

Insects

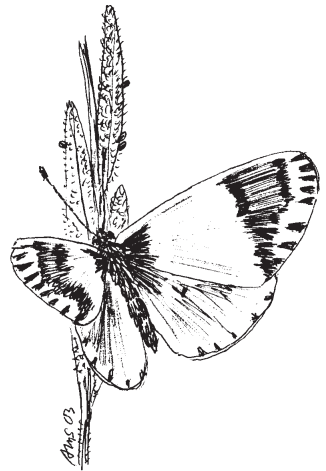
Compared with plants and vertebrates, there is little information on terrestrial insects at the reserve. Aquatic insects, discussed in the aquatic ecology chapter, have been studied as part of Homestake's water quality monitoring program, but there have been no comprehensive surveys or monitoring of the terrestrial insects. Butterflies of the area are well known thanks to the work of Dr. Arthur Shapiro at UC Davis. Ants of the region have been extensively studied by Dr. Philip Ward at UC Davis, and Dr. Brian Fisher, now of the California Academy of Sciences, conducted a survey of the ants of the reserve.

Here we provide an overview of what is known about insects at the reserve, focusing in particular on butterflies and ants and their responses to the serpentine substrate. Our list of insect families is far from complete (Appendix 3), but should provide a good starting point for future faunal surveys of the reserve. A good reference for identifying the most common insects on the reserve is Powell and Hogue's *Field Guide to California Insects* (1979). A search through the *Bulletin of the California Insect Survey* (Berkeley: University of California Press) may assist in the search for other serpentine endemic insects.

Butterflies

Our butterfly list (Appendix 4) comes from the work of Dr. Arthur Shapiro of UC Davis, who has surveyed and collected butterflies throughout California, including in the Morgan Valley area. This list gives the species found on the reserve; the habitats in which they tend to be found in their flying, adult stage; and the plants they eat in their larval (caterpillar) stage. A diagram of butterfly seasonality (Appendix 5) gives the times of year when each species may be seen in the adult stage. To identify these butterflies and learn about their life histories, a good reference is *Peterson's Field Guide to Western Butterflies* by Opler and Wright (1999).

The evolutionary ecology of serpentine-associated butterflies has been a subject of particular interest to Dr. Shapiro and his students. Every butterfly species has a limited range of host plants on which its caterpillars feed, and compared with other plant-feeding insects, butterflies tend to be dietary specialists using only one or a few plant species. Since some plants are restricted to serpentine soils, it is not surprising that some butterfly species are strongly associated with the serpentine habitat. Here we describe some species known to be associated with serpentine; see Harrison and Shapiro (1988) and Gervais and Shapiro (1999) for additional information on serpentine butterflies.



Sara Orange-Tip (female)
(*Anthocharis sara*)

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Muir's Hairstreak (*Mitoura nelsoni muiri*) is a true serpentine endemic throughout its range. Muir's Hairstreak uses the serpentine endemic species McNab (*Cupressus macnabiana*) and Sargent's cypress (*Cupressus sargentii*) as host plants in all populations north of San Francisco Bay. South of the bay, several populations feed on California juniper (*Juniperus californica*), although in San Luis Obispo County they are found on a lone stand of Sargent's cypress. The McLaughlin population of Muir's Hairstreak is one of the largest in California. Its rich dark brown color may aid in thermoregulation, as the species is among the earliest-flying butterflies in the area. The adults nectar on redbud (*Cercis occidentalis*). The males are often seen sitting on mud puddles. They form "leks", or territorial assemblages, in early afternoon on the tops of the cypresses and can often be seen chasing one another in a dazzling display of aerobatics above the trees. Most of the males in an area will assemble at a single tree, but it will be a different tree from day to day. Johnson's Hairstreak (*Mitoura johnsoni*) is expected to occur on the McLaughlin reserve but has never been found there; its caterpillars feed on mistletoe on gray pine, which is common at the reserve.

Wright's Dusky Wing (*Erynnis brizo lacustra*) is one of five dusky-winged skippers found on the reserve, and is the only serpentine endemic. The northern populations of Wright's Dusky Wing use the serpentine species leather oak (*Quercus durata*) as their larval host plant. The larvae feed on the youngest leaves of the oak, which are presumably softer and lower in tannins than adult leaves. South of a line from Placerville to San Francisco, Wright's Dusky Wing populations may be found off serpentine and feed on a variety of oak species.

The Columbia Skipper (*Hesperia columbia*) and Lindsey's Skipper (*Hesperia lindseyi*) are confined to serpentine on the reserve and the surrounding areas, but not throughout their ranges. Skippers are a distinctive group of butterflies with heavy bodies resembling moths, a fast buzzing flight, and hook-shaped clubs on the ends of their antennae. Columbia and Lindsey's Skippers are bunchgrass-feeding butterflies and will not eat introduced Mediterranean annual grasses. Bunchgrasses are much more common on serpentine, but both skippers also occur on non-serpentine areas where bunchgrasses are available, for example farther north in the Coast Range. Lindsey's Skipper is often found flying very low to the ground in serpentine grasslands, or nectaring on milkweeds (*Asclepias* spp.).

California Whites (*Pteris sisymbrii*) feed primarily on serpentine endemic jewelflowers (*Streptanthus* spp.). Edith's Checkerspots (*Euphydryas editha*) populations in this region feed on warrior's plume (*Pedicularis densiflora*); although the plant is not confined to serpentine, the butterfly has been found only on serpentine in this region.

Anise Swallowtail (*Papilio zelicaon*) is common throughout the western United States, and feeds on plants in the carrot family including the invasive fennel (*Foeniculum vulgare*). Populations on serpentine, such as those at the reserve, feed on serpentine endemic species of *Lomatium*. In most of its range the Anise Swallowtail is capable of undergoing more than one generation per year, but populations on serpentine may be genetically limited to a single brood per year. The pupae in serpentine populations

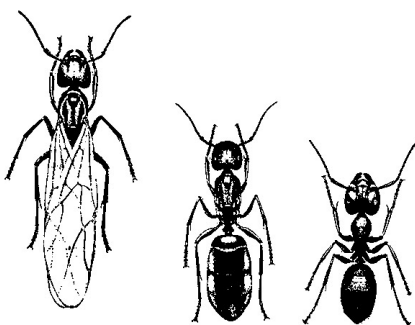
may even remain dormant for several years before metamorphosing into adults; this is likely an adaptation to a harsh and fluctuating environment, just like seed dormancy in plants. Indra Swallowtails (*Papilio indra*), a much less common species, also use *Lomatium* spp. as host plants. Adults are mostly black, while the caterpillars are brightly banded in pink and black.

Gorgon Coppers (*Lycaena gorgon*) only fly for 4-6 weeks but are extremely abundant when found. Their larval host plant is wild buckwheat (*Eriogonum* spp.; often *E. nudum*). Adults often nectar on woolly sunflower (*Eriophyllum lanatum*). Satyr Anglewings (*Polygonia satyrus*), Zephyr Anglewings (*Polygonia zephyrus*), and Mourning Cloaks (*Nymphalis antiopa*) all hibernate through the winter as adults and re-emerge in late winter or early spring. Ox-Eyed Satyrs (*Cercyonis pegala boopis*) are commonly seen along streambanks, dodging into thick vegetation to escape harassment. These species are found commonly both on and off of serpentine.

Ants

In 1996, Dr. Brian Fisher conducted a survey of ants at the reserve to determine how ant communities differed between serpentine and non-serpentine habitats, as well as different vegetation types (Fisher 1997). The results of this survey (Appendix 6) suggest that equivalent numbers of species are found on both soil types, but species composition and abundance differ; abundances are generally lower on serpentine.

The one possible candidate for a serpentine-endemic ant at the reserve is the undescribed species *Formica* cf. *xerophila*. The “cf” in its name implies it may be a new species closely related to the already-described *F. xerophila*. Dr. Philip Ward has found this new form only on serpentine elsewhere in the California Coast Range; it resembles *F. xerophila* from the Great Basin and southern California. As its name would suggest (“*xerophila*”, lover of dry habitats), this insect is found in arid climates, often in places with bare soil and southern exposure. Fisher suggests that *Formica* cf. *xerophila* might require serpentine soils for nesting purposes.



Winged adult, wingless adult, and worker forms of the carpenter ant, *Camponotus* spp.

The ecological effects of ants on the plant community have been studied at another serpentine site, Stanford University’s Jasper Ridge Reserve in San Mateo County. The harvester ant *Messor andrei*, which is also found at McLaughlin Reserve, makes chaff mounds that may be hot spots for plant regeneration. Brown and Human (1997) found evidence that at least two non-native annual grasses and a non-native forb were colonizing the enriched soils of the ant mounds more readily than the surrounding grasslands.

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Other studies of insects on serpentine

Other terrestrial insect research conducted at the reserve includes the doctoral thesis of Dr. Amy Wolf at UC Davis (1998, 1999), who studied the pollination biology of serpentine sunflower (*Helianthus exilis*) and coast range morning glory (*Calystegia collina*). The sunflower is pollinated by various small and a few large bees (*Bombus* spp. and *Apis mellifera*), beetles (*Nemognatha* spp.), butterflies, and syrphid and bombyliid flies. Its seeds are attacked by a tephritid fly (*Paracanthus cultaris*) and a gelechiid moth (*Dichomeris baxa*). When attacked by the fly the flowers become deformed; moth attack leaves frass in the flowers. The morning glory is mainly pollinated by native bees in the genera *Dialictus*, *Evyllaesus*, *Halictus*, *Andrena*, *Bombus*, *Agapostemon*, *Ceratina*, *Dialictus*, *Lasioglossum*, and *Osmia*, as well as introduced honeybees (*Apis mellifera*). The large bee *Diadasia* sp. is considered to be a specialist pollinator of *Calystegia*.

Metal accumulation by insects on and off serpentine soils has received some attention elsewhere. Some of the first studies were designed to use insects, particularly termites, to help prospectors locate gold (West 1965). In a Californian study, Boyd and Martens (1989) examined the success of the common cabbage butterfly (*Pieris rapae*) in feeding on the Sierran serpentine endemic *Streptanthus polygaloides*, a plant known to hyperaccumulate nickel in its tissues. Larvae that fed on *S. polygaloides* grown on nickel-rich soil showed elevated mortality. A comparison study of the serpentine-adapted butterfly *Pieris sisymbrii* would be of interest.

Arthropods known as harvestmen, related to spiders, are known to show restriction to serpentine. Dr. Darrell Ubick of the California Academy of Sciences has identified serpentine-endemic harvestmen in two genera belonging to the family Phalangodidae. The genus *Microcina* occurs only in the San Francisco Bay Area and most of its species are serpentine endemics. The genus *Calicina* is found throughout California, and has some two dozen species of which several occur primarily or exclusively on serpentine. In all likelihood, serpentine-endemic species of *Calicina* also inhabit the McLaughlin reserve.