



California tiger salamander (*Ambystoma californiense*). Photo: Jeff Wilcox

SPECIES SPOTLIGHT:

California Tiger Salamander (*Ambystoma californiense*)

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The biodiversity that meets the eye when walking through California's grasslands is a small percentage of that which exists beneath the soil surface, where complex food webs exist among and between the roots that nourish the plants above ground. California tiger salamanders (*Ambystoma californiense*) live most of their adult lives within this root zone in burrows of rodents such as California ground squirrels (*Otospermophilus beecheyi*) and pocket gophers (*Thomomys* spp.) (Loredo et al. 1996). These large salamanders, approximately 10 inches in length (Storer 1925), are endemic to California and play an important role as underground predators of invertebrates, primarily insects (Stebbins 1951). California tiger salamanders have a biphasic life history (Wilbur 1980), which means life begins in an aquatic environment, followed by transformation through metamorphosis to a terrestrial adult phase. This unique species is adapted to breed in vernal pools (Shaffer 2004), formerly a common feature among many California grasslands.

With the onset of winter rains, adult California tiger salamanders leave their underground burrows under the cover of darkness and migrate (sometimes over 2 km.) overland to breeding ponds. Males arrive first, sometimes weeks in advance (Loredo and Van Vuren 1996, Trenham et al. 2000), where they await the arrival of females. Following courtship and mating, females deposit individual eggs (sometimes in small clusters) on submerged vegetation (Storer 1925). Larvae emerge from eggs in 2-4 weeks at a length of approximately 1 cm., but the small size belies a voracious predator.

Because most vernal pools begin to dry as soon as the rains stop, larvae must eat as much as possible to grow to a size that will allow them to undergo the energetically demanding process of metamorphosis before vernal pools dry completely. The larger they are at metamorphosis, the better their chances of surviving to breeding age (Searcy et al. 2015). The smallest salamander larvae prey on zooplankton such as water fleas (*Daphnia* spp.) and then move on to larger aquatic prey as they grow, sometimes exhibiting cannibalism when the opportunity presents itself (Anderson 1968). Vernal pools are fishless, and once salamander larvae attain a large enough size, they are often the largest predator in the pools. As summer approaches and vernal pools dry, metamorphosis begins and larvae transform from gilled aquatic larvae to air-breathing terrestrial salamanders. Again under the cover of darkness, the transformed juvenile salamanders exit the pond and search for refuge in a burrow. Juvenile salamanders may travel up to 1.6 km. from their breeding pond in their first year (Trenham and Shaffer 2005). Once ensconced in their underground refugia, little is known of the behavior of juvenile and adult California tiger salamanders. Sexual maturity is attained at 2 years but female salamanders may breed only once in their lifetime (Loredo and Van Vuren 1996, Trenham et al. 2000).

Though primarily an animal of the grasslands, California tiger salamanders are linked by their biphasic life history to ephemeral water bodies, such as California's once extensive vernal pool

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California Tiger Salamander *continued*

systems. These two geographic features were historically found together throughout much of the Great Central Valley and along the coastal plains in northern and central California. Agriculture and residential sprawl have eliminated more than 85% of California's vernal pool habitats (Holland 2009), thus eliminating much of the breeding and upland habitat for California tiger salamanders. Genetic investigation has revealed three distinct population segments: the two oldest and isolated salamander populations occur in Santa Barbara and Sonoma counties, while the larger and less isolated group exists in the Great Central Valley and the San Francisco Bay area (Shaffer et al. 2004). The U. S. Fish and Wildlife Service listed the Santa Barbara population as endangered under the Endangered Species Act in 2000, the Sonoma population as endangered in 2002, and the remaining group as threatened in 2004 (USFWS 2004). The state of California listed this species as threatened in 2010.

While habitat loss is the primary reason for its declining populations, the California tiger salamander has exhibited behavioral plasticity by inhabiting fishless man-made ponds such as reservoirs constructed for flood control, and for watering livestock (Barry and Shaffer 1994, Wilcox et al. 2015). In addition, they have shown the ability to colonize fishless perennial ponds (Alvarez 2004, Wilcox et al. 2015) and have moved out of the valley floor to rangelands with ponds at elevations above 900 meters. With the exception of remaining vernal pool systems and some park lands, California's rangelands now sustain this species. As a top predator, the California tiger salamander depends on a healthy and diverse prey base, which in turn requires a healthy and functioning ecosystem. Unless you are standing at the edge of a pond on a cold and rainy night in the dead of winter, you may pass an entire lifetime without seeing this large endemic salamander. However, if we can preserve our grasslands and the vernal pools within them, the salamander will be there fulfilling its role as top predator, contributing to ecosystem function by keeping herbivorous insects in check, and cycling important nutrients back into the soil.



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