

WHAT IS A VERNAL POOL?

Vernal pools are temporary wetlands. They fill during winter rains and then dry down in the late spring. The vernal pool annual cycle actually consists of three distinct stages: an aquatic stage, a waterlogged terrestrial stage, and a drought stage. The cycle of flood and drought create extreme conditions for the plants and animals that live in vernal pools. Because of that, many of the inhabitants of vernal pools can live nowhere else!

The physical conditions that give rise to vernal pools at Phoenix Park include a hardpan layer below the soil surface. This hardpan of soil bound together by a cement of iron oxide and silica (silicon dioxide, SiO₂) to form a dense, nearly solid mass that prevents rainwater from percolating downward. Rain water perches above the hardpan and becomes evident as vernal pools where there are depressions in the landscape.

The aquatic stage of a vernal pool begins shortly after the first winter rains. The pools remain flooded for a few weeks or a few months. During this stage, the vernal pool plants germinate and the aquatic organisms that occupy the pools hatch, grow and reproduce. During the aquatic stage, the pools are also visited by a variety of birds and animals that come to feed on the aquatic organisms.

The waterlogged terrestrial stage begins as the winter rains diminish and warming weather causes the water to slowly evaporate. The water is also taken up by rapidly growing plants: some water may leak through tiny cracks in the hardpan. During this stage, the aquatic organisms begin to die off and the vernal pool plants put on a burst of growth and begin to bloom. The vernal pool flowers create colorful concentric rings, patches and ribbons of flowers, during the early spring.

The drought stage begins once the soil has completely dried. The aquatic organisms have long ago perished. The plants have set seed and begin to wither and die. During the height of the drought phase, the eggs and cysts of aquatic organisms and the seeds of the vernal pool plants bake in the summer sun. The drought stage is often six to eight months long. But with the next year's winter rains, the burst of life and activity begins anew.

The plants and animals that live in vernal pools are highly dependent upon how long the pools are flooded. Each organism has a unique requirement about how long it needs or can tolerate the wet season. Small, shallow pools have completely different species than the large, deeper pools. Vernal pools are like snowflakes – no two are alike.

VISITING VERNAL POOLS

About 90% of California's vernal pools have already been destroyed through habitat conversion to agricultural uses and urban development. We hope that you take time to both enjoy and protect those that remain. For the benefit of future visitors and hundreds of vernal pool species, please:

- Stay on the designated trails
- Keep pets on a leash
- Take only pictures, and leave only footprints



AREA IN DETAIL

The red outline shows the natural area within Phoenix Park. Vernal pools are found within the dashed orange line.

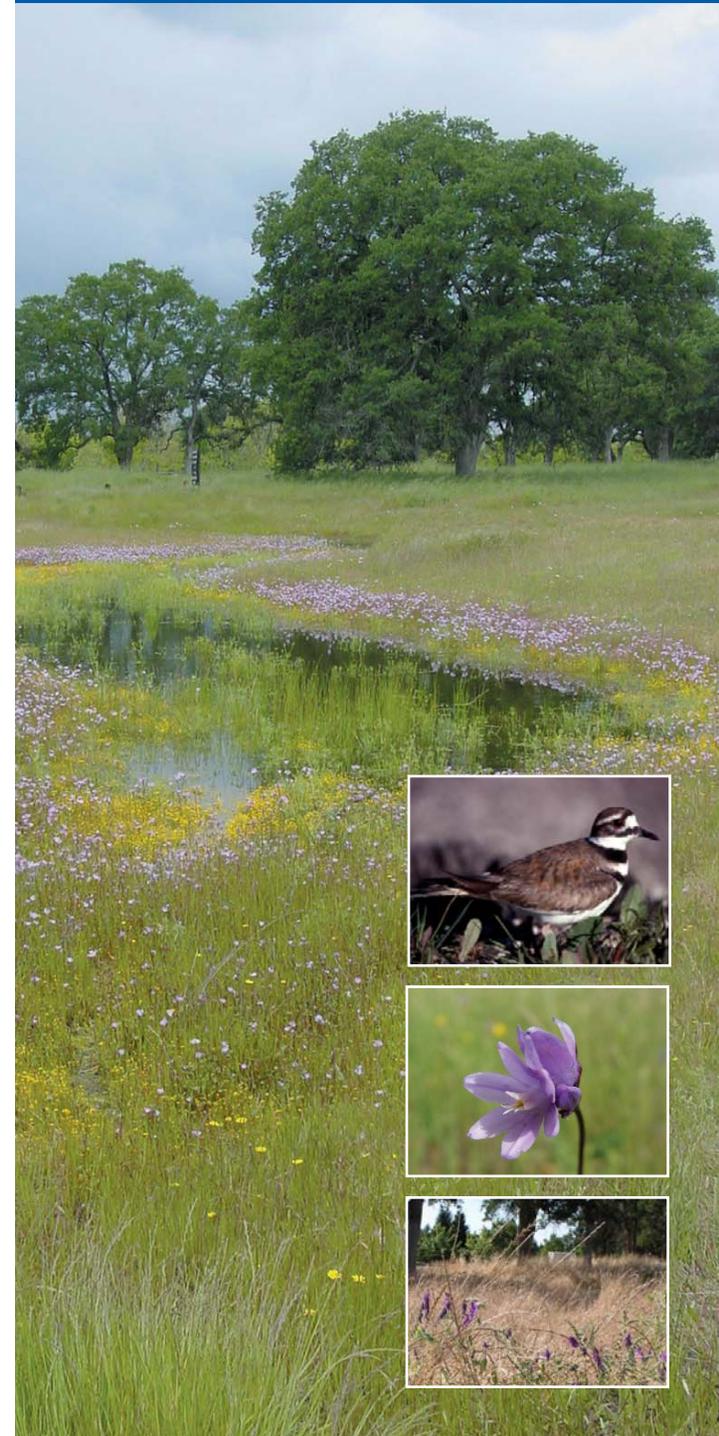
Visitors are encouraged to stay on defined pathways and trails to avoid damage to sensitive plants and animals.

For brochures, posters or to arrange visits for large groups, please contact the Fair Oaks Recreation and Park District
[916-966-1036](tel:916-966-1036).



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The Phoenix Park Vernal Pools A National Natural Landmark





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Lentil Clam Shrimp



© David Rosen www.wildsidephotography.com

Western Spadefoot Toad



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Greater Yellowlegs



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Valley Garter Snake

VERNAL POOL ANIMALS

Animals that can be found in and around vernal pools consist of three general types—those that only live in vernal pools, those that use vernal pools for part of their lifecycle, and those that visit vernal pools to feed or rest. Of these general types, the animals that can only live in vernal pools are most unique. Many of these species are threatened by extinction due to past and ongoing destruction of their vernal pool habitat.

While most of the aquatic organisms that live only in vernal pools are smaller than a pinhead, several larger freshwater crustaceans—fairy shrimp, clam shrimp and tadpole shrimp—can be observed swimming and feeding. The fairy shrimp is translucent, about a half inch long, and can be observed swimming upside down. Clam shrimp are generally reddish, about the size of a dime, and occasionally jet through the water using their 14 pair of antennae and legs. Tadpole shrimp resemble horseshoe crabs and can be observed feeding along the mud in the bottom of the pools.

The freshwater crustaceans have evolved a very unique adaptation to survive the extreme conditions of summer drought. They produce cysts! A cyst is a living embryo encased in a hard shell. The shell helps the embryo survive the heat and desiccation of the drought phase. When the rain returns, the embryo can hatch out very quickly to begin eating, growing and reproducing. This is an advantage when your aquatic world only lasts for a few weeks.

The creatures that occupy vernal pools for only a part of their life cycle consist of two general categories: amphibians and insects. Both of these groups use vernal pools during their larval phase.

Amphibians mate and lay eggs in vernal pools. Their tadpoles are aquatic until they metamorphose into adults. Then they become terrestrial until the urge to reproduce brings them back to the pools. During the waterlogged terrestrial phase you can often see young frogs, newly metamorphosed into adults, on the muddy edges of the pools. And, anytime when there is some water present, you can hear the chorus of frogs in the early morning and at dusk.

Some insects follow the same type of lifecycle. They breed and lay their eggs in the vernal pools. Their aquatic larvae are fierce predators and quickly grow due to the abundance of prey in the vernal pool aquatic ecosystem. Eventually they undergo metamorphosis and emerge as terrestrial adults able to fly off to new habitats. But, some insects are actually great swimmers even in their adult stage. Look for diving beetles popping up to the surface to capture air under their wings before they dive again in search of prey.

The visitors to vernal pools consist mostly of migrating waterfowl and shorebirds. They come to feast on the abundant aquatic organisms. As the aquatic stage progresses into the waterlogged terrestrial stage, the birds visiting the pools also changes. During the aquatic stage, the pools are often visited by ducks and geese which feed on crustaceans and the submerged plants. As the pools begin to dry, egrets and herons come to feed on small frogs, snails and insects. The muddy banks of the vernal pools are great places to look for bird footprints.

Even during the drought stage, birds and animals continue to visit the vernal pools. They come to feed on the eggs, cysts and seeds left behind by last year's generation. When they come to do that, other animals come to feed upon them. Thus, vernal pools form a large and very complex food chain critical to the survival of many species.

VERNAL POOL PLANTS



Over 200 species of plants grow in vernal pools. Of those, half are rarely found outside this unique habitat. Plants that occur in vernal pools have several unique adaptations that allow them to survive the extremes of flood and

drought. Most vernal pool plants are annuals, living only during the short winter and spring seasons before setting seed and dying. These plants tend to be of small stature, but with relatively large flowers. Their goal is not to grow big and survive a long time – but instead to reproduce and make plenty of seeds for the next generation.



Having few leaves and very showy flowers is part of the vernal pool plants' strategy for producing seed for the next generation. While the concentric circles, ribbons and patches of pink, yellow, white, and blue blossoms are pleasing

to the human eye, their actual purpose is to attract the specialist bees that pollinate their flowers. Many vernal pool plants have evolved a unique co-dependent relationship with native, solitary, ground nesting bees. The bees use the pollen of the plants to feed their offspring and while collecting pollen they also pollinate the plants.

This special adaptation ensures that the plants produce lots of seeds and the bees also produce a new generation. One amazing aspect of this relationship between the vernal pool flowers and bees is that in drought years, when there are few flowers, the bees may stay underground and wait until a better year before emerging to collect pollen.

Another unique survival adaptation of vernal pool plants is their strategy for seed dispersal. Most don't even try to disperse their seeds! If you have evolved to live in a flooded area for most of your life, and require the drying down phase to stimulate flowering and seed production—why would you want to cast your seeds into unsuitable habitat? In fact, a number of vernal pool species actually plant their seeds at the base of the parent plant. This ensures that the seeds are in the best possible location to germinate, grow and reproduce next year.

