Anchialine Pond Shrimps

Antecaridina lauensis
Calliasmata pholidota
ʻŌpae ʻula or *Halocaridina rubra*
Halocaridina palahemo
Metabetaeus lohena
Procaris hawaiana
Palaemonella burnsi
Vetericaris chaceoru

Metabetaeus lohena
Courtesy Karl Magnacca

SPECIES STATUS:
All Federally Listed as Candidates except *Halocaridina*
All State Listed as Candidates except *Halocaridina*
IUCN Red List - Not considered
All Endemic except *Antecaridina*, *Calliasmata*, *Metabeteus*

SPECIES INFORMATION: This group of species live in underground (hypogeal) environments and in anchialine ponds which have a mix of freshwater and seawater through underground connections to the sea. All of the species except *A. lauensis*, *C. pholidota*, and *M. lohena* are endemic to Hawaii. ʻŌpae ʻula reaches 1.5 centimeters (one-half inch) in length and is an herbivore that grazes on algal, bacterial, and diatom films growing on rocks and other hard substrates. They can also filter feed in mid-water and at the surface. The other species are all larger (up to five cm or two inches long) and some are predatory. *M. lohena* is a snapping shrimp and feeds on ʻōpae ʻula. *C. pholidota* feeds on crustaceans and polychaetes, while *P. hawaiana* has been seen feeding on shrimp. All have red color and reduced appendages. ʻŌpae ʻula carry about 12 fertilized eggs under their abdomen for a brood period of about 38 days. They reproduce one to two times per year. Lifespan of ʻōpae ʻula is long, up to 20 years in captivity. Less is known about the life history of the other species, but they are relatively long-lived for species in their taxa. *A. lauensis* and *M. lohena* can live six years. *C. pholidota* is blind. *A. lauensis,* ʻōpae ʻula and *M. lohena* occur in salinities of two to 36 ppt. The rarer species are all found in pools with higher salinities, usually above 15 ppt. All occur in water temperatures above 20° C. ʻŌpae ʻula also has an unusual amount of intraspecific variability that has been quantified from location to location suggesting the preserving genetic diversity may be an issue. Unpublished genetic analyses indicate *H. palahemo* and ʻōpae ʻula may not be separate species but part of a genetically diverse cryptic species complex.

DISTRIBUTION: Historic distribution includes 600 to 700 anchailine pools on Oʻahu, Maui, Molokaʻi, and the island of Hawaiʻi and an unknown underground distribution. Currently they

occur in fewer anchialine ponds on Maui and Hawai'i, and 'ōpae 'ula occurs in an artificially created anchialine pond on Kaho'olawe and natural and artificial habitats on O'ahu and Moloka'i. 'Ōpae 'ula has also been found in the ocean near a freshwater extrusion. Two of the species (*V. chaceorum* and *H. palahemo*) only occur in a single pool each (on Hawai'i). Only 'ōpae 'ula and *M. lohena* have a widespread distribution. The other four species occur in no more than four pools each. Six of these eight species can be found in both the Ahihi-Kina'u (Maui) and Manuka (Hawai'i) Natural Area Reserves (NARs). Some species occur in Wainapanapa Maui; the Waikoloa Anchialine Pond Preserve in North Kona, Hawai'i, the Ka Lae area near South Point Hawai'i on Department of Hawaiian Home Lands property, and in the Kaloko-Honokohau National Historic Park and Hawaii Volcanoes National Park, all on Hawai'i. 'Ōpae 'ula is known from Barbers Point, Flat Island, Waianae, and an aquaculture facility in Kahuku, all on O'ahu.

ABUNDANCE: Abundance of anchialine shrimps in the Waikolao area has been constant, except for increases in 'ōpae 'ula abundance since 1996. 'Ōpae 'ula is the most abundant anchialine shrimp species, and in good habitat, densities can be hundreds of individuals per square meter. Only a handful of *V. chaceorum* have ever been seen. *H. palahemo* has not been seen in recent surveys. Because many of the species occur in the interstitial crevices it is difficult to determine the full population size or even spatial extent of populations of these species and no quantitative abundance estimates exist. Overall populations may have declined because many pools have been filled or suffered from introduced fishes.

LOCATION AND CONDITION OF KEY HABITAT: Anchialine pond shrimp are found in underground (hypogeal) salt waters and in anchialine ponds, which are found in geologically young lava fields near the coast. The lava in these areas has fissures that connect the ponds to the ocean. Thus these ponds are always close to the sea and have varying salinity levels and tidal influence. Most ponds are less than 100 square meters (1000 square feet) in size and less than 1.5 meters (five feet) in depth. Anchialine pond shrimp are found in the water column and on the substrate of anchialine ponds as well as in the interstitial spaces that are part of the system linking the pond's water to oceanic influences. Many ponds have been filled or had non-native species introduced. One pond was created accidentally by a large bomb explosion on Kaho'olawe and subsequently colonized by 'ōpae 'ula through unknown mechanisms as the nearest anchialine ponds are at least ten kilometers (6 miles) away. Possibilities include transport by birds or an already existing underground population. Another pond was created for use in aquaculture industry and was colonized by 'ōpae 'ula that turn out to be of a unique genetic make-up, suggesting that the shrimps may have colonized from a previously unknown, but nearby underground source. Thus it is very unclear the extent to which anchialine ponds are necessary for the survival of 'ōpae 'ula. The ponds may be a source of increased primary productivity to the anchialine shrimp and associated community as the underground habitat is likely low in productivity without these connections.

THREATS:

- Habitat destruction has reduced available habitat for anchialine pond shrimps. On the island of Hawai'i much development has occurred in the major area for anchialine pools between Kawaihae and Kailua-Kona leading to the filling in of many pools. A monitoring system was set up at Waikaloa to assess the impacts of development there;

- A number of introduced species may compete with them for food or prey on them. Introduced fishes (Tilapia, koi, mosquitofish and guppies) and Tahitian prawns are a major predatory threat and alter the habitat use of remaining shrimp. Over 90 percent of the anchialine ponds in the Kona coast of Hawai'i are contaminated with non-native species. The presence of introduced fishes leads the shrimps to retreat into crevices in the substrate. As a result the ponds become overgrown with algae, leading to greatly accelerated debris accumulation and decay of the ponds, suggesting 'ōpae 'ula is a keystone species;
- Pollution of pools by refuse and human use of the water;
- Anchialine pools themselves may thus serve as conduits for pollutants and predatory impacts to the underground areas that may be the primary habitat of these species;
- Collectors taking 'ōpae 'ula to sell for aquarium use or fish feed threaten some ponds.

CONSERVATION ACTIONS: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. In addition to common state-wide and island conservation actions, specific actions include:

- Fencing the pools in 'Ahihi Kina'u NAR, and possibly elsewhere;
- Educating people to the value of, threats to and conservation actions to protect the ponds;
- Restoration of habitat by removal of introduced species;
- Creation of man-made pools should be explored;
- Maintain healthy populations with appropriate fishing regulations and education;
- Closure and rerouting of a portion of the road adjacent to 49 pools in Manuka NAR has been proposed.

MONITORING:

- Continue surveys of population and distribution in known and likely habitats;
- Develop quantitative survey methods.

RESEARCH PRIORITIES:

- Improve understanding of life history of anchialine pond shrimps including the importance of ponds vs. underground habitats to the existence and size of shrimp populations;
- Understand the ecological importance of interactions with introduced competitors and predators;
- Research the life history of introduced competitors and predators to develop removal or control strategies;
- Partner with the Environmental Protection Agency to develop acceptable alternatives to, or methods to use rotenone in removing introduced fishes.

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