**Disease** Red fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. *magnificae*) is common throughout the range of red fir and infests 40 percent of the stands in California. Heavily infected trees suffer significant growth losses and are subject to attack by *Cytospora abietis*, a fungus that kills branches infected by dwarf mistletoe and further reduces growth. Because of reduced vigor, infected trees are more susceptible to bark beetle attack and other diseases (Silvics).

The trunks of California white fir are often malformed or broken off where dwarf-mistletoe infections have created stem cankers that cause weak spots. Infected trees may suffer significant growth losses and become more prone to infection by other diseases such as *Cytospora abietis*, a fungus that causes ”flagging” and kills branches and further reduces growth. Infected trees are also more susceptible to attacks by bark beetles and heart rots. (FEIS)

White fir can be severely damaged or is highly susceptible to a number of decay fungi including *annosus* root disease, *Armillaria* root disease, laminated root diseases, yellow cap fungus, Indian paint fungus, and white pocket rot. *Annosus* root disease may be the most damaging pathogen to true firs east of the Cascades in the Pacific Northwest. Although it does not usually kill white fir directly, *annosus* produces moisture stress and loss of vigor and can predispose the tree to attack by bark beetles. (FEIS)

Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) is the most serious parasite of Sierra lodge- pole pine. Fungi that cause stem cankers and blister rusts can also do significant damage to Lodgepole stands. (FEIS, Silvics) The most prominent disease of western white pine has historically been blister rust, although it is expected that its importance will decline in the future due to natural and bred resistance. The foremost root disease of western white pine is *Armillaria* spp., causing fading foliage, growth reduction, root-collar exudation of resin, dead and rotten roots, and black rhizomorphs. Many other fungi are capable of causing decay in injured or overmature trees, and rot often becomes excessive in trees over 120 years of age.

**Insects** The most severely damaging insect pest on both red and white fir is the fir engraver (*Scolytus ventralis*). This bark beetle is found throughout the range of red fir and causes severe damage nearly every- where. Losses under epidemic conditions can be dramatic. Anything that reduces tree vigor - *Annosus* root disease, dwarf mistletoe, *Cytospora* canker, overstocking, drought, or fire damage - increases susceptibility to fir engraver attack (Silvics).

Other white fir pests include the Douglas-fir tussock moth, which is a serious defoliator, as are the western spruce budworm and the white fir needle miner. White fir seedlings and saplings lack chemical defenses against, and tend to be killed by budworm feeding, while healthy mature trees usually survive. Insects that may cause damage to white fir cones and seeds include seven genera, the most abundant and damaging of which are seed maggots and the fir cone looper. Cutworms may cause significant seedling mortality. (FEIS)

The mountain pine beetle (*Dendroctonus ponderosae*) is the most severe insect pest affecting Sierra Lodgepole pine. Epidemics can kill 33 to 66 percent of large trees in a stand. Infestations commonly last 5 to 7 years, and occur in 20- to 40-year cycles. Mountain pine beetle outbreaks create a large amount of fuel build-up. Watersheds can release up to 30 percent more water because of the dead trees killed by mountain pine beetle. Western white pine is also susceptible to mountain pine beetle, as well as emarginate ips (*Ips emarginatus*), and is the principal host for the ips beetle (*Ips montanus*). (FEIS)