

Ecological Relationships Lesson #3: CLARK THE NUTCRACKER

Overview: This introduces the art of creating a species account. The account identifies the important qualities of a species through a scientific drawing. This then leads to exploration of the interrelationship of the Clark's Nutcracker (a type of woodpecker) and the whitebark pine.

Learner Outcomes

Youth will:

1. Know how to complete a species account identifying the important species characteristics through a scientific drawing.
2. Know the life history of the Clark's Nutcracker.
3. Understand mutualism in the ecological context of Yellowstone National Park.
4. Know how to define whitebark pine ecosystem functions.

Getting Ready

Materials: Youth need journals and writing utensils; staff need colored pencils, poker chips, and handouts.

Preparation: For the "Made for Each Other" activity, set up the whitebark pine food sources in 4 piles of poker chips and spread them out in the center of the area. The three cache sites should not be more than seven feet apart and should be on the outside circle of the food source. Assign cache sites to each group. Use different objects to mark the cache sites.

Location: A large area (25 x 25 yards) would be preferable for the "Made for Each Other" activity. An ideal location would have whitebark pines and/or Clark's Nutcracker activity.

Background

The following material is not required to instruct this lesson. Adapted from Yellowstone Resources and Issues Handbook: 2013.

Forest Insect Pest

The conifer trees of Yellowstone face many threats, however the most damaging one is the native pine bark beetle. It is indicated that this species has been around for centuries. The beetles damage trees with their larvae, which then hatch into adults that consume the inner bark. Their feeding activity can girdle a tree in one summer, which kills the tree. The needles usually drop within the next year, leaving a standing dead tree. Pockets of red-needled trees are evident throughout the park. Forest structure, tree health, and climate are the major factors determining the extent of an outbreak; drought and warmer temperatures can make a forest more vulnerable to infestation.

Pest Activity

The severity of insect-caused tree mortality has increased in recent years throughout the West, and the insects have spread to previously unaffected plant communities. Several native bark beetle species in the Scolytidae family are altering extensive areas within Greater Yellowstone. Mountain pine beetle activity in 2010 was largely confined to the northwest part of the park, in high-elevation whitebark pine and lower elevation lodgepole pine. Defoliation of Douglas fir and Englemann spruce by the western spruce bud-worm is present in the park throughout the lower Lamar and along the Yellowstone and Lamar River valley, but spread considerably less in 2010 than in recent years. These trends appeared to continue in 2011, when the park was only partially surveyed.



Lesson at a Glance

Species Accounts (25 minutes)

Using their imagination, youth will record a detailed species account of a possible specimen from the Lewis and Clark Expedition.

Clarks Nutcracker and Whitebark Pine (10 minutes)

Next, youth will judge the quality of an original Clark's species account and are introduced to Clark's Nutcracker and whitebark pine species.

Made for Each Other (25 minutes)

Youth will transform into Clark's Nutcrackers to demonstrate how seed caching, whitebark pine seed dispersal, and mountain pine beetle are interconnected through an energizer called Made for Each Other, which reinforces the concepts in the species accounts.

Concluding the Lesson (10 minutes)

This lesson ends with reflection on the relationships addressed in the lesson.



Future of Insect Outbreaks in Yellowstone

Landscape-scale drought and the availability of suitable host trees have contributed to the initiation and persistence of insect outbreaks. Healthier trees can defend themselves from beetle attack by “pitching out” adult females as they try to bore into the tree. Extreme winter temperatures can kill off overwintering broods and wet summer weather impedes the insect’s ability to invade additional trees. Insect activity also decreases as the older and more susceptible trees are killed off. Spruce beetles have declined because they have killed almost all of their preferred food sources (spruce trees more than 10 inches in diameter).

Researchers, supported by the National Park Service, will investigate the interactions between insect’s infections and wildfire. Recent and ongoing studies are focusing on how bark beetle epidemics may affect fire behavior in lodgepole-dominated forest and comparing the resulting fire hazard with that in Douglas fir forests.



Suggested Procedure

Species Accounts (30 minutes)

The staff will:

1. Begin this lesson by asking youth to imagine the place, the people, and themselves in what you are about to describe:
2. Read the following:

The day is August 22, 1805. We are along the Lemhi River in Idaho, sent on the Lewis and Clark Expedition to assist in taking field notes of new species along the way. You are a naturalist/explorer and this is your first time out West. You will never make it to Yellowstone on the Lewis and Clark Expedition, but a year from now you will camp with Captain William Clark on the outskirts of present day Livingston, Montana. You wake to the cold and notice the frost that covers everything. You set out early and, after a mile, are forced to cross the river. You notice how close the mountains are to the river, and realize how difficult they would be to cross. They are very steep, tall, and seem to have many rocky areas. You have to cross them, however, and on your way over you come across a species you have never seen before. You quickly pull out your sketchpad and a pencil. (The Journals of the Lewis and Clark Expedition, 2005).
3. Explain that a species account is a detailed record of observation for a species. Making these detailed records is what naturalists and explorers have done for years to record natural history. **(D1)**
4. Instruct them to pick either a plant or animal in the nearby area and explain that it is their job to record everything they see about it.
 - a. Collect the following information while observing your specimen:
 - i. Create a macro picture of the species
 - ii. Create a micro picture of one specific part (i.e. leaf, petals, feather, foot, tail, etc.)
 - iii. Complete a written description that captures subtle markings and general observations.
 1. Example: For **plant** observations - size, color, shape, phenology (stage of development: for example buds, leaves or flowers present, , leaf color, leaf

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3. Instruct them to brainstorm a list of what the description should have included to communicate details about the specimen.
4. Ask: Can you identify the bird? (Answer: Clark's Nutcracker)

Clark's Nutcracker and Whitebark Pine (5 minutes)

1. Next explain that this was the first account of the Clark's Nutcracker. What we have learned about it today is a collection of many species accounts and observations over time. For example: The Clark's Nutcracker has taught scientists that organisms sometimes work together symbiotically, engaging in actions that are mutually beneficial to each species. This unique relationship is what Clark observed in this journal entry when the Clark's Nutcracker was feeding "on pine burs."
2. Explain that they will be learning more about the unique relationship between the Clark's Nutcracker and the whitebark pine. Divide them into two groups and present one species account to each group to review.
3. After reviewing the species accounts, have them present the key points that they learned to the other group. Encourage them to ask questions while they listen to the presentations, and as staff you should ask about things that will make them think deeper. For example: How does the Clark's Nutcracker find its cache sites after caching the seeds?

Transition: After both groups have shared each of their species accounts, ask them to summarize the relationship between the Clark's Nutcracker and the whitebark pine. Explain that they will be learning about how this relationship is currently being affected by the white bark pine beetle, and that everything is interconnected.

Made for Each Other (25 minutes)

This activity is an energizer that transforms youth into Clark's Nutcrackers to demonstrate how seed caching, whitebark pine seed dispersal, and mountain pine beetle are interconnected.

1. They will work in pairs for this activity. The staff acts as the timekeeper.
2. Each pair will have three cache sites where they will bring their food collected from whitebark pine trees (also known as the food sources).

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development), habitat, micro habitat, signs of browse, insects present, abundance in the area, possible associations with other species, etc. .

2. Example: For **animal** observations - size, age, sex, fur, or plumage colors, appearance or condition of the individual, location and plant community where you observe it, behaviors, interactions with other animals, vocalizations, etc.
5. Staff should work with youth to create thoughtful species accounts.
6. After they have completed the species account, ask them to pair up and try to identify their partner's species account solely on the written description, as if it were a field guide.
7. Afterwards, ask them to regroup and discuss the following questions: **(F1)**
 - a. What was the most interesting detail you noticed about your partner's specimen?
 - b. Do you know someone that uses these skills in their life?
 - c. What areas of science do you think these skills would be most helpful?

Transition: Ask: What information did you discover about your specimen that you did not expect to find while doing the species account?

Next ask them to evaluate the following passage from Clark's journal dated August 22, 1805:

1. Saw [a] Bird of the wood pecker kind which fed on Pine burs, its Bill and tale white, the wings black, every other part of a light brown, and about the size of a robin (Lewis & Clark Interactive Journey Log: Clark's Nutcracker, 1996).
 - a. Summary of the key identifying points:
 - i. Bird of the wood pecker kind
 - ii. Fed on pine burs
 - iii. Bill and tale white
 - iv. Wings black every other part of a light brown
 - v. About the size of a robin
2. Ask: What do you think of the quality of this description?

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3. A large space is required for this set up (25 x 25 yards, see staff notes for suggested setup).
 - a. Set up the whitebark pine food sources in 4 piles of poker chips, spreading out in the center of the area.
 - b. The 3 cache sites should be a least 5 feet apart and should be on the outside circle of the food source. Assign cache sites to each group. Use different objects to mark the cache sites (i.e. a backpack or rock).
4. Explain the rules: Only one person from the pair may leave the cache site to collect the food sources (poker chips). This must be done by picking up the food sources one at a time, then returning with them balanced on two fingers (the index and middle fingers). The other person must stay behind to guard the cache site from predators (i.e. other youth). Explain that each poker chip represents 50 pine seeds because Clark's Nutcracker can carry multiple pine seeds in their sublingual pouch. To survive the winter, they must have collected 500 seeds (10 poker chips).
5. They have three minutes to collect food from the four whitebark pine food sources. When time is up, count how many seeds they have in their cache. If they did not cache any seeds, they have died from starvation and are out of the next round.
6. Before the second round, introduce the mountain pine beetle. Share how mountain pine beetles infect whitebark pine and impact conifer forests. The mountain pine beetle attacks two of the food sources, decreasing the amount of seeds available for caching.
7. Play again for three minutes to collect food from the two remaining trees. Count the number of pine seeds (poker chips) collected.
8. Discuss why some were able to cache enough seeds to survive and some were not. Additionally, mention how losing whitebark pine trees to mountain pine beetles affected the amount of pine seeds available. Ask:
 - a. What are three adaptations that Clark's Nutcrackers have to aid in seed caching?
 - b. Do you think that the mountain pine beetles limited the amount of seeds you were able to cache?

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- c. What ecosystem functions do you think whitebark pines play a role in? *Answer:* Whitebark pine forests provide many important ecosystem functions to subalpine environments. They are important food sources for not only Clark's Nutcracker, but also other species of birds, red squirrels, and even bears. In addition to the food supply, whitebark pine helps to control run off and erosion of heavy snow melts in the summer by stabilizing the rocky soils and providing shade, delaying snow melt.

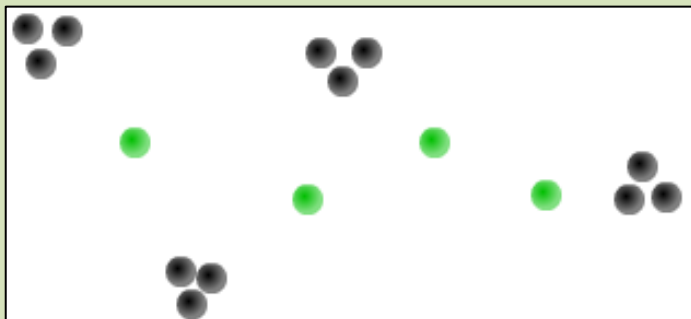
Conclusion: (10 minutes) **(S1)** Discuss the relationships addressed in the lesson. Power the discussion by having them journal their questions, thoughts, and ideas. Use the following prompts:

1. What importance do the plants and animals of the forest have for each other? Brainstorm the connections between water, soil, bugs, salmon, plants, trees, etc.
2. What is the special relationship that the Clark's Nutcracker has with the whitebark pine trees of the forest?
3. How is the whitebark pine dependent on the Clark's Nutcracker? How is the Clark's Nutcracker dependent the whitebark pine?
4. What importance does the whitebark pine have in the forest?
5. What animals would be affected if all the whitebark pine were to die? What could happen to the whole forest as a result?
6. What would happen if the Clark's Nutcracker were to disappear from the forest? Alternatively, what would happen to Clark's Nutcracker if all the whitebark pines were to die?
7. What other relationships are interdependent in Yellowstone National Park? (i.e. bees/flowers)



Staff Notes:

Suggested Layout of the **Made for Each Other** Activity



KEY



Green circle represents a Parent Tree



3 black circles represents a Cache Site



Assessment Check Ins:

(D1): This demonstrates the prior knowledge and interest in making deep observations through words and drawings. This information will assist the staff in understanding how clearly they came to understand their subject through this activity.

(F1): This provides information on what is being learned from their observations. This assessment will encourage them to think critically.

(S1): Assesses what youth have learned and if they can transfer it into similar ecological relationships.



Reference:

Karl, J. (2000). *Nucifraga columbiana: Clark's Nutcracker*. Retrieved from Idaho Museum of Natural History: http://imnh.isu.edu/digitalatlas/bio/birds/sngbrd/corvids/clnu/clnu_mai.htm

Klamath Bird Observatory. (2009). Retrieved Klamath Basin Birding Trail Education Kit, Crater Lake NP Edition: <http://www.klamathbirdingtrails.com/pdf/craterlake/plan-cl-clarks.pdf>

Lanner, R. (1996). *Made For Each Other: A Symbiosis Of Birds and Pines*. New York: Oxford University Press.

Lewis & Clark Interactive Journey Log: Clark's Nutcracker. (1996). Retrieved from National Geographic: http://www.nationalgeographic.com/lewisandclark/record_species_125_11.html

Sierra Club of Canada, BC Chapter Education Program. Green Star! Newsletter Kit Lesson Plan: Clark the Nutcracker Story. Retrieved 2011 August 28 from http://www.sierraclub.bc.ca/education/resources-tools/clarks-nutcracker_lesson-plan-k-4/at_download/file

The lesson plan "Clark the Nutcracker" served as the central activity in this lesson. This lesson was modified in the following ways: Instructional language was changed to match the REC and the introduction and conclusion are additions to this lesson.

University of Nebraska Press / University of Nebraska-Lincoln Libraries-Electronic Text Center. (2005, March). *The Journals of the Lewis and Clark Expedition*. Retrieved from: <http://lewisandclarkjournals.unl.edu/>

USDA Forest Service. (2013, January 23). *Pinus albicaulis*. Retrieved from <http://www.fs.fed.us/database/feis/plants/tree/pinalb/all.html>



Yellowstone National Park. Yellowstone and the Lewis & Clark Expedition. Retrieved March 23, 2013 from National Park Service: <http://www.nps.gov/yell/planyourvisit/upload/Yell273.pdf>

Handouts:

- Species Account of the Clark's Nutcracker
- Species Account of the Whitebark Pine
- Drawings of Clark's Nutcracker and whitebark pine



Species Account of the Clark's Nutcracker

The following material is from Karl, 2000.

Name: Clark's Nutcracker- *Nucifraga columbiana*

Family: Corvidae

Physical Description: 12-13" (30-33 cm). "Black wings and tail with large white patches; gray body with white undertail coverts; dark bill and eyes."

Song: A guttural kraa-kraa, and a repeated, dry krak-krak-krak-krak-krak

Distribution: Resident from central British Columbia, southwestern Alberta, western and central Montana, and western and southeastern Wyoming, south through mountains of central Washington, eastern Oregon, and central and eastern California and Nevada, to northern Baja California. Also present in Rockies to east-central Arizona and southern New Mexico. Wanders irregularly beyond normal range.

Habitat: Found in open coniferous forests and in forest edges and clearings (primarily in mountains, but also in lowlands in winter). Preliminary results of Idaho-Montana study suggest Clark's Nutcrackers are more common in rotation-aged than old-growth Douglas-fir stands.

Diet: Pine seeds are primary food for both adults and nestlings, but individuals will also eat insects, acorns, berries, snails, carrions, and sometimes, eggs and young of small birds.

Ecology: To survive long winters of the subalpine environment, Clark's Nutcracker caches whitebark pine seeds by burying the seeds on southern slopes where less snow accumulation occurs. A sublingual pouch below their tongue allows them to transport 55 to 75 seeds at a time to cache sites in multiple sites at different elevations. A remarkable spatial memory allows them 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 they use landmarks to remember the various locations.

Reproduction: Both sexes incubate 2- 6 eggs, for about 18 days. Young leave the nest at 24-28 days.

Species Account of the Whitebark Pine

The following material is from USDA Forest Service, 2013.

Name: Whitebark Pine- *Pinus albicaulis*

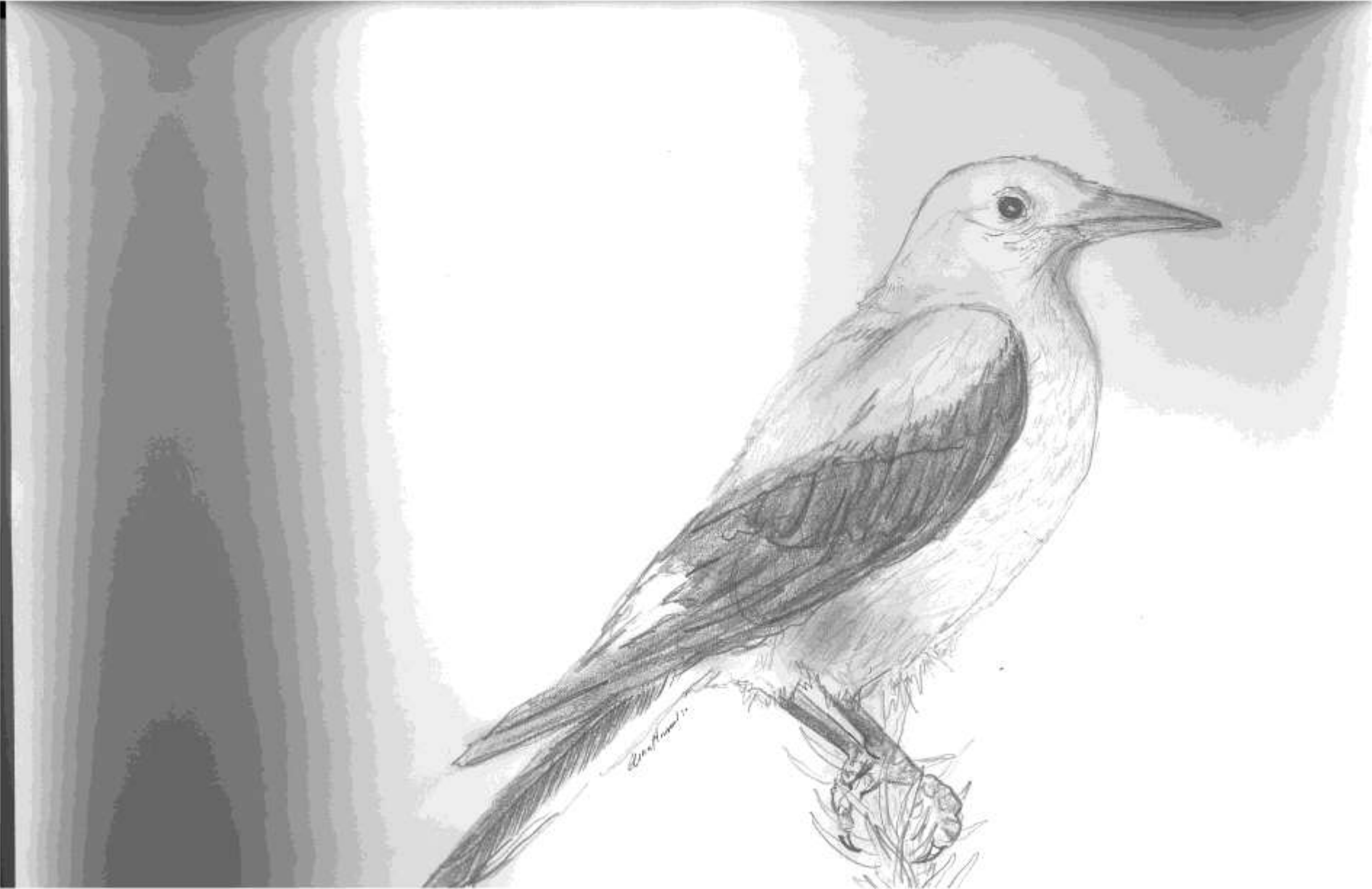
Family: Pinaceae

Physical Description: It is often found as krummholz; trees dwarfed by exposure and growing close to the ground. In more favorable conditions, trees may grow to 66 feet in height, although some can reach up to 89 feet.

Distribution: Whitebark pine is limited to the high mountains of western North America, where it has been present for the past 8,000 years. In the USA the range extends from the Canadian border of the Cascade Mountains through Washington and Oregon to southern California. It is also present at high altitudes throughout the Rocky Mountain range.

Ecology: Whitebark pine is a keystone species of the upper subalpine ecosystem and serves several important functions throughout its range. Clark's Nutcrackers and whitebark pines have evolved a special ecological relationship: they are co-evolved mutualisms. Mutualism is an ecology term that refers the interaction between two species in which both benefit. Whitebark pine seeds are an important food source for the birds because they are high in fat and protein. The birds open the cones from the tree and disperse the seeds; this is important for the trees since the cones do not open naturally like most other conifers. Additionally, the birds cache their seeds to feed on during the winter months, but the ones that they don't eat will develop into new trees. Thus both Clark's Nutcrackers and whitebark pines benefit from one another. Scientists believe that a single Clark's Nutcracker will plant an entire forest of whitebark pines in its lifetime. Whitebark pine forests provide many important ecosystem functions to subalpine environments. They are important food sources for not only Clark's Nutcracker, but also other species of birds, red squirrels, and even bears. In addition, they 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 mountain pine beetles.

Mountain Pine Beetle: Since 2000, the climate at high elevations has been warm enough for the beetles to reproduce within whitebark pine, often completing their life cycle within one year and enabling their populations to grow exponentially. These higher temperature trends have been attributed by some researchers to climate change. Regardless of cause, the mountain pine beetle upsurge has killed large numbers of whitebark pines. This jeopardizes current and future whitebark pine restoration efforts because they are killing trees genetically resistant to white pine blister rust.



Drawing by Elena Houseal 2014

