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Disturbances of Plant Communities : Spruce Bark Beetle Infestation

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Disturbances of Plant Communities: Spruce Bark Beetle Infestation

The spruce bark beetle (*Dendroctonus rufipennis*) is not new to the area, nor is it the only insect to affect the region's forests. Epidemic scale outbreaks are known to have occurred on the lower Kenai Peninsula as far back as the mid-1800s. The recent epidemic, however, has certainly been the most significant terrestrial ecological disturbance to the area in recorded history (Wittwer et al. 1998).

Notable outbreaks were not noted in the Kachemak Bay Watershed until the 1950s and early 1960s when the first outbreak was observed near Anchor Point. At approximately the same time, beetle outbreaks were growing outside of the Watershed. An extended period of drought is thought to have contributed to the surge in outbreaks by reducing trees' ability to resist and recover from beetle attack. Increased rainfall in the late 1960s, however, dampened the drought conditions, curtailing a more widespread epidemic. By the late 1970s, beetle outbreaks had skyrocketed again on the Kenai Peninsula. Despite this outbreak, the Kachemak Bay Watershed remained healthy until 1984 when an outbreak in the Fox River drainage began to expand, and beetles commenced consuming forests along East Road on the northern side of the Bay. Meanwhile, a small infestation in Mallard Bay, on the southern side of the Watershed, expanded to 12,000 acres by 1988. In addition, more outbreaks were developing to the north of Homer, near Ninilchik and Crooked Creek. There was some thought that the maritime climate of the Bay area would keep the outbreaks from expanding throughout the area, but this was not to be the case.

The Bark Beetle Infestation in the Kachemak Bay Watershed



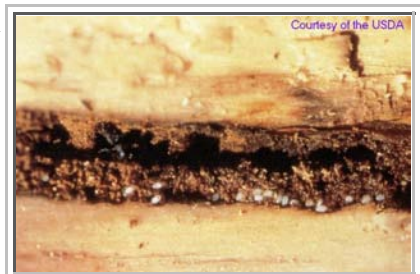
Adult female spruce bark beetle.

By 1998, it is estimated that 2.3 million acres had been impacted by the beetle epidemic on the Kenai Peninsula. Infestations on the majority of the Peninsula peaked in 1995 and 1996. However, the Kachemak Bay Watershed continued to experience an increase in [beetle activity](#) through 1998. Beetle activity on the northern side of the Watershed slowed considerably by 1997, but outbreaks continued to expand on the southern side, especially in China Poot Bay, Sadie Cove, and Port Graham. This trend of decreasing activity on the northern side and increased activity on the southern side is expected to persist for several years (Wittwer et al. 1998).

Spruce Bark Beetle Life History

The spruce bark beetle primarily attacks white spruce (*Picea glauca*), Sitka spruce (*Picea sitchensis*), Lutz spruce (*Picea glauca X lutzii*), and occasionally black spruce (*Picea mariana*). Usually beetle populations are kept in check by parasites, disease, climatic factors, and the availability of host trees. The beetles typically live in wind-thrown, or otherwise downed trees, including those left from logging and clearing practices. However, when beetle populations increase to high levels, they begin to enter large diameter standing trees (Holstein et al. 1999).

Adult females attack host trees, usually from May through October. They bore into the cambium layer of the trees, create egg galleries, and deposit eggs on both sides of the gallery. Larvae hatch from the galleries and create side galleries by boring out from the central gallery. The beetles typically have a two-year life cycle, living as larvae the first winter, and as adults the second winter (Wittwer et al. 1999). Emerging adults seek new host material in which to lay their eggs.

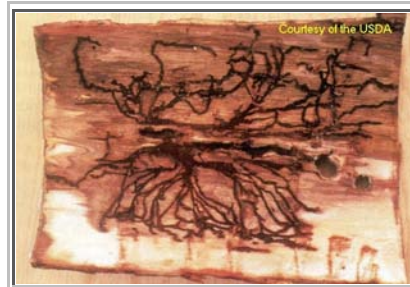


Adult females initiate attacks by laying their eggs in the cambium layer of the spruce trees.

Potential Ecological Changes

The spruce bark beetle has been identified as one of the most potent natural disturbances in the forest ecosystems of south central Alaska (Wittwer et al. 1999). Vast acres of dead and dying timber are left in the wake of declining beetle activity. As a result, changes in hydrology (HDR Alaska Inc. 1998),

changes in woody debris inputs to streams, and changes and long-term shifts in wildlife habitat occur. Grass, especially bluejoint (*Calamagrostis canadensis*) and tall fireweed (*Epilobium angustifolium*) tend to invade sites once the spruce canopy has opened up. Once the grass becomes established, it becomes difficult for spruce seedlings to root, resulting in long-term changes to the plant community (Holstein et al. 1995).



The larvae mine the inner bark, leaving behind larval galleries as evidence.

Predictions on the effects of the spruce die-off on wildlife vary. Overall, ecologists anticipate an increase in the total number of wildlife species with 50 to 70 percent canopy removal. However, with 80 to 100 percent canopy removal, wildlife diversity is expected to decrease. Bird species associated with shrubs will likely increase, while those associated with forested habitats will decrease. Of the 39 mammal species that

frequent the Kenai Peninsula, 13 are expected to decrease in abundance, while eight (those not associated with forest habitats) are expected to increase (Suring 1998). Moose are expected to increase only if the woody vegetation that they forage on regenerates (Stephenson 1998). Black bear populations may increase if moose calves increase; however, black bears are generally closely connected with extensive forest-lands (Collins 1998). An increase in human access, created by logging roads, will likely have significant adverse impacts on animals that are sensitive to disturbance, notably brown bears, martens, and wolverines (Suring 1998). A literature review on the potential impact of habitat changes caused by the spruce bark beetle epidemic on eight species injured by the *Exxon Valdez* oil spill revealed little in the way of direct consequences (Parry and Albert 1998). This review looked at the impact of potential habitat changes on bald eagles (*Haliaeetus leucocephalus*), cutthroat trout (*Onchorynchus clarki*), Dolly Varden (*Salvelinus malma*), harlequin duck (*Histrionicus histrionicus*), marbled murrelet (*Brachyramphus marmoratus*), pink salmon (*Onchorynchus gorbuscha*), river otter (*Lutra canadensis*), and sockeye salmon (*Onchorynchus nerka*). The reviewed studies indicate that fish species may be impacted by long-term changes in woody debris input to streams. Harlequin ducks and river otters might experience positive short-term benefits as a result of a potential increase in nesting/denning sites created by dense undergrowth and downed wood. Bald eagles and marbled murrelets would experience a decrease in suitable nest sites where spruce is the dominant tree.

Socioeconomic Changes

Ecological changes have accompanying socioeconomic impacts. A shift in

the long-term vegetation community from timber to grasslands may impact local livelihoods. Within three years of the attack, spruce has lost value as saw timber due to rot. Dead trees may retain some value for firewood or chips if they remain standing; however, standing dead trees become susceptible to wind-throw. Changes in scenic quality may result. In some cases scenic views decline as entire landscapes are covered with dead and dying trees. However, clearing activities and natural wind-throw may create better scenic views on properties that previously were obscured by dense forest.

Increased fire hazard has been identified as the largest human concern caused by the dying forest. The grasses, which typically invade once the spruce canopy is reduced, tend to ignite easily. This, in combination with the dead trees and increased wind, creates the potential for fire to move quickly and to burn at high temperatures (Wittwer et al. 1998). East Road on the northern side of the Kachemak Bay Watershed was identified as the most seriously threatened "urban/wildland interface fire area" on the Kenai Peninsula (Kenai Peninsula Borough 1998). The factors that led to this designation include:



1. An area of 60,000 acres of dead spruce forest stretches for approximately 25 miles between Homer and the head of the Bay;
2. Approximately 2,500 people live within this area, with East Road being the only access road out of the area; and
3. The majority of the small access roads leading from East Road are substandard, would not support fire engines, and are impassable during the spring "breakup" season (Alaska Department of Natural Resources 1998)

In the summer of 1999, people's fears were realized when a small, backyard fire near Fritz Creek spread out-of-control. Helicopters sporting water buckets, airplanes carrying fire retardant, and dozens of firemen working in conjunction with local residents running backhoes and other heavy equipment eventually extinguished the fire. Massive amounts of dead trees, limited access, and the number of people living in the area created the potential for catastrophe. Fortunately, there was little loss of property and no loss of life; however, dozens of homes were evacuated. The community recognized that the situation could have easily been worse if there had been less preparation. Fire and other ramifications of the massive spruce die-off will continue to affect the Watershed for many years to come (See related section: [Socioeconomic Profile](#)).

There are a variety of techniques that could be useful for managing (preventing, mitigating, or reducing) the impacts of the spruce bark beetle infestation. The method chosen depends on the long-term objectives for the area and the economics associated with [management decisions](#) (Wittwer et al. 1998). There are two primary reasons why many landowners have chosen to log their properties:

1. Affected trees lose their value as timber within three years of beetle attack; and
2. Many landowners are concerned about defensible space around their homes.

In terms of tree regeneration, scientists and managers do not agree on the long-term benefits of logging. Some believe that the strategy of logging with subsequent replanting is the most expedient way to ensure that new forests will grow where the old ones have died. Others argue that allowing trees to fall naturally provides nutrients to the soil, which is better for the long-term health of the forest. A few large-scale clear cuts have been conducted in the Kachemak Bay Watershed. On the southern side of the Bay, the native villages of Port Graham and Nanwalek have logged thousands of acres, and the Seldovia Native Association recently logged 375 acres on Peterson Point, directly across from the Homer Spit. Many smaller land holdings have also been logged on the northern side of the Watershed.

In summary, the spruce bark beetle epidemic has changed the landscape, the ecology, and the livelihoods of the Bay area. There has been little research conducted on the ecological impacts of the die-off, although socioeconomic repercussions have been explored to some extent. The full extent and impact of the epidemic will not be known for many years to come. Spatial and temporal data on forest damage related to the spruce bark beetle can be viewed in the *Spruce Bark Beetle Infestation* view of the accompanying [ArcView® project file on the Terrestrial Environment](#).

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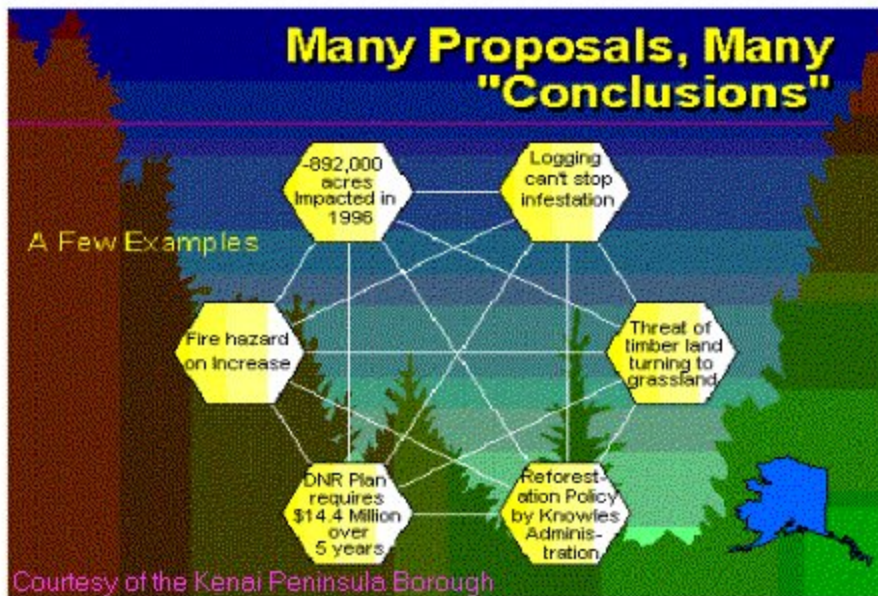
Conditions in Alaska. USDA Forest Service, Alaska Region and the Alaska Department of Natural Resources, Division of Forestry. Anchorage, AK.

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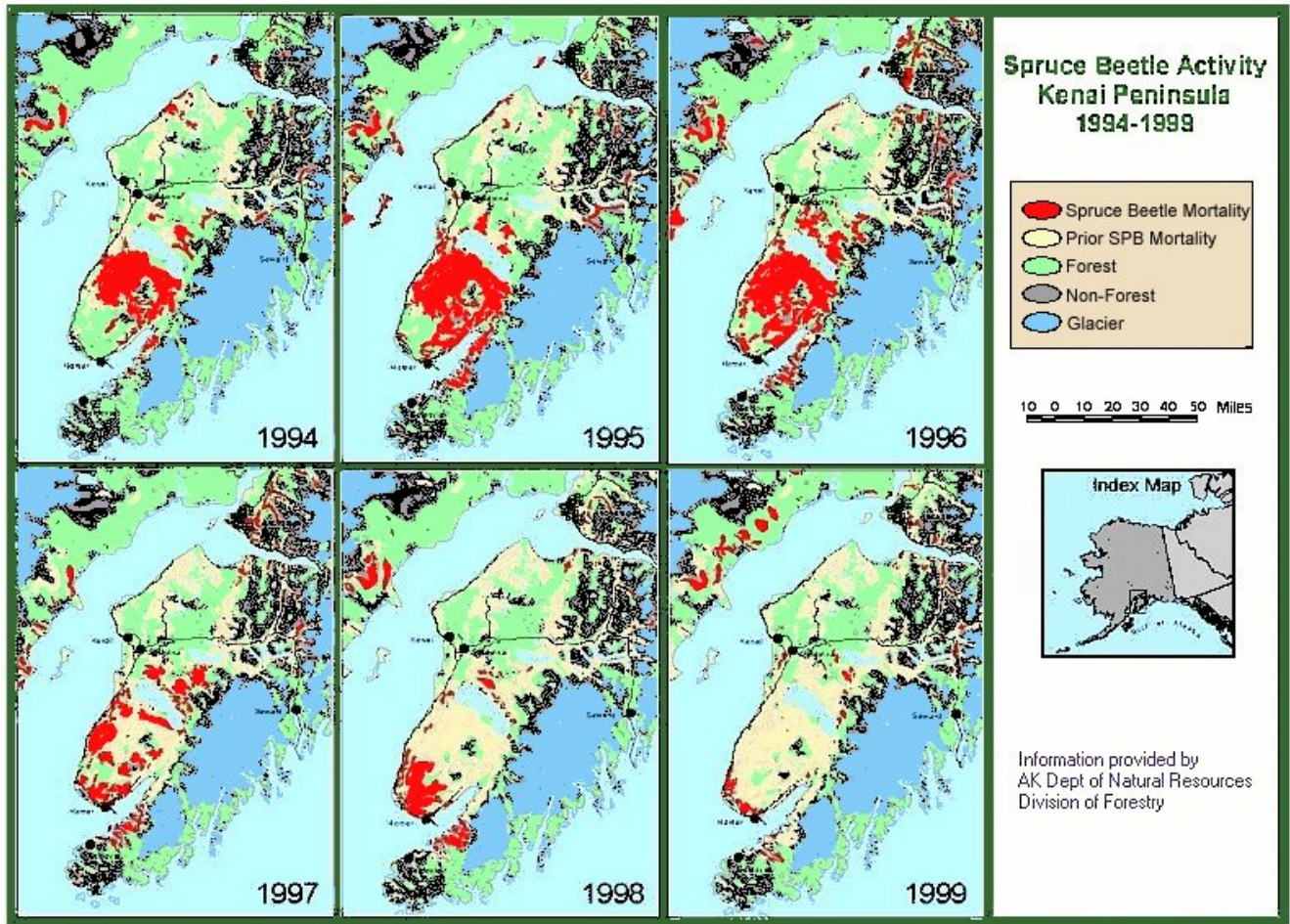


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This cartoon image, used in a seminar for members of the Kenai Peninsula Borough Spruce Bark Beetle Task Force, illustrates several of the dominant issues regarding management of the spruce beetle epidemic.



This series of maps, derived from aerial surveys conducted by the Alaska Department of Natural Resources and the US Forest Service, illustrate changes in spruce bark beetle activity between 1994 and 1999.