stumps. A sublingual pouch below their tongue allows Clark's Nutcrackers to transport 55 to 75 seeds at a time to cache sites. Clark's Nutcracker's cache the harvested seeds in multiple sites at different elevations. A remarkable spatial memory allows Clark's Nutcracker to remember where they cached tens of thousands of seeds in thousands of cache sites for up to nine months. One observer recorded a single bird caching 35,000 seeds at 9,500 different cache sites. Studies show that Clark's Nutcrackers remember exact locations of cache sites by using landmarks.

Clark's Nutcrackers and whitebark pines have evolved a special ecological relationship: they are co-evolved mutualists. Mutualism is an ecology term that refers the interaction between two species in which both benefit. Whitebark pine seeds are high in fat and protein providing an important food source to Clark's Nutcrackers. The cones of the whitebark pine do not open

naturally to drop seeds like most other conifers. Instead, scientists believe that the whitebark pine relies on the Clark's Nutcracker to prey open cones and disperse the seeds. Clark's Nutcracker's cache seeds to feed on during the winter months. Seeds that are left in caches will establish new stands of whitebark pine. Thus both Clark's Nutcrackers and whitebark pine benefit from one another. Nutcrackers receive a high fat and protein food source and the whitebark pine receives a seed dispersal agent. Scientists believe that a single Clark's Nutcracker will plant an entire forest of whitebark pines in its lifetime.

Photo by Tom Grey

Whitebark pine forests provide many important ecosystem functions to subalpine environments. They are important food sources for not only Clark's Nutcracker, but other species of birds, red squirrels, and even bears. In addition to the food supply, whitebark pine help to control run off and erosion of heavy snow melts in the summer by stabilizing the rocky soils and providing shade, delaying patches of snow melt. Whitebark pine forests are being threatened across their entire range by an introduced fungus: white blister rust. Spores of the fungus inflect five needled pines, such as whitebark pine, while the mycelium (fungi roots) inflects the stems and roots of the pines causing tissue death in almost all pines infected by the fungus. Land managers are monitoring the impact of white blister rust in National Parks and Forests where whitebark pine are found. They are also beginning reforestation efforts of whitebark pine.

Seed Harvesting

Watch a short video clip of a Clark's Nutcracker harvesting whitebark pine seeds:

http://www.whitebarkfound.org/video/Nutcracker%20eating%20WBP%20seeds%20video.wmv

Getting Ready!

1. Read background information.
2. Secure gym space or use of a field for the Clark's Nutcracker caching activity.
3. Make copies of the *Student Journal: Clark's Nutcracker and Whitebark Pine Forests.*

Photo courtesy NPS

Discuss!

1. Share with students some of the life history of Clark's Nutcracker and the habitat where it lives.
2. Review what is a habitat and habitat components (food, water, shelter and space). Brainstorm with the class to identify the four Clark's Nutcracker habitat components they might find at Crater Lake National Park.
3. Introduce students to the ecological concept of mutualism and explain how whitebark pine and Clark's Nutcracker benefit one

Lesson Plan

4. Explain to students that they will transformed into Clark's Nutcrackers to learn about seed caching and whitebark pine seed dispersal.

Investigate!

1. See following page for game set up.
2. Students are to work in pairs for this activity. Each student pair will have three cache sites were they will bring food collected from whitebark pine trees (food sources). Only one student from the pair may leave the cache sight to collect pine seeds (poker chips) by picking them up one at a time and carrying them back balanced on two fingers. The other student must stay behind to guard the seeds at the three cache sites.
3. The instructor acts as the time keeper. Students will have three minutes to collect food from the four parent trees. At the end of the three minutes, record the names of students who were not able to cache any seeds. If a student goes three rounds with out caching any seeds they have died from starvation.
4. After the 2nd and 3rd round introduce white blister rust infections. Share with students how white blister rust infect whitebark pine and the impact of the fungus in conifer forests. The white blister rust kills one parent tree per round, decreasing the amount of available seeds available for caching.
5. After the 4th round, a heavy snow fall buries any available pine seeds at the remaining two parent trees. Now, the students must forage in the lower elevation forests.
6. Introduce remaining poker chips for students to cache.
7. Allow students to continue to harvest for one or two more rounds depending on time. To make the game more challenging for older students, parent trees can continue to be lost to either white blister rust or heavy snow.
8. After the available food sources have been lost to snow or white blister rust, have students count the number of tokens collected.
9. Each food token represents 50 pine seeds because Clark's Nutcracker can carry multiple seeds in their sublingual pouch.
10. Students must have collected at least 1,000 seeds (20 tokens) to survive the winter.
11. Discuss with students why some pairs were able to cache enough seeds to survive and some were not. Discuss with students how losing whitebark pine trees to white blister rust affected the amount of pine seeds available.
12. Ask students questions from the right hand panel to follow up.

Suggested Questions:

What are three adaptations that Clark's Nutcrackers have to aid in seed caching?

What animals rely on whitebark pine as a food source?

Why do you think scientists are concerned about white blister rust?

Do you think that the white blister rust limited the amount of seeds you were able to cache?

White Blister Rust

White blister rust is a native fungus of Asia and it was introduced to North America by a shipment of trees from Europe in 1910. This fungus is a major killer of 5-needled pine saplings making forest regeneration difficult. The spores of white blister rust also enter older whitebark pine through stomatal openings on the needles or wounds in the branches. Once infected it can take several years to kill a mature tree however the fungus significantly reduces tree vigor and cone and seed production. White blister rust has an alternate host in currant and gooseberries. Management of white blister rust includes the breeding and planting of 5-needled pines with various levels of resistance to the fungus.

For more information on whiter blister rust visit: *http://www.fs.fed.us/rm/highelevationwhitepines/Threats/blister-rust-threat.htm*

Teacher Tips

Game Set Up!

Parent Tree (Food Source)

3 Cache Sites