

Monitoring Spruce Bark Beetles in Katmai National Park and Preserve

By David Manski

Spruce bark beetles (*Dendroctonus rufipennis*) are indigenous to spruce forests at Katmai National Park and Preserve. Since human activities, such as right of way clearance, contributed to significant beetle outbreaks elsewhere, there was concern that maintenance practices in the developed areas of the park might lead to human-induced increases in the local beetle population.

This study was undertaken to provide baseline conditions on the incidence of beetle killed spruce in Brooks Camp, the major developed area in Katmai, and to identify potential human activities that might be enhancing beetle population growth.

Spruce Beetle Biology

In Alaska and British Columbia, the spruce bark beetle is an important insect in mature spruce forests. For the amount of damage they can cause, spruce bark beetles are surprisingly small; adults are about the size of small grains of steamed rice.

Like other *Dendroctonus* species, small numbers of beetles naturally exist in spruce forests with populations typically controlled by parasites and predators. However, beetle population increases can occur after perturbations to the forest (like blowdown or logging) that result in large accumulations of debris. These materials provide additional breeding habitat for beetles and eventually cause significant population increases. Beetles become a concern if their population outgrows the supply of dead and injured trees and moves into nearby living trees.

Spruce bark beetles may have either one or two year life cycles. Adults become active in spring, with females emerging first to search for new host material. Upon finding a suitable tree, the female drills through the bark and constructs an egg gallery parallel to the wood grain usually above the entrance hole. After mating, 4 to 14 eggs/cm of gallery are laid in clusters, hatching by August into larvae. As the larvae feed in the cambium, they construct their own galleries perpendicular to the egg gallery, overwinter in the infested trees and develop into pupae and adults the following spring.

The spruce bark beetle has a symbiotic relationship with a blue stain fungus. While larvae feed on one vital tissue, the fungus feeds on another and shuts down the tree's water-circulation system. The tree dies of thirst and starvation.

Monitoring Methodology

To test the hypothesis that the number of beetle-killed trees was not greater closer to Brooks Camp, spruce trees were surveyed at two locations: immediately adjacent to this area of intensive human activity and at an area approximately 5.6 km away. Major developments at Brooks Camp include a 60-guest lodge, employee housing, a visitor center, maintenance and service buildings, a powerhouse and a 28-site campground. Both sites were parts of an approximately 2,500 ha contiguous stand of white spruce.

The Bitterlich variable radius technique was used to sample spruce stand structure and tree mortality at randomly selected points along transects. The diameter at breast height (dbh) and condition (live or dead) of each sample tree were recorded. Dead trees with galleries, numerous entrance holes and/or beetles were considered to be beetle killed. Increment

cores of live and beetle killed spruce were extracted to assess relationships between tree growth and tree mortality.

Conditions Found at Katmai

Only 6 percent of the 641 trees examined on the two study sites were killed by the spruce bark beetle. Apparently human activities had not influenced the incidence of beetle mortality on spruce. The relative numbers of live and dead spruce and the sizes of trees killed by beetles were statistically similar on survey plots located immediately adjacent to and away from the development. Sampling also indicated that maintenance along a service road at Brooks Camp had not significantly promoted beetle activity; spruce located 15 and 200 m from the road were equally likely to have been killed by beetles.

In and around Brooks Camp, diameters of beetle-killed spruce were smaller than live spruce. In more severe outbreaks in other areas, spruce mortality tends to occur in larger diameter trees. The small proportion of trees killed by beetles in this study contrasts sharply to areas undergoing more extensive infestations. For example, at Glacier Bay NP, where spruce beetles are found in greater densities, spruce mortality due to bark beetles on sample plots reached over 50 percent.

Research elsewhere indicated spruce beetles did not attack hosts solely according to their diameter, but favored trees that had grown slowly in the years before an infestation. This was also found in the Katmai study. Apparently the more vigorous spruce are best able to repel attacking beetles.

Implications for Management

This study provided baseline data on the current incidence of beetle-killed spruce in and near a de-

veloped area of Katmai NP & P. The information can help evaluate future levels of beetle infestation and/or other disturbances in the spruce forest. Additional surveys should be conducted if casual observations indicate increases in spruce mortality. Quantitative data can be obtained rapidly and effectively by one or two people using the variable radius method.

Planned changes in maintenance practices at Brooks Camp should be evaluated for potential impact on spruce beetles. Beetle outbreaks can begin when dead or dying trees and shrubs accumulate. Activities that may lead to an abundance of suitable breeding habitat for beetles should be avoided. For example, during brush and/or tree clearing along service roads, all vegetation should be removed. Chipping cleared trees and shrubs and using the product in rehabilitating eroded trails and campground sites would be an excellent way to dispose of this material.

Because spruce beetles in this and other studies were shown to attack slow-growing trees, the vigor of high value spruce in Katmai's developed zones could be maintained or enhanced by active management. Manipulations that might decrease susceptibility to attack by beetles include: aeration of the soil around the base of the trees; spacing trees to reduce competition for light and soil moisture; placing wood chips on the ground over tree roots and erecting fences or other barricades around trees to prevent soil compaction.

Away from the developed areas, infestations occurring in response to natural forest perturbations should be monitored, but allowed to run their courses.

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Spruce bark beetles have ravaged this tree at Katmai NP & P.