

Oak Woodland Invertebrates: *The Little Things Count*



“When we try to pick out anything by itself, we find it hitched to everything else in the universe.” This well-known quote from the pioneering conservationist John Muir serves as both a starting point and a framework for the exploration of a largely unnoticed universe in a new University of California publication. This publication (number 21598) explores the complicated world of insects in our oak woodland.

California oaks are the dominant tree species in the coastal ranges and the foothills surrounding the Central Valley. Oak trees cover about 10 million acres, roughly 10 percent of California’s land area. Many woodlands in California include several different types of oaks. More than 25 oak species, natural hybrids and varieties, are native to California, and nine of these occur only in California. Some oak woodlands contain other native trees, including grey pine and California buckeye, and a variety of shrub species. The ground below the oaks is typically carpeted with non-native grasses introduced from the Mediterranean region. However, native bunch grasses and a variety of forbs occur in many woodlands, and springtime displays of native wildflowers often brighten the understory.

Oak woodlands teem with a wide variety of animal life. Over 300 species of vertebrates (animals with backbones) use California’s oak woodlands, including 170 bird species, 80 mammal species, and 60 species of amphibians and reptiles. Although oak trees provide valuable habitat elements (nesting sites, cover, thermal protection, food) for many different vertebrates, relatively few species make direct use of oaks as a food source. For example, less than 20 percent of the bird and mammal species in oak woodlands eat acorns, and the percentage of mammals that browse directly on oak leaves, twigs, and roots is even smaller. But the myriad of invertebrates in oak woodlands converts the sunlight, carbon dioxide, and mineral nutrients absorbed by oak trees into food for many birds, amphibians, and mammals.

When we look closely at individual oak trees, we begin to glimpse the universe of the invertebrates. They buzz and drift through the air; climb along and tunnel through oak leaves, stems, and roots; dig through the soil; and swim in watercourses and seasonal ponds. Invertebrate organisms vastly outnumber their vertebrate counterparts in the oak woodlands; 10 to 100 million individual invertebrates may be present within a single acre of oak woodland.

Invertebrates lack not only backbones, as their names implies, they have no internal skeleton at all. This lack of internal support limits the size these animals can attain. In our oak woodlands, most invertebrates are less than one inch long; some are microscopically small. Nearly all of the invertebrates in the oak woodlands fall within a large taxonomic group or phylum called the Arthropoda; literally, “joint-footed” invertebrates. The arthropods are further divided into classes that include the Insecta (insects), Arachnida (spiders, ticks, mites, and scorpions), Crustacea (pill bugs and crabs), Chilpoda (centipedes), and Diplopoda (millipedes). All of these classes are represented in the oak woodlands, but insects and arachnids are by far the most numerous. More than 5,000 species of insects and arachnids may be found in California’s woodlands.

Virtually every part of an oak tree- roots, trunk, bark, branches, leaves, and acorns- serves as food for a number of invertebrates. Invertebrates, especially insects, may be categorized as oak pests if they feed on living plant tissues. However, only a handful of the more than 800 species of insects that feed directly on the tissues of living oaks can cause enough damage to be considered significant pests.

Most of the insects that feed on oaks are specialists that can tolerate the high levels of tannins in oak tissues. Tannins are bitter-tasting chemicals produced by plants and can discourage feeding by both vertebrates and invertebrates. As California’s oak-feeding arthropods have evolved along with their host plants over the past 15 million years, the oaks have waged chemical warfare by varying their tannin content and composition to discourage would-be oak feeders. This strategy has been only partly successful. As they coevolved with the oaks, oak-feeding insects accumulated adaptations that allow them to tolerate or even utilize the tannins in oak tissues. In the most extreme example of coevolution, cynipid wasps and other arthropods that produce oak galls actually put oaks to work for them by manipulating oak biochemistry. Many oak-feeding arthropods subsist exclusively on oaks.

This article adapted from Cooperative State Research, Education and Extension Service, USDA. Please contact Ken Churches at cdcalaveras@ucdavis.edu or (209) 754-6475 with your agricultural questions. To speak with a Certified Master Gardener: Calaveras (209) 754-2880, Tuolumne (209) 533-5696, Amador (209) 223-6837, El Dorado (530) 621-5543.