

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

SCIENTIFIC NAME: *Metabetaeus lohena*

COMMON NAME: Anchialine pool shrimp

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: April 2010

STATUS/ACTION

Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status

New candidate

Continuing candidate

Non-petitioned

Petitioned - Date petition received: May 11, 2004

90-day positive - FR date:

12-month warranted but precluded - FR date: May 11, 2005

Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is 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 the 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.

Listing priority change

Former LP:

New LP:

Date when the species first became a Candidate (as currently defined): October 25, 1999

Candidate removal: Former LPN:

- ___ A – 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.
- ___ U – 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.
- ___ F – Range is no longer a U.S. territory.
- ___ I – Insufficient information exists on biological vulnerability and threats to support listing.
- ___ M – Taxon mistakenly included in past notice of review.
- ___ N – Taxon does not meet the Act’s definition of “species.”
- ___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Crustaceans; Family Alpheidae (snapping shrimp)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Maui, Hawaii, and Oahu.

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Maui, Hawaii, and Oahu.

LAND OWNERSHIP: On Maui and Hawaii, the pools are located on State owned lands in the State Natural Area Reserve System and on Federal lands managed by the National Park Service. On Oahu, pools are located on State lands owned by the State’s Division of Aquatic Resources (DAR) and Parks and Recreation Department, and on Federal lands managed by the U.S. Fish and Wildlife Service (Service).

LEAD REGION CONTACT: Linda Belluomini, (503) 231-6283, linda_belluomini@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish & Wildlife Office, Christa Russell (808) 792-9400, christa_russell@fws.gov

BIOLOGICAL INFORMATION

Species Description

Metabetaeus lohena grows up to 0.7 inches (18 millimeters) in length, and body coloration ranges from pale-pink to brilliant red. There is a conspicuous mandibular (mouthpart) spot (Banner and Banner 1960, p. 301). Its chelae (claws) are relatively large and conspicuous. Locomotion is accomplished by crawling along the substrate. Although it has been thought to feed on another anchialine pool shrimp *Halocaridina rubra* (Holthuis 1973, p. 36), close observation in captivity and in the field indicate that they are likely not primarily predators (Tom Iwai, Island Aquaculture & Aquaponics, pers.comm. 2010).

Taxonomy

Metabetaeus lohena was described by Banner and Banner (1960, pp. 299-303). This species is recognized as a valid taxon in Holthuis (1973).

Habitat/Life History

Metabetaeus lohena is known to occur in both low and high salinity anchialine pools on the Hawaiian islands of Maui and Hawaii, and possibly on Oahu. Anchialine pools are land-locked bodies of water that occur coastally but are not openly connected to the ocean. They are mixohaline, with salinities ranging from 2 parts per thousandth (ppt) to concentrations just below that of sea water (32 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 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).

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, p. 607). While a number of species of anchialine shrimp have disjunct, global distributions within these habitats, most geographic locations contain some endemic taxa (Maciolek 1983, p. 607). *Metabetaeus lohena* is one of these endemic taxa known only from the islands of Maui, Hawaii, and Oahu in the state of Hawaii. Historically, *M. lohena* has been reported from at least 61 anchialine pools on the islands of Maui, Hawaii, and Oahu (HBMP 2006).

Current Range/Distribution

During Brock's (2004, pp. 30-57) most recent survey of Ahihi-Kinohi'o Natural Area Reserve (NAR), located on the island of Maui, *Metabetaeus lohena* was observed in 9 pool groups. On the island of Hawaii, the State has been conducting surveys of Manuka NAR since 2008 and found *M. lohena* in 13 pools (T. Sakihara, DAR, *in litt.* 2010). In addition, *M. lohena* was found in one pool at Halape in Hawaii Volcanoes National Park (T. Jones, National Park Service, *in litt.* 2010). On the island of Oahu, *M. lohena* has been found in one pool in Waianae on State owned property, one pool at Malaekahana State Park, and, due to recent restoration efforts, this species now occurs in one pool at the Kalaeloa Unit of the Pearl Harbor National Wildlife Refuge .

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, and this trait has precluded researchers from obtaining more accurate population size estimates during surveys for the species (Holthuis 1973, p. 36; Maciolek 1983, pp. 613-616). Many of the rare species of anchialine shrimp, including *Metabetaeus lohena*, have merely been noted as present or absent from pools that have been surveyed (often with the aid of baiting). Loss of shrimp species from

suitable habitat is likely the best, or only, measure of species decline since 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 refuse receptacles as an example of habitat degradation. He also stated that refuse like bottles and cans appear not to have any short-term negative impact but 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.

The pools on Maui and Hawaii Island where this species occurs are within State Natural Reserve Areas (NARs) and a National Park. Dumping does occur in both NARs and while none has yet occurred within the pools, this threat remains a possibility (Brock 2004, pp. 13-17). In 2006, on the island of Oahu, Service employees documented dumping of trash and animal refuse in one of the pools occupied by this species. Clean up immediately followed and *Metabetaeus lohena* was subsequently seen in the pool (L. Wada, Service, pers. comm. 2006).

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 occupied by this species on the island of Hawaii and Maui are possible but have not, at present, been documented. The pools on Oahu are too small to be used for swimming or bathing.

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

The Service has become aware of companies and private collectors using anchialine pool shrimp and related shrimp species for self-contained aquariums similar to those marketed by Ecosphere Associates, Inc. (Ecosphere Associates 2006, p. 1). One company located in Hawaii, Fuku Bonsai, has already begun using Hawaiian anchialine pool species for the aquarium hobby market (Fuku-Bonsai 2007, p. 1). For commercial purposes, currently only a State Commercial Marine License is required to collect anchialine pool shrimp. Collection is prohibited in State NARs but not in the State Parks or City and County property.

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 discard or 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 (*Oreochromis mossambica*), out-compete the native herbivorous species of shrimp that typically serve as the prey-base for the rarer, predatory species of shrimp (Bailey-Brock and Brock 1993 p. 354). Introduction of nonnative fish including bait-fish into such pools may have been a major contributor to the decline of these shrimp (Brock 2004 pp.13-17).

Invasion, with human assistance, of anchialine pools by nonnative fish is a potential threat and is the most significant impact to pool shrimp and their habitat since all 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. However, signs may not be an adequate deterrent. For example, since 1985 signage was used to keep 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 time, alien fish had invaded two thirds of the system and all the anchialine pool shrimp disappeared (Brock 2004, pp. 13-17).

No alien fish species were seen during the most recent survey of the Maui and Hawaii island pools where these shrimp occur (Brock 2004, p. i). In 2006 there was no evidence of nonnative fish in either of the pools on the island of Oahu during site visits by Service employees (L. Wada, pers. comm. 2006).

D. The inadequacy of existing regulatory mechanisms.

Metabetaeus lohena 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, the pools located within the State NARs are protected by state statutes that prohibit the removal of any native organism and the disturbance of pools (Administrative Rules, Sec. 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. However, while 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 State's 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).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

On Maui and Hawaii island, the pool groups containing *Metabetaeus lohena* lie within the Ahihi-Kinau State NAR and the Manuka State NAR and Hawaii Volcanoes National Park, respectively.

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). 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. In addition, signs have been placed at the pool locations at both NARs forbidding disturbance of the pools.

In August 2007, we jointly resurveyed Ahihi-Kinau State NAR with the State DAR. We found no evidence of any non-native fish in the pools we surveyed and we found *Metabetaeus lohena* in all of the pool groups it was known from. We were scheduled to resurvey the Ahihi-Kinau State NAR at night during the high-high tide in July 2008 with the State DAR, however, due to State budget shortfalls the trip was cancelled. Our joint efforts with the State DAR to develop a statewide monitoring plan for anchialine pool shrimp, including *M. lohena*, also been put on hold.

On the island of Oahu, at the Pearl Harbor National Wildlife Refuge Kalaeloa Unit, pool restoration efforts are complete. Thirteen out of fourteen pools have been completely restored and another anchialine pool shrimp, *Halocaridina rubra* has recolonized all of the pools to date. In addition, *Metabetaeus lohena* has naturally recruited into one of the pools.

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 Service on January 15, 2009. Results of that meeting include an update on the status of monitoring efforts across the State, initiating development of a common monitoring protocol, and the establishment of a listserv.

SUMMARY OF THREATS

Based on our evaluation of habitat degradation and loss due to bulldozing, fill, and illegal trash dumping 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, fill, bulldozing, and the threat of the release of nonnative fish in any one of the known pools where *Metabetaeus lohena* occurs. In addition, overcollection by the aquarium hobby market is a potential threat to *Metabetaeus lohena*. Collection of the species is prohibited in both NARs, as well as disturbance of the pools. Enforcement of these prohibitions is difficult and the negative effects from the introduction of nonnative fish are extensive and happen quickly. Collection and disturbance are not prohibited at either site on Oahu. 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 pools for evidence of trash dumping, presence of nonnative fish and other habitat changes
- Conduct ecological research on habitat requirements and basic life history of *Metabetaeus lohena*
- Conduct research on the captive propagation of *M. lohena*

LISTING PRIORITY

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

Rationale for listing priority number:

Magnitude: The threats to *Metabetaeus lohena* from habitat degradation and destruction, and predation by nonnative fish are of high magnitude because this species occurs in only 26 pools across three islands. All individuals of this species within a pool may be adversely impacted by a single dumping of trash or release of nonnative fish in any of its remaining sites.

Immediacy of Threats: Threats to *Metabetaeus lohena* from nonnative fish, dumping, fill,

recreational activities, development and overcollection are non-imminent because they are not on-going. Nonnative fish are not currently present in the pools in which *Metabetaeus lohena* currently occurs.

Rationale for Change in Listing Priority Number (insert if appropriate)

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

Is Emergency Listing Warranted?

No. 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 *Metabetaeus lohena* 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 (BRD), State officials with the Department of Land and Natural Resources, 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 as well as relevant species experts contacted. Information contained in this assessment form was verified by species experts.

List of Experts Contacted:

Name	Date	Affiliation
Thomas Iwai	February 19, 2010	Division of Aquatic Resources (Retired)
Michael Yamamoto	February 19, 2010	Division of Aquatic Resources (Retired)
Annette Tagawa	February 19, 2010	Division of Aquatic Resources
Troy Sakihara	February 19, 2010	Division of Aquatic Resources
Dan Polhemus	February 19, 2010	Division of Aquatic Resources
Robert Nishimoto	February 19, 2010	Division of Aquatic Resources
Richard Brock	February 19, 2010	University of Hawaii
Scott Santos	February 19, 2010	Auburn University
David Foote	February 19, 2010	USGS-BRD
Sallie Beavers	February 19, 2010	National Park Service
Tahzay Jones	February 19, 2010	National Park Service

The Hawaii Biodiversity and Mapping Program (HBMP) lists this species as imperiled (HBMP 2006). *Metabetaeus lohena* is included in the list of species in Hawaii's 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 *Metabetaeus lohena* will be one of the species covered by the new plan (Mitchell *et al.* 2005).

COORDINATION WITH STATES

On February 11, 2010, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. No response was received.

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.
- Banner, A.H. and D.M. Banner. 1960. Contributions to the knowledge of the Alpheid shrimp of the Pacific Ocean; Part VII. On *Metabetaeus* Borradaile, with a new species from Hawaii. *Pacific Science* 14:299-303.
- Brock, R.E. 2004. Anchialine Resources in Two Hawaii State Natural Area Reserves: Ahihi Kinau, Maui Island and Manuka, Hawaii Island with Recommendations for Their Management. Prepared for the U.S. Fish and Wildlife Service by Environmental Assessment, LLC.
- Brock, R.E., J.E. Norris, D.A. Ziemann, and M.T. Lee. 1987. Characteristics of water quality in anchialine ponds of the Kona, Hawaii, coast. *Pacific Science* 41:200-208.
- Center for Conservation Biology 1994. Nectar, fecundity and conservation planning. Center for Conservation Biology Update, Vol. 8(1): 10 (summer).
- Ecosphere Associates. 2006. Ecosphere Associates Inc. The perfect balance of science and art. <http://eco-sphere.com>. Downloaded on 6 April 2007.
- Fuku-Bonsai. 2007. Fuku-Bonsai Inc. The amazing Hawaiian micro-lobsters. <http://fukubonsai.com>. Downloaded on 6 April 2007.
- Hawaii Biodiversity and Mapping Program. 2006. *Procaris hawaiiiana*. <http://hbmp.hawaii.edu/>. Downloaded on 9 April 2007.
- Holthuis, L.B. 1973. Caridean shrimps found in land-locked saltwater pools at four Indo-west Pacific localities (Sinai Peninsula, Funafuti Atoll, Maui and Hawaii Islands), with the

description of one new genus and four new species. *Zool. Verhadenlingen* 128:3-55.

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.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. *Hawaii's Comprehensive Wildlife Conservation Strategy*. Department of Land and Natural Resources. Honolulu, Hawaii. 722 pp.

Personal Communications and *in litt*.

Iwai, Tom. Owner, Island Aquaculture & Aquaponics. (Retired DAR) Phone conversation January 11, 2010.

Jones, Tahzay. Data Analyst, National Park Service. Email in response to request for information, dated March 26, 2010.

Sakihara Troy. Biologist, Division of Aquatic Resources. Email in response to request for information, dated March 29, 2010.

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:

Carolyn D. Bohan
Acting Regional Director, Region 1, Fish and Wildlife Service 5/18/10
Date

Rowan W. Gould
ACTING
Director, Fish and Wildlife Service October 22, 2010

Concur:

Do not concur: _____
Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review: April 14, 2010
Conducted by: Lorena Wada, Pacific Islands FWO
Biologist, Prelisting and Listing Program

Comments:
PIFWO Review

Reviewed by: Christa Russell Date: April 19, 2010
Prelisting and Listing Program Coordinator

Marilet Zablan Date: April 26, 2010
Assistant Field Supervisor, Endangered Species Division

Gina Shultz Date: April 30, 2010

Acting Field Supervisor