Monarthrum scutellare Ambrosia Beetle

This beetle attacks dying, weakened, or diseased trees, but prefer very recently killed trees, stumps or parts of trees. In March, the male beetles penetrate the sapwood to a depth of 2 inches. The female joins the male, mates and introduces the fungus, Monilia brunnea. Both sexes develop excavate two to four diverging galleries deep into the heartwood, each two to six inches long. The female excavates egg niches in the sidewalls of the galleries. The hatched larvae extend the egg niches into "larval cradles." M. brunnea grows into the cradles and serves as a larval food source for the beetles. Excavation of egg galleries lasts for two to four months, new adult beetles emerge through the same entrance holes made by parent beetles. There are two generations per year with two major flight periods; the first in March and the second in September. However, beetles may fly almost every day during the growing season because different development stages overlap.

M. detinger Ambrosia beetle Minor is named

Armillaria mellea
Hypoxylon thouarsianum Oak fungus conks (Black)
Phytophthora

Pseudopityophthorus pubipennis Western Oak Bark Beetle

These beetles reproduce in great numbers primarily in firewood, emerging to attack Live Oaks and Tan Oaks. They usually attack severely injured or dead and dying trees but also may attack lower branches and trunks near the base of healthy oaks. Adult beetles emerge in the spring to fly to host trees to feed and reproduce in dead or dying oaks. Their frass is darker brown.

They bore through the bark and construct two transverse egg galleries in the bark and sapwood. Females lay eggs along both sides of the galleries. As beetles bore through the bark they introduce a fungus not yet identified that stains and kills the inner sapwood around the egg galleries. The construction of egg galleries girdles and plugs the vessels in the outer sapwood that transport water and nutrients upward to the tree crown. After the eggs hatch the larvae make fine threadlike tunnels through the phloem into the inner bark where they later pupate. Newly formed adults make their own exit holes through the bark, emerge and fly to attack other oaks. The time it takes the Oak Bark beetle to grow from egg to adult varies seasonally. This beetle has two or more generations a year and, because successful generations overlap, the adults fly almost everyday during the growing season.

OTHER MANAGEMENT CONSIDERATIONS:

Mesic coast live oak woodlands with shrub understories have adequate regeneration, while xeric woodlands are likely to have limited recruitment [30]. Thus, northern coastal populations of this tree are generally stable, but the species is in decline in southern California [112,142]. Coast live oak regeneration in xeric sites can be improved by reducing grazing intensity or protecting individual seedlings from livestock [32,64,122,123]. Other threats to this oak include urban and rural development, increased recreational use of oak woodlands, and cutting trees for firewood [128,142]. Some coast

live oak woodlands were cleared to increase forage for domestic livestock, but since the early 1970s, urban and residential development have had a much larger impact [1]. Coast live oak populations in Baja California were not as heavily logged as in California, as natural gas and propane were available when human populations in the area expanded. Here heavy grazing around population centers has been the primary anthropogenic limitation on recruitment [107]. Presence of honey-fungus (*Armillaria mellea*) in the soils of sites now bereft of coast live or other oaks is a good indicator of oak dominance in the past [22].

Diseases: The most serious threat to coast live oak, other red oaks, and related non-oak species in the beech family is "sudden oak death." The primary pathogen response for sudden oak death is the fungus *Phytophora ramorum*. Previously described only as a greenhouse pathogen from northern Europe, its origins are uncertain [55,103,135]. Another pathogen, *Hypoxylon thouarsianum*, is associated with the disease as a secondary fungus. Mature coast live oak are highly susceptible to sudden oak death, which can kill apparently healthy trees within a few weeks to several years. Sudden oak death has reached epidemic proportions in California and southwestern Oregon and is particularly virulent on California's central coast, where coast live oak is the dominant red oak species [103,135]. For example, coast live oak on 2 sites in Marin County showed infection rates of 35% in 2000 and 38% in 2001, and 16% in 2002 and 19% in 2001, respectively. Coast live oak mortality at the 2 sites rose from 8 to 15% and 6 to 8% during that time. About 1/3rd of coast live oak on the 2 sites showed evidence of infection.

Etiology of sudden oak death is unclear as of this writing (2002). Bark and ambrosia beetles (Scolytidae) are associated with infected trees and may be vectors for the fungal pathogens [103] Coast live oak on moist sites may be more vulnerable to *Phytophora ramorum* infection than trees on drier sites [149]. Ability of infected trees to overcome the disease is unknown [103]. Besides species in the oak family, a variety native woody plant species serve as alternate hosts for *Phytophora ramorum* (i.e., *Rhododenron* spp., huckleberries (*Vaccinium* spp.), and manzanitas). Although currently isolated to 2 west coast states, seedling inoculum trials suggest that some eastern red oak species may be even more susceptible to sudden oak death than coast live and related California red oaks [135]. Standard fungicide treatments (e.g., metalaxyl, cupper sulfate, and phosphoric acid) have shown positive control of *Phytophora ramorum* in preliminary tests. Fungicides may provide *Phytophora ramorum* control in urban settings and protect small groups of wildland trees, but are not likely to be practical in large wildland settings [78]. Information on how sudden oak death is transmitted [40], diagnosed [135], and can be monitored [78] is available.

Coast and interior live oaks are susceptible to oak drippy-nut disease, which develops after wasps, acorn weevils, or other acorn feeders puncture acorns and allow the bacteria *Erwinia quercina* to develop within [17]. *Diplodia quercina*, a fungal pathogen that grows hyphae through wounds, may cause dieback of large branches of coast live oak, valley oak, and California black oak. "Twigblight" in coast and interior live oaks is caused by the fungal pathogens *Cryptocline cinerescens* and *Discula quercina*; dieback

may range from a few twigs to the entire crown [69]. Epidemics of oak wilt disease, caused by the pathogen *Ceratocystis fagacearum*, have occurred among Texas oaks in urban forests and in live oak (*Q. virginiana*) savannas; coast and interior live oaks are more resistant [4]. Watering during summer may cause root rot as a result of *Armillaria mellea* infection or crown rot as a result of *Phytophthora* spp. infection [69].

Insects: The California oakworm (*Phryganidia californica*) feeds on older leaves in early summer and leaves of all ages later in summer [98]. This moth occurs at low density in most years but periodically, in approximately 5- to 7-year intervals, increases to outbreak levels that defoliate coast live oak [71]. The California oakworm may feed on coast live oak year-round, as it has summer and winter generations that feed without diapause. Outbreak frequency may be related to climate: cold winters cause mortality [105]. Acorn feeders include the acorn weevil (*Curculio occidentalis*) and to a lesser extent, the filbertworm (*Melissopus latiferreanus*). One survey in northern California found that 38% of coast live oak acorns had some boring and larval infestation, 70% of which were acorn weevils and 30% were filbertworms. Infestation was greater on cooler, more shaded aspects of trees [90].