



U.S. GEOLOGICAL SURVEY and the NATIONAL PARK SERVICE - OUR VOLCANIC PUBLIC LANDS

# Inventory of Anchialine Pools in Hawai'i's National Parks



**Figure 1.** A large anchialine pool set back from the ocean along the Kona Coast: a place where fresh groundwater mixes with saltwater. (Photo © Greg Vaughn/www.GregVaughn.com)

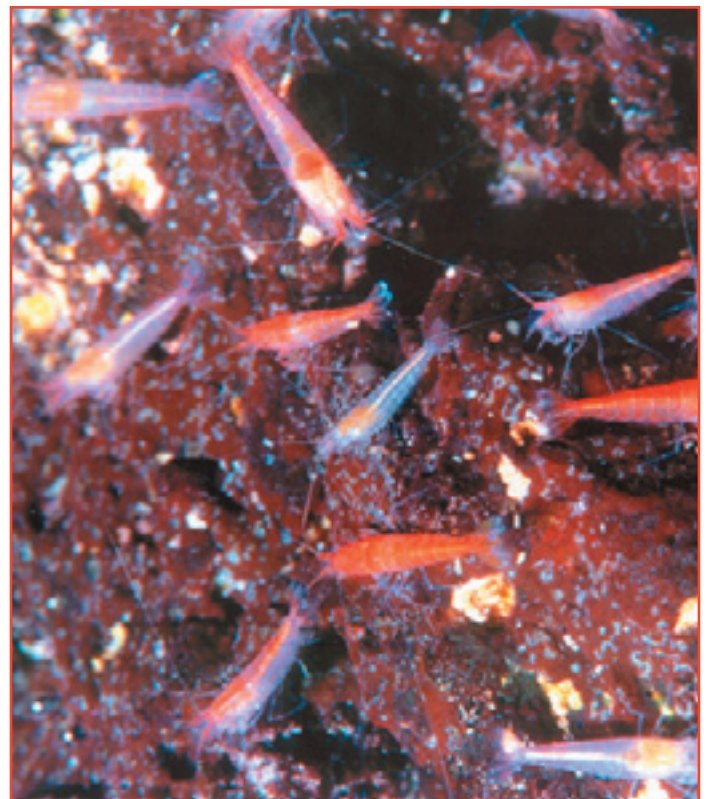
## Background

Anchialine (“near the sea”) pools are rare and localized brackish waters along coastal lava flows that exhibit tidal fluctuations without a surface connection with the ocean (Fig. 1). In Hawai‘i, these pools were frequently excavated or otherwise modified by Hawaiians to serve as sources of drinking water, baths and fish ponds. National Parks in Hawai‘i possess the full spectrum of pool types, from walled fish ponds to undisturbed pools in collapsed lava tubes, cracks and caves. Pools contain relatively rare and unique fauna threatened primarily by invasive species and habitat loss. In collaboration with the National Park Service’s Inventory and Monitoring Program, the U.S. Geological Survey’s Pacific Island Ecosystems Research Center undertook inventories of these unique ecosystems in two National Parks on the island of Hawai‘i: Hawai‘i Volcanoes National Park and Kaloko-Honokohau National Historical Park.

## Pools Harbor a Charismatic Fauna

Many endemic and native shrimp species occur in anchialine pools throughout the Hawaiian Islands, one of which is the small ‘ōpae‘ula (*Halocaridina rubra*; Fig. 2). ‘Ōpae‘ula naturally cover pool bottoms in a thick red carpet, feasting on pool algae. These shrimp can utilize underground cracks to travel between pools. They have few natural enemies, resulting in a high susceptibility to introduced predators such as fish and prawns. ‘Ōpae‘ula are typically skittish and scarce, or absent all together in pools containing exotic fish.

Like many other Hawaiian organisms, native shrimp species provide an interesting example of evolution by adaptive radiation. Among these species, some inhabit deeper areas of the pool, while some stay near surface waters. They also exploit different feeding strategies; while many feed on bacteria and algae, one species (*Metabetaeus lohena*; Fig. 3) has evolved to prey on other members of its evolutionary group, including ‘ōpae‘ula. Several of these unique species are candidates for endangered species status.



**Figure 2.** Tiny ‘ōpae‘ula cover the rocky bottom of an anchialine pond. (Photo © J.P. Hoover; used with permission)



**Figure 3.** A native predatory shrimp, *Metabetaeus lohena*.



**Figure 5.** USGS technician surveys for alien invertebrates with assistance from local high school students.

**Figure 4.** A mated pair of orange-black damselflies perch above a pool at Kaloko-Honokohau National Historical Park.



### Surveys Detect Endangered Damselflies

Another candidate endangered species found in anchialine pools is the orange-black damselfly (*Megalagrion xanthomelas*) or *pinao 'ula* (Fig. 4). These damselflies feed on both native and exotic flies, including mosquitoes, which breed in the pools. *Pinao 'ula* breed in both fresh and brackish pools along coastal areas, which are commonly threatened by development. Very few of these habitats are protected; in Hawai'i, only three National Historical Parks contain suitable breeding habitat for *pinao 'ula*, and all three parks are located on the west coast of Hawai'i Island.

### Threats to Anchialine Pools

In addition to habitat loss due to coastal development, anchialine pools are also threatened by invasive species (Fig. 5). Alien invertebrates, such as ants and spiders, pose a serious threat to anchialine pool biota. Ants are dominant predators within pool complexes, preying on native insects perched on poolside vegetation, and consuming native shrimp when pool waters recede during low tides. Invasive orb-weaver spiders construct webs across and around pools, catching native insects (Fig. 6). These spiders are extremely prolific around some pool complexes, and while impacts are not well documented, they are suspected to have significant impacts on native insect populations.



**Figure 6.** An invasive orb-weaver spider (*Argiope appensa*) with damselfly prey wrapped in its web at the edge of a pool.

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