U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Procaris hawaiana

Common Name:

Anchialine Pool Shrimp

Lead region:

Region 1 (Pacific Region)

Information current as of:

06/01/2013

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Hawaii, HI, Maui, HI
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Hawaii
- **US Counties**: Hawaii, HI, Maui, HI
- **Countries**: United States

Land Ownership:

The two Maui pool systems known to contain *Procaris hawaiana* occur on State land within the Ahihi-Kinau Natural Area Reserve (NAR). On the island of Hawaii, 12 pool systems occur on State land within the Manuka NAR and 1 pool occurs on State land, owned and managed by the Department of Hawaiian Home Lands (DHHL).

Lead Region Contact:

ARD-ECOL SVCS, Jesse D'Elia, 5032312349, jesse_delia@fws.gov

Lead Field Office Contact:

PACIFIC ISLANDS FISH AND WILDL OFC, Kristi Young, 503 231-6845, kristi_young@fws.gov

Biological Information

Species Description:

Procaris hawaiana (Holthuis 1973, pp. 12-19) ranges in total length from 10 to 30 millimeters (mm) (0.4 to1.2 inches (in)). This species has a pink to light-red pigmentation which is darkest along the midline with the dorsal thorax white to yellow. Black pigments are associated with the eyes. Conspicuous chelapeds (claws) are lacking. Locomotion is accomplished by swimming with the swimmerets (pareopods and uropods) and occurs just above the substrate to mid-water (Holthuis 1973, pp. 12-19).

Taxonomy:

Procaris hawaiana was described by Holthius in 1973. This species is recognized as a valid taxon in MacLauglin et al. (2005).

Habitat/Life History:

Procaris hawaiana is known to occur from mid-salinity (19 to 25 parts per thousandth (ppt)) anchialine pools. Anchialine pools are land-locked bodies of water that occur coastally but are not openly connected to the ocean (Macioleck 1983, pp. 607-612). They are mixohaline (or brackish), with salinities typically ranging from 2 ppt to concentrations just below that of sea water (32 ppt), although there are pools recorded as having salinities as high as 41 ppt (Maciolek 1983, pp. 607-612; Brock et al. 1987, p. 200). Anchialine pools are subject to tidal fluctuations. Except for some records of endemic eels, anchialine pools in Hawaii do not support native species of fish although some species of nonnative fish have been introduced and are currently recognized as problems (see Disease or Predation section below) (Bailey-Brock and Brock 1993, p. 354; Brock 2004, p. i). Little is known about the reproductive biology or the diet of this shrimp although it has been documented to scavenge other species of anchialine shrimp and has taken frozen brine shrimp (Holthuis 1973, pp. 12-19) when in captivity. The shrimp family Procarididae is represented by a small number of species globally and there are only two species within the genus *Procaris* (Holthuis 1973, pp. 12-19). The second species, *P. ascensionis*, is restricted to similar habitats on Ascension Island in the South Atlantic Ocean.

Historical Range/Distribution:

Although anchialine pools are widespread, being found in areas such as Saudi Arabia, Madagascar, Fiji, and other Indo-Pacific islands, the total area occupied by them globally is extremely small (Maciolek 1983, pp. 607-612). While a number of species of anchialine shrimp have disjunct, global distributions within these habitats, most geographic locations contain some endemic taxa (Maciolek 1983, pp. 607-612). *Procaris hawaiana* is one of these endemic taxa known only from the islands of Hawaii and Maui in the state of Hawaii.

Current Range Distribution:

Currently in the state of Hawaii, there are an estimated 650 anchialine pools, approximately 90 percent of which occur on the island of Hawaii (Brock 2004, p. i). Of the approximately 585 anchialine pools found on the island of Hawaii, only 25 are known to contain *Procaris hawaiiana*. During nocturnal/diurnal surveys

conducted from 2009-2010, 19 pools within the Manuka NAR were found to contain *P. hawaiana*. Five additional pools located on unencumbered state land adjacent to the coastal NAR boundary also contained *P. hawaiiana* (recorded in a total of 24 pools within the Manuka watershed) (Conry, in litt. 2012). There is also a single pool located at Lua o Palahemo, where *P. hawaiiana* co-occurs with another candidate anchialine pool shrimp species, *Vetericaris chaceorum* (Holthuis 1973, pp. 12-19; Maciolek 1983, pp. 607-614; Brock 2004, pp. 30-57). On Maui, *P. hawaiana* occurs in two pools at Ahihi-Kinau NAR (Holthuis 1973, pp. 12-19; Maciolek 1983, pp. 607-614; Brock 2004, pp. 30-57). Including the two pools located on the island of Maui, *P. hawaiiana* occurs within 27 distinct anchialine pools within the State of Hawaii.

Population Estimates/Status:

Like other anchialine pool shrimp species, this species inhabits an extensive network of water-filled interstitial spaces (cracks and crevices) leading to and from the actual pool, a trait which has precluded researchers from ascertaining accurate population size estimates (Holthuis 1973, p. 36; Maciolek 1983, pp. 613-616). Often, surveys for many rare species of anchialine pool shrimp, including *Procaris hawaiiana*, involve a present or absent survey approach in their respective habitat (often with the aid of baiting). Absence, and presumably extirpation, of shrimp species from suitable habitat is likely the best or only measure of species decline as population sizes are not easily determined (Holthuis 1973, pp. 7-12; Maciolek 1983, pp. 613-616).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

On the island of Hawaii it is estimated that up to 90 percent of the anchialine pools have been destroyed or altered by human activities (Brock 2004, p. i). The more recent human modifications of anchialine pools include the bulldozing and filling of pools (Bailey-Brock and Brock 1993, p. 354). Dumping of refuse and the introduction of nonnative fish (see Disease or Predation section below) have impacted other anchialine pools on this island (Brock 2004, pp. 13-17).

Brock (2004, pp. 13-17) identified the use of anchialine pools as dumping pits as an example of habitat degradation. Brock also noted that garbage like bottles and cans appear to have no negative impact, while the dumping of used oil, grease and oil filters has resulted in the disappearance of another species of anchialine pool shrimp, *Halaocaridina rubra*, from a pool adjacent to Honokohau Harbor on the island of Hawaii. Lua o Palahemo lies within lands administered by the States DHHL and is accessible to the public. Currently, there are no known plans for future use of these lands. In 2005, U.S. Fish and Wildlife Service (FWS) employees noted no evidence of dumping, though it had previously occurred there (Brock 2004, pp. 13-17).

The two Maui pools known to contain *Procaris hawaiana*, were modified for use as fish ponds by early Hawaiians and later inhabitants of the area but are within Ahihi-Kinau NAR. Dumping is known to occur in the Maui NAR, and while none has yet occurred within the pools, this threat remains a possibility (Brock 2004, pp. 13-17).

Trampling damage from use of anchialine pools for swimming and bathing has been documented in the Hawaiian Islands (Brock 2004, pp. 13-17). Similar impacts to the anchialine pools on the islands of Hawaii and Maui are possible but have not, at present, been documented.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

The FWS has become aware of companies and private collectors using anchialine pool shrimp and related shrimp species for commercial sales of self-contained aquariums similar to those marketed by Ecosphere

Associates, Inc. (Ecosphere Associates 2006, p. 1). One company located in Hawaii, Fuku Bonsai, has been using Hawaiian anchialine pool species for the aquarium hobby market for several years (Fuku-Bonsai 2007, p. 1). For commercial purposes, a Department of Land and Natural Resources-Division of Fish and Wildlife issued Native Invertebrate Research and Collecting permit is required to collect anchialine pool shrimp. All terrestrial and aquatic invertebrates (including anchialine pool shrimp) are protected under (1) the State of Hawaii Revised Statutes (1993) Chapter 195D-4-f License; and (2) DLNR Chapter 124 Indigenous Wildlife, Endangered and Threatened Wildlife, and Introduced Wild Birds (Conry, in litt. 2012). Collection is prohibited in State NARs but not in the State Parks or City and County property where some anchialine pools occur.

C. Disease or predation:

In Hawaii, predation by introduced nonnative fish is considered to be the greatest threat to native shrimp within anchialine pool ecosystems (Bailey-Brock and Brock 1993, p. 354; Brock 2004, pp. 13-17). Anchialine pools have been used to both discard and hold bait-fish and/or aquarium fish (Bailey-Brock and Brock 1993, p. 354). These fish either directly consume the native shrimp or, as with introduced tilapia fish (*Oreochromis mossambica*), outcompete the native herbivorous species of shrimp that typically serve as the prey-base for the rarer, predatory species of shrimp, thereby disrupting the natural and delicate ecological balance in these systems (Bailey-Brock and Brock 1993 p. 354). Introduction of nonnative fish including bait-fish into many of Hawaiis anchialine pool systems may have been a major contributor to the decline of the pools and the shrimp inhabiting them (Brock 2004 pp.13-17).

Invasion, with human assistance, of anchialine pools by nonnative fish is the most significant threat to anchialine pool shrimp and their habitat since the pools are easily accessible to the public. Within the State NARs, disturbance of the pools is prohibited and informative signs have been placed at the sites. At Lua o Palahemo a sign stating Lua o Palahemo site disturbance subject to fine HRS 6E and 16 USC 3701 has been placed at the single pool located there. However, signs may not be an adequate deterrent. For example, since 1985 signage was posted to warn people from entering the Waikoloa Anchialine Pond Preserve at Waikoloa, North Kona, Hawaii. Visitors were not allowed into the pool preserve but could walk around the perimeter. In December 2003, it was discovered that someone had released tilapia and mosquito fish into the system. Within six months following the introduction, nonnative fish had invaded two thirds of the system and all the anchialine pool shrimp disappeared (Brock 2004, pp. 13-17).

Nonnative fish species were not seen during the most recent survey of the Maui pools where *Procaris hawaiana* occur (Brock 2004, p. i). On the island of Hawaii, there was no evidence of nonnative fish in the pool at Lua o Palahemo during a site visit by FWS employees in 2005.

D. The inadequacy of existing regulatory mechanisms:

Procaris hawaiana currently receives no protection under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544). Although there are no existing regulatory mechanisms that specifically protect this species, 2 Maui pools and 12 Hawaii Island pools are located within the Ahihi-Kinau NAR and Manuka NAR, respectively. This designation specifically prohibits the removal of any native organism and the disturbance of pools (Administrative Rules, Sect. 13-209-4). The State NARs were created to preserve and protect samples of Hawaiian biological ecosystems and geological formations; and are actively managed and monitored for their unique ecosystems. Though signs are posted that provide notice to the public that the pools are off-limits to bathers and other activities that could damage the pools, the States NARs have no funding for proper enforcement to stop such activity.

E. Other natural or manmade factors affecting its continued existence:

Even if the threats responsible for the decline of this species were controlled, the persistence of existing populations is hampered by the small number of extant populations and the small geographic range of the

known populations. This circumstance makes the species more vulnerable to extinction due to a variety of natural processes. Small populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988; Center for Conservation Biology 1994). Small populations are also demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio (Lande 1988). In addition, large-scale water withdrawal from underground water sources may impact anchialine pools. This underground water withdrawal may increase salinity levels and negatively impact species that rely on the delicate balance of the mixohaline habitats (Conry, in litt. 2012).

Conservation Measures Planned or Implemented :

On Maui, *Procaris hawaiana* pools occur within the Ahihi-Kinau State NAR. Ahihi-Kinau was the first NAR to be established by the State of Hawaii, and in fact, the presence of the anchialine pools and their rare resident shrimp species was a key reason this area received this designation (Holthuis 1973, pp. 4-5). On the island of Hawaii, 19 pools occur within the Manuka NAR. This species receives some protection under the State statutes that specifically prohibit the disturbance or removal of any plant or wildlife and the disturbance of any pond or lake. Additionally, signs have been placed at the pool locations at Lua o Palahemo and Ahihi-Kinau State NAR prohibiting entry into and disturbance of the pools.

In August 2007, we jointly resurveyed Ahihi-Kinau State NAR with personnel from both the State NAR and DAR. We found no evidence of any non-native fish and found *P. hawaiana* in one of the pool groups in which it was previously known to occur.

On June 16, 2008, a symposium on anchialine pool conservation and management was held at the 89th annual meeting of the American Association for the Advancement of Science, Pacific Division. In addition, a statewide meeting concerning the monitoring of anchialine pools was hosted by the FWS on January 15, 2009. Results of that meeting include: an update on the status of monitoring efforts across the State; initiated development of a common monitoring protocol; the establishment of a listserv; and development of an anchialine pool symposium annually at the Hawaii Conservation Conference beginning in 2010.

In May 2010, FWS again jointly surveyed Ahihi-Kinau State NAR with personnel from both the State NAR and DAR. We found *P. hawaiiana* in its one known system there and no evidence of non-native fish in the pools we surveyed.

In July 2010, FWS jointly surveyed Lua O Palahemo with State NAR and DAR personnel. Permits were obtained from DHHL to access the property and multiple traps of different types were set within the pool. In addition, an underwater video camera was deployed. The water was extremely turbid and visibility was very poor. Between 3-6 meters (m) (9-18 feet (ft)) we encountered hard bottom throughout the pool. After extensive searching we were able to find an opening that allowed us to deploy several traps and our underwater video camera. With the video camera, we reached an approximate depth of 33 m (100 ft) before we hit hard bottom again. We collected one *P. hawaiiana* and captured five more on film. The underwater video also recorded large amounts of detritus throughout the depth of the pool. Water temperature was 28°C (82°F) and salinity 25 ppt.

In February 2011, FWS reviewed and commented on the National Park Services draft long term monitoring plan for anchialine pools within their boundaries on the island of Hawaii.

Summary of Threats :

Based on our evaluation of habitat degradation and loss due to bulldozing, the dumping of trash and fill in anchialine pools, and the effects of predation by nonnative fish, we conclude there is sufficient information to develop a proposed listing rule for this species due to the threat of habitat destruction or contamination by

dumping of trash and fill, and bulldozing, and the threat of the release of nonnative fish into any one of the known pools where *Procaris hawaiana* occurs. In addition, overcollection by the aquarium hobby market is a potential threat to the species. Collection of *P. hawaiana* is prohibited in the Ahihi-Kinau and Manuka NARs, but is not expressly prohibited at Lua o Palahemo. Disturbance of the pools is prohibited at both locations. However, enforcement of these prohibitions is difficult and the negative effects from the introduction of nonnative fish could still quickly and suddenly occur. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

- Monitor known pool habitats for evidence of trash dumping, presence of nonnative fish and other habitat changes, and take appropriate action if evidence indicates impacts to the pools
- Conduct ecological research on habitat requirements and basic life history of *Procaris hawaiana*
- Conduct research on the captive propagation of *P. hawaiana*

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	**5**
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

The threats to *Procaris hawaiana* from habitat degradation and destruction, and predation by nonnative fish are of high magnitude because this species occurs in only three pool systems on two islands. All individuals of this species within a pool may be adversely impacted by a single dumping of trash or release of nonnative fish into any of its three remaining population sites.

Imminence :

Threats to *Procaris hawaiana* from nonnative fish, the dumping of trash and fill, recreational activities, development and overcollection are nonimminent because they are not on-going. Nonnative fish are not currently present in the pools in which *P. hawaiana* currently occurs.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

Procaris hawaiana is currently known from three populations, two of which are located within the State's Ahihi-Kinau and Manuka NARs. State statutes may provide some protection to the species. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the species' total populations within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *P. hawaiana* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

Description of Monitoring:

We conducted literature searches for recent articles on this species and contacted relevant species experts. The U.S. Geological Survey-Biological Resource Discipline, State officials with the DLNR, and Bishop Museum, University of Hawaii, and Auburn University researchers were contacted regarding the current status of this species. No additional information on the species status was found over the past year.
This level of monitoring is appropriate to update the status of the species because a thorough literature search was conducted and relevant species experts were contacted. Information contained in this assessment form was verified by species experts.

List of Experts Contacted:

Thomas Iwai March29, 2011 DAR (Retired)
Annette Tagawa January 10, 2011 DAR
Scott Santos January 10, 2011 Auburn University
Matt Ramsey January 10, 2011 DOFAW
Anne Brasher January 10, 2011 USGS-BRD

The Hawaii Biodiversity and Mapping Program (HBMP) lists this species as critically imperiled (HBMP 2006). *Procaris hawaiana* is included in the list of species in Hawaiis 2005 Comprehensive Wildlife Conservation Strategy (Mitchell et al. 2005). In addition, in March 2007 the State of Hawaii initiated a separate strategic plan focusing exclusively on invertebrates. It is expected that *P. hawaiana* will be one of the species covered by the new plan (Mitchell et al. 2005).

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

none

Indicate which State(s) did not provide any information or comment:

Hawaii

State Coordination:

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. No additional information or comments on this species were received from the State.

Literature Cited:

Bailey-Brock, J.H., and R.E. Brock. 1993. Feeding, reproduction, and sense organs of the Hawaiian anchialine shrimp Halocaridina rubra (Atyidae). Pacific Science 47:338-355.

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Lande, R. 1988. Demographic models of the northern spotted owl (Strix occidentalis caurina). Oecologia 75:601-607.

Maciolek, J.A. 1983. Distribution and biology of Indo-pacific insular hypogeal shrimps. Bulletin of Marine Science 33:606-618.

MacLaughlin, P.A., D.K. Camp, M.V. Angel. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans. American Fisheries Society Special Publication 31. Bethesda MD, USA. 545 pp.

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Personal Communications and In Litteris

Conry, P.J. CNOR 2012, Response to request for comments on USFWS species assessment and listing priority assignment forms, April 9, 2012.

Gagne, B. Executive Secretary for the Hawaii Natural Area Reserves System Commission. Email regarding States response to candidate assessment forms, dated August 29, 2006.

FWS. 2005. Notes regarding site visit to Lua o Palahemo.

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  06/13/2013
Date

Concur:  10/28/2013
Date

Did not concur: _____ _____
Date

Director's Remarks: