

**The Bushy Lake Ecosystem**  
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Those who walk along our iconic American River are used to watching the river flow downstream between forested riparian habitat. The bountiful life of this area includes meandering salmon, diving river otters, gliding dragonflies, and a great diversity of feeding birds. Nestled in a floodplain of the American River Parkway, closer to the levee by Cal Expo, you will find Bushy Lake, a manmade pond surrounded by riparian vegetation that includes cottonwood, willow, box elder,

walnut, and ash. Bushy Lake is better characterized as a pond. Ponds and lakes are examples of lentic ecosystems, standing waters in a basin or depression surrounded by land. Ponds tend to be smaller and shallower, and light is able to penetrate the bottom. Rooted vegetation is also more prevalent in ponds.

Cool wet winters and hot dry summers and falls characterize Mediterranean climate regions like California. Under these conditions, many ponds seasonally dry out, as does Bushy Lake, but groundwater pumped by Cal Expo supplies the pond's water during dryer seasons. A pond like Bushy Lake in the American River floodplain is a unique habitat that provides opportunities for wildlife viewing, enjoyment of the outdoors, and a serene oasis for reflection.



Satellite view of the floodplain.

### Why are ponds/lakes important?

Like many freshwater bodies, ponds are vital to human well-being and ecological function (Wilson & Carpenter 1999, Carpenter et al. 2011). Some of these benefits involve extraction from the pond, using it as a water supply or for food (fish) or fiber (plants). Other benefits do not include extraction. Ponds contribute to flood control, water quality maintenance, aesthetics, recreation, cultural and spiritual significance, wildlife viewing, and biodiversity. The presence of Bushy Lake in the American River Parkway and adjacent to Cal Expo make it a prime location for the appreciation of this region's bountiful natural history.

## What animals and plants can be found at Bushy Lake?

Ponds and lakes support an amazing diversity of organisms. Most of the life present at Bushy Lake is microscopic, including viruses, bacteria, fungi, rotifers, protozoans, and photosynthetic algae. These organisms decompose, absorb light for photosynthesis, and consume other organisms. This microbial world is incredibly diverse; in fact, a recent estimate (Locey & Lennon 2016) claims there are as many as 1 trillion bacteria species alone! These organisms have been evolving for billions of years and are crucial for all ecosystems, including Bushy Lake.



**Figure 1. Dragonfly nymphs can be found in Bushy Lake. This is the aquatic stage of their life cycle. As you can see, they come in many shapes and colors. These voracious predators will eat other aquatic insects (including mosquitos), frog tadpoles, and small fish.**

Moving up in size, many invertebrate species are found in and around Bushy Lake, including snails, crustaceans, and insects. Both crustaceans and insects are arthropods and common to all water bodies. You will find many species also found in the river, but because Bushy Lake does not have fish, you will likely find more insect species here since fish are their main predators.

Crustaceans are mostly aquatic and, therefore, you would expect to find many of these species in Bushy Lake. These include water fleas (Cladocera), amphipods (Amphipoda), copepods (Copepoda), and seed shrimp (Ostracoda). They feed on the algae, bacteria, protozoans, and other small animals. In fish-filled environments, these are the favorite meals, but they are otherwise plentiful here without fish.

Insects can be found underwater in Bushy Lake, flying above it, and in the soils. They're using it as their habitat or are temporarily here for hunting or mating. Some aquatic insects live in the pond only temporarily and have "complex life cycles." Insects with complex life cycles live part of their lives (as larvae) in the water and develop into adults that are terrestrial. Examples of insects with this life cycle

are mosquitos and dragonflies. Others spend most of their lives in the aquatic environment, including diving beetles (Dytiscidae), water boatmen (Corixidae), and backswimmers (Notonectidae).

*How did they get here?* There are two ways these organisms end up in an aquatic habitat, by active or passive dispersal. Active dispersers move from one location to another by flying. Some (with complex life cycles) fly to ponds to lay eggs. Most of the species falling into this category are insects. Passive dispersers, on the other hand, do

not have adaptations for movement and rely on wind, water, and larger animals for dispersal. Most of the passive dispersers are crustaceans.

The large vertebrates will tend to attract most of your attention on a visit to Bushy Lake. You may see turtles, river otters, or frogs. Along the banks of the lake, you may also see deer, coyotes, foxes, snakes, and lizards. The bird diversity is extensive and ever changing with the seasons. Resident species, such as red-shouldered hawks, kestrels, scrub jays, black phoebe, and northern flicker, mix with species traveling between Alaska and Mexico along the Great Pacific Flyway. In Bushy Lake, you will see ducks of different species, and along the edges, it is common to see turkey and quail. Keep in mind, many of these species would not be here without Bushy Lake!

Plant life here consists of a diversity of habitats and species. Pond vegetation includes floating plants, duckweed and water fern (Azolla), and rooted emergent vegetation, like cattails, along the perimeter of Bushy Lake. Along the edge, riparian vegetation rings the pond and includes ash, cottonwood, elderberry, and willow. This vegetation provides plentiful shade and living space for animals. Fallen leaves, branches and logs are found in the pond, and their decomposition contributes nutrients and energy to the Bushy Lake food web.

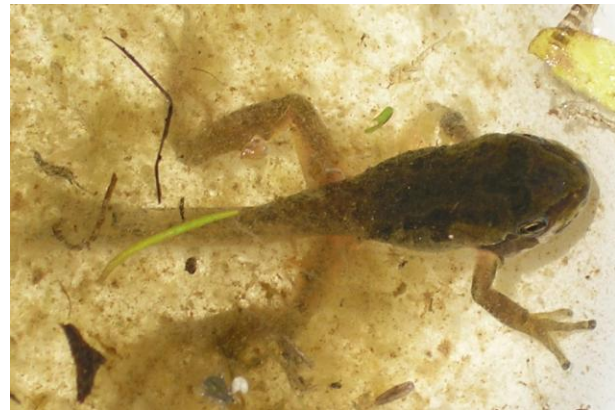


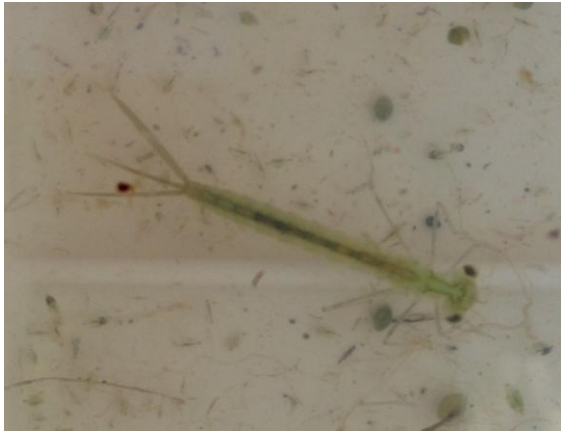
Figure 2. Frogs and tadpoles can be seen at Bushy Lake. Here is a tadpole transitioning to an adult frog. As tadpoles, they tend to eat algae and then consume insects as adults.

### What is a food web?

A food web represents the flow of energy (by way of feeding relationships) and the cycling of nutrients in an ecosystem. It consists of trophic levels, groups of organisms that share a common intake of energy or feeding behavior. For example, the herbivore trophic level includes all of the animals that consume plants. In Bushy Lake, the sources of energy come from photosynthesis by algae and plants.

Decomposition of surrounding vegetation that has dropped leaves and branches also contributes energy and nutrients to Bushy Lake, which the decomposers use. The energy moves to the next trophic level of invertebrates, including copepods, water fleas, and amphipods, which consume organisms at that microbial level. Grazers, including tadpoles and snails, and other herbivores, including water boatmen, also feed off algae and plants at the bottom trophic level.





**Figure 3. Damselfly nymph can be seen at Bushy Lake. This is the aquatic stage of their life cycle. Like dragonfly nymphs, they are voracious predators.**

Larger invertebrate predators make up the next trophic level feeding on the herbivores. These include dragonfly and damselfly larvae and nymphs, backswimmers, and predaceous diving beetles. Birds and other terrestrial animals also partake in consuming algae and plants, or larger invertebrates, of ponds.

This simple portrayal of the food web is not necessarily complete. Many species within trophic levels consume each other, and many species consume organisms at different trophic levels, called omnivores.

### **Human Impacts and Conservation**

Many disturbances befall these important ecosystems. Over-extraction of water clearly reduces the habitat for most organisms. Other disturbances, more subtle, can also have negative impacts.

Pollutants, including pesticides and herbicides, can directly affect animals and plants in pond ecosystems by reducing their numbers. This then affects the rest of the food web. Many toxins can be absorbed by organisms and held in their tissues to be passed on to animals that consume them. These toxins can accumulate in organisms and increase in concentration as it heads up the food web, a process known as biomagnification.

Another type of pollution is nutrient pollution, which occurs as the result of nutrient runoff from urban and agricultural areas. The accumulation of nutrients, primarily nitrogen and phosphorus, can occur in waterbodies in a process known as eutrophication. Excessive nutrients greatly increase the algae, causing an algae bloom, which blocks sunlight from reaching other plants. As algae die, bacteria begin to decompose it and increase in number. The large number of bacteria depletes oxygen in the pond and thereby deprives other organisms of that oxygen, which creates a “dead zone,” no longer able to support life. Eutrophication is one of the world’s greatest threats to water bodies because of the impact on plants, animals, and water quality.

There are many other issues that ponds face, including invasive species. Climate change has resulted in warmer temperatures and dryer conditions in the past few years: in 2014 and 2015 Bushy Lake dried up during the late summer and fall months before the rainy season. The contributions of scientific



**Figure 4. Giant water bug, sometimes known as toe biters, can be found at Bushy Lake. These are also voracious predators that consume other insects, snails, tadpoles, and fish.**

evaluation, biological monitoring, citizen science, and education will help with the assessment of these threats to Bushy Lake.

People worldwide tend to focus on large bodies of water, as we do in the Sacramento region. However, much recent research has shown that small bodies of water, like ponds, are equally important for ecosystem services, function, and biodiversity (DeMeester et al. 2005, Downing 2010). This underscores the importance of this ecosystem's contribution to the natural history of our Sacramento region.

A better understanding of these ecosystems can lead to identifying and offsetting human disturbances on these unique ecosystems. It has been suggested that their small size, high sensitivity to the environment, and great biodiversity and function make them excellent candidates as ecological sentinels. Your visit to Bushy Lake and appreciation for everything it has to offer—the views, the wildlife, and serenity—is a valuable step toward the education of students of our region's rich natural history.

### **References**

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