Insects and Disease

Goal: Part 219 of the National Forest System Land and Resource Management Planning regulations (36 CFR section 219.12) requires the monitoring of forest health and determining if destructive insect and disease organisms have increased following vegetation management. Areas are identified where there is an increase to damaging levels. Monitor forest health and determine if there is an increase following vegetation management as required by the above referenced regulations.

Objective: Identify areas where destructive insect and disease organisms increase following management. Evaluate the results and modify vegetation management practices if they increase to damaging levels.

Background: A key premise of ecosystem management is that native species have adapted to, and in part, evolved with natural disturbance events. Climate can alter natural disturbances, stimulate native insects and diseases, and influence the vigor of trees and understory plants. Yellow-cedar decline (described below) appears to represent a situation where vulnerability in one species is exposed by a modest change in climate, particularly warmer winters and reduced snowpack. Along with wind, avalanche, and other disturbance agents, insects and diseases are important factors in the health of the Tongass National Forest. Most occurrences of insects and disease are natural and considered a part of, and contributing factor to, ecosystem diversity. Endemic levels of insect and disease activity are usually allowed to run their course.

As part of the Invasive Species Program there has been an Early Detection and Rapid Response program in place since 2001. Though insects have been the main focus of reporting, plants and plant diseases will become part of this effort. This is much like the Gypsy Moth, Nun Moth, Rosy Gypsy Moth, and Pine Moth trapping that has been going on for some time. Early detection may have limited the impact of recently introduced insects into North America (e.g. Asian Longhorn Borer, Emerald Ash Borer, and Sirex Borer).

The gypsy moth (North America) has been an important pest of hardwoods in the Northeastern United States since its introduction in 1869. Nun moth (Eurasia) larvae feed on and kill primarily conifers (spruce, pine, fir, and larch species) but can also defoliate deciduous trees and shrubs (beech, hornbeam, birch, and oak species.). Rosy Gypsy Moth (Asia) attacks many species of birch, chestnut, walnut, apple, oak, willow, basswood, elm and other deciduous trees. Pine Moth (Europe) is one of the most harmful insect pests of Scots pine. It has also been known to attack other pines, e.g. the black pine, eastern white pine, and mountain pine.

Monitoring Question: Are destructive insect and disease organisms increasing to potentially damaging levels following management activities?

The Forest Service's State and Private Forestry, Forest Health Group, conducts annual aerial detection surveys over Southeast Alaska. The location of insect and disease activity is mapped and entered in a geographic information system (GIS) database. In addition to the aerial survey work, on-the-ground site visits and observations are also conducted. Forest Inventory Plots are used to develop information on extent and impact of diseases such as dwarf mistletoe. Ground observations and inventory plots are used because some agents cannot be detected from the air or by remote sensing. In general, current management reduces the incidence and severity of insect and disease occurrence by removing infected trees through timber harvest. Even-aged vegetation management (clearcutting, seed tree or shelterwood regeneration methods) removes defective trees with fungal infections or those with mistletoe. The Forest Plan in 1997 estimated that approximately 80 percent of future harvests would use the even-aged system and the 2008 Forest Plan estimates that approximately 70 percent will use the even-aged system. Past even-aged management has been above this level. The young growth that results after an even-aged harvest is vigorous and usually decay-free.

Currently the Forest Service is exploring alternatives to clearcutting where portions of the stand, either as single trees or groups of trees, are left as legacy (residual) trees. Questions have been raised as to whether increased blowdown and increased insect and disease damage will occur due to bole wounding of residual trees and/or retention of mistletoe and other infestations within the stand. These questions will be studied in a series of three research installations across the Tongass National Forest. Results on logging damage and blowdown from two of these sites are being finalized and will be released later in 2009. .

Monitoring Results

The most important diseases and natural declines on the Tongass National Forest are wood decay of live trees, hemlock dwarf mistletoe, and yellow-cedar decline. Heart and butt rot fungi cause substantial decay in late seral spruce-hemlock forests. Currently, there are no serious insect threats to old-growth stands. No serious insect or disease organisms in young-growth stands were detected through monitoring efforts. Dwarf mistletoe is present in some stands following partial harvests, but at disease levels less than occurred before harvest.

Heart rot decays are a key agent causing small-scale disturbance on the Tongass. The heart rot results in bole breakage in older trees. Average defect in late seral stands is approximately 1/3 of gross volume. The incidence of decay is significantly related to tree age. Research by Kimmey (1956) also indicates that volume losses are small in young trees. Hemlock and spruce less than about 100 years of age are generally sound. Older hemlock deteriorates at a faster rate than Sitka spruce. Kimmey's research found defect was 5 percent for Sitka spruce and 16 percent for hemlock trees in the 151 to 200 year age class (Farr, 1976). At 300 to 400 years of age, spruce was relatively rot-free, whereas decay in hemlock averaged 30 to 40 percent on a board-foot basis (Farr, 1976).

Hemlock dwarf mistletoe is an important disease of western hemlock throughout the Tongass, though it is absent from the Yakutat Ranger District. Like heart rot, dwarf mistletoe incidence does not change significantly from year to year. Dwarf mistletoe is largely eliminated with clearcut harvesting and young-growth stand development. The disease is present following partial harvest at in concurrence with the number, size, and infection levels of residual hemlocks. Given these factors, dwarf mistletoe can be managed predictably to any desirable level.

Trends in populations of insects are generally linked to weather conditions as opposed to forest management practices. For example, the spruce needle aphid occurred on 44,400, 29,500, 20,200, and 9,286 acres in 1998, 2000, 2001, and 2003, respectively. However, no spruce aphid defoliation was recorded in 2009.

Hemlock sawfly and black-headed budworm, also defoliating insects, have caused growth loss, top kill, and mortality in late-seral forests. Outbreaks can affect western hemlock and to a lesser extent Sitka spruce throughout the Tongass. An outbreak in the early 1950s resulted in top kill and mortality on only a fraction of the acres affected. In 2009, 482 acres of black-headed budworm defoliation were mapped on Dry Island. Approximately 5,200 acres of hemlock sawfly defoliation of western hemlock was from Wilson Arm of Smeaton Bay near Ketchikan to the middle of Kuiu Island west of Petersburg.

Spruce beetle mortality was mapped in scattered patches through 104 acres in Southeast Alaska in 2009. This was consistent with typical spruce beetle mortality in Southeast Alaska.

During 2009, western balsam bark beetle was responsible for six acres of subalpine fir mortality in Taiya Inlet.

Porcupine caused mortality was attributed to 147 acres scattered throughout the Tongass National Forest. Mortality occurred from Excursion Inlet to Twelve Mile Arm, Prince of Wales Island. Flooding mortality was mapped on 45 acres throughout Southeast Alaska.

An unidentified cause was attributed to western hemlock mortality on 1,900 acres from the Juneau area to the south end of Dall Island. 970 acres of mortality was recorded in Sandborn Canal and Farragut River drainages. Forest Service researchers examined area of mortality and found that the declining hemlock are in various locations from poorly drained to well-drained sites. The mortality seems sudden in nature and maybe root involved, but does not appear to be an aggressive root pathogen that causes centers of activity.

Yellow-cedar decline continues as a natural, chronic, site-specific mortality problem in Southeast Alaska. Recent research indicates that trees may be dying from freezing injury in areas that have inadequate snowpack in late winter and early spring. This association of the lack of snow and yellow-cedar mortality is seen at several spatial scales. Snags of yellow-cedar accumulate on affected sites and forest composition is substantially altered as yellow-cedar trees die, often giving way to other tree species. Western and mountain hemlock, and western red cedar are favored in stands with dead yellow-cedar overstory. Approximately 500,000 acres of yellow-cedar decline have been mapped across an extensive portion of southeast Alaska. Most of the yellow-cedar in these stands is dead and is represented by mixtures of dead standing trees that died within the last 100 years. The amount of old and newer mortality suggests that yellow-cedar decline began at the end of the Little Ice Age, but accelerated in the second half of the 1900s. Thus, the onset of yellow-cedar decline was probably the result of a natural climatic cycle, but it is conceivable that the concentrated mortality since 1950 may indicate a response to human-induced climate warming. In 2009, observations during the forest health aerial detection survey showed that there was 15,100 acres of recent tree death in many forests with yellow-cedar decline. This was probably the result of below average snowfall, conditions that appear to cause yellow-cedar freezing injury and widespread mortality.

Evaluation of Results

Although yellow-cedar decline is not a management induced problem, recent research indicates good recovery rates of wood from snags. Wood from dead cedar retains all strength properties, up to 80 years after death. Given the large acreage of decline and the value of the wood, there is interest in salvage recovery. Plant succession favoring other tree species will probably proceed whether salvage occurs or not. Planting or favoring yellow-cedar during thinning on non-decline sites can help offset the losses of the species elsewhere. Appropriate sites to plant and manage yellow-cedar include those with good drainage, higher elevation, in the northeast portion of the panhandle, or in the vicinity of Yakutat. A comprehensive conservation and management strategy is being developed for yellow-cedar to help maintain this valuable tree species in the context of a changing climate.

The monitoring work conducted annually by the State and Private Forestry branch of the Forest Service, Forest Health Group and Tongass National Forest Silvicultural staff is adequate to assess threats and impacts from insects and disease.