

Kauai Cave Amphipod
(*Spelaeorchestia koloana*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

5-YEAR REVIEW

Species reviewed: Kauai Cave Amphipod (*Spelaeorchestia koloana*)

I. GENERAL INFORMATION

A. Methodology used to complete the review

This review was conducted primarily by the U.S. Fish and Wildlife Service's (Service) lead biologist in the Pacific Islands Fish and Wildlife Office (PIFWO), and reviewed by the Recovery Program Leader and Assistant Field Supervisor, Endangered Species, before PIFWO submission to the Regional Office. Information collected during both the critical habitat designation and recovery planning processes served as the primary sources for this review, as well as monitoring data collected by the Service over the past 10 years.

B. Reviewers

Lead Region: Region 1

Lead Field Office: Pacific Islands Fish and Wildlife Office, Gina Shultz, Assistant Field Supervisor, Endangered Species.

C. Background

1. **Federal Register (FR) notice announcing initiation of this review:**
July 6, 2005. Endangered and Threatened Wildlife and Plants; Initiation of 5-year Reviews (of 33 species in Region 1). 70 FR 38972-38975.
2. **Species status:**
Stable (2006 Annual Recovery Data Call report).
3. **Recovery achieved:**
1, meaning 0 - 25 percent of the identified recovery objectives for the Kauai cave amphipod have been achieved, as reported in the 2006 Annual Recovery Data Call report.
4. **Listing history:**
Original Listing:
FR Notice: 65 FR 2348 Endangered and Threatened Wildlife and Plants; Final Rule to List Two Cave Animals from Kauai, Hawaii, as Endangered.
Date listed: January 14, 2000
Entity listed (*species, subspecies, DPS*): Species
Classification (*threatened or endangered*): Endangered

Revised Listing, if applicable
NA

5. **Associated actions:**
68 FR 17430 Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Kauai Cave Wolf Spider and Kauai Cave Amphipod; Final Rule; published on April 9, 2003.
6. **Review History:** February 9, 2005. Draft recovery plan development.
7. **Species' Recovery Priority Number at start of review:** 1, indicating this species has a high degree of threat and a high recovery potential.
8. **Recovery Plan or Outline:**
Name of plan: Recovery Plan for the Kauai Cave Arthropods: Kauai Cave Wolf Spider (*Adelocosa anops*) and Kauai Cave Amphipod (*Spelaeorchestia koloana*).
Date issued: July 19, 2006 (approved April 28, 2006)
Dates of previous revisions: NA

Some of the recovery actions identified in the plan are being implemented. Several willing landowners have worked cooperatively with us to install gates for three caves to prevent unauthorized access and one more gate over an additional cave is planned to be installed this year. These same landowners have allowed projects to restore, protect, and enhance overlying plant communities of five different caves. Monitoring for the presence/absence and numbers of animals encountered is also being conducted biannually.

II. REVIEW ANALYSIS

- A. **Application of the 1996 Distinct Population Segment (DPS) policy**
Not applicable, as the Kauai cave amphipod is not a vertebrate species and the DPS policy only applies to vertebrates.
- B. **Recovery Criteria**
 1. **Does the species have a final, approved recovery plan?**
 Yes
 No
 2. **Does the recovery plan contain recovery (i.e., downlisting or delisting) criteria?**
 Yes
 No
 3. **Adequacy of recovery criteria.**
 - a. **Do the recovery criteria reflect the best available (i.e., most up-to-date) information on the biology of the species and its habitat?**
 Yes
 No

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

 X *Yes*

 No

4. List of the recovery criteria as they appear in the recovery plan, noting which of the 5 listing factors* are met.

Downlisting to threatened status may be considered when nine populations, spread across the known range, are shown to be:

Self-sustaining populations (contain representatives of all generations, sexes, and age classes);

Stable or increasing (intrinsic growth rate (λ) is greater than or equal to 1) over a monitoring period of at least 10 consecutive years;

Protected from non-native, predatory species; human visitation of caves (dumping area, party site); bio-control agents; pesticides, development; or other damaging land uses such as quarrying, filling areas, rain water diversion due to surface areas being covered by asphalt or other artificial surfaces which lack or have only limited permeability (Listing Factors 1, 3, and 5); and

With the habitat being used in a fashion consistent with conservation (protecting cave habitat from future development, preventing disturbance to cave interiors via gating, and protecting and/or restoring the vegetation which lies over the cave) (Listing Factors 1 and 5).

These downlisting criteria have not been met as the Kauai cave amphipod is currently thought to occur as a resident population in only three caves.

Delisting may be considered when 12 populations, spread across the known range, are shown to meet the same 4 downlisting criteria described above.

Listing Factors 2 and 4 do not apply to this species.

*1) Present or threatened destruction, modification or curtailment of its habitat or range.
2) Overutilization for commercial, recreational, scientific, or educational purposes.
3) Disease or predation.
4) Inadequacy of existing regulatory mechanisms.
5) Other natural or manmade factors affecting its continued existence.

C. Updated Information and Current Species Status

1. Improved Analyses:

 Yes
 X No

2. Biology and Habitat:

a. **Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:**

The Kauai cave amphipod (*Spelaeorchestia koloana*) is an obligate cave-dwelling arthropod restricted to the Hawaiian island of Kauai. It has only been found in the Koloa Basin of the island of Kauai where lava tubes and other cave bearing rock are present. The Kauai cave amphipod has been regularly observed in 3 caves, their numbers typically ranging from 8 to 40, but greater than 300 individuals have been encountered in 1 of these caves, likely in response to periodic food enhancement conducted by research biologists (U.S. Fish and Wildlife Service, unpublished data 1996 through 2005). No population estimates currently exist for this arthropod. However, the Kauai cave amphipods have been found in caves scattered through the Koloa District which may indicate a larger population and/or populations. The existence of amphipods in geographically separate areas may make them less vulnerable to catastrophic events that might impact a single cave.

Nothing is known of the reproductive biology of this amphipod.

b. **Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding):**

There is no new information regarding the genetics of this species.

c. **Taxonomic classification or changes in nomenclature:**

There is no new information regarding the taxonomic classification or nomenclature of this species.

d. **Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range):**

There is no new information.

e. **Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):**

See discussion below under the five-factor analysis.

- f. **Other:**
NA

3. **Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):**

a. **Present or threatened destruction, modification, or curtailment of its habitat or range:**

Development in the Koloa District of Kauai (construction of roads, houses, golf courses, and a quarrying operation (Howarth 1981; Mueller-Dombois and Howarth 1981; Howarth and Stone 1993; KPMG Peat Marwick 1993; Burney *et al.* 2001)) poses a threat to rocky cave-containing areas located in substandard agriculture land. Many of the newer land uses do not rely on the presence of deep, well-developed soils and modern technologies allow the importation of soils into otherwise unsuitable sites.

These land uses continue to destroy cave and mesocavern habitats, isolating cave-dwelling arthropod populations through fragmentation of Kauai cave amphipod habitat. Intervening caves, subterranean cracks, and mesocaverns being destroyed or filled with soil may confine populations of cave-dwelling species to caves without climatic refugia (*e.g.*, cracks and mesocaverns with high relative humidity), increasing chances of local extinction during periods of prolonged drought. Smaller, isolated populations of Kauai cave amphipods will have a greater likelihood of extinction due to chance events, and their isolation means these areas will not be able to receive recruits from or provide colonists to adjacent cave systems.

Caves, subterranean cracks, and mesocaverns are periodically exposed to the surface environment during construction activities and this can result in the desiccation of cave habitat and provide access to alien species.

Urbanization typically results in large areas being covered by asphalt or other artificial surfaces that lack or have only limited permeability. Reduced local ground water recharge may greatly reduce humidity levels within caves, subterranean cracks, and mesocaverns, degrading or eliminating habitat for these species.

Human visitation to and uses of caves are recognized as being a serious threat (Culver 1986). Cave ecosystems are affected by the following activities: used as sites for dumping and filling; contaminated by surface sources of toxic chemicals from spills, pesticides, and waste disposal which enter caves via streams and/or ground-water seepage; and mining and quarrying. In addition, Polynesians utilized caves as burial sites and many of the caves in

the Koloa District show signs of this use (Hammatt and Tomonari Tuggle 1978; Hammatt *et al.* 1988), which often attract curiosity seekers (Howarth 1982, 1983; Culver 1986).

The narrow passages in many caves increase the chances that human visitors may inadvertently and unknowingly crush or injure ground-dwelling cave-inhabiting species or destroy food resources such as root systems, which are critical to most Hawaiian cave systems. Cave visitors may leave trash or toxic materials in caves, both of which can have devastating effects. Discarded food and trash can attract arthropods (*e.g.*, cockroaches) that can compete with the resident cave-dwelling animals, and elevated numbers of such scavengers may attract non-native predators (*e.g.*, centipedes, spiders) that may prey on the natural cave inhabitants. Discarded trash can attract social insects such as ants which have had a devastating impact in cave systems in Texas (U. S. Fish and Wildlife Service 1994) and have likely had similar impacts in Hawaii (Howarth 1985; Cole *et al.* 1992).

Nicotine, contained in cigarette smoke, is a powerful insecticide that can have devastating effects in the cave environment (Howarth 1982). Use of open fires in caves and cave openings may have massive, unseen impacts on cave-dwelling species both from the release of toxic fumes as well as from drying the cave interior, reducing relative humidity (Howarth 1982).

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

NA

c. Disease or predation:

We are currently unaware of any diseases affecting the Kauai cave amphipods. Non-native predators are known to feed on mainland cave-dwelling species (U.S. Fish and Wildlife Service 1994) and are assumed to compete with resident cave-dwelling animals for common food resources which are already in low supply. Howarth (1981) documented the replacement of an endemic cave-dwelling spider, *Erigone stygius*, by a non-native web-building cave-dwelling spider, *Nesticus magera*. There is good evidence to suggest that the Kauai cave amphipod is preyed upon by the non-native brown violin spider (*Loxosceles rufescens*; A. Asquith, *in litt.* 1994a, b; D. Hopper, *in litt.* 1999). Web-building spiders, such as the brown violin, may pose a particularly serious threat since webs present a method of predation to which the Kauai cave amphipod is likely not adapted (Howarth 1981). Lastly, the introduced lesser brown scorpion (*Isometrus maculatus*) and centipedes (*Scolopendra* spp.) have both been observed in some of the caves inhabited by the endemic cave-dwelling species and the

generalized diet of these predators would certainly include Kauai cave amphipods.

d. Inadequacy of existing regulatory mechanisms:

We are unaware of any threats the species face due to the inadequacy of existing regulatory mechanisms.

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

Runoff and recharge that contain urban and household pesticides may inadvertently deliver high concentrations of insecticides or other pesticides (*e.g.*, herbicides, fungicides) into cave and mesocavern habitats, with potentially devastating effects on the Kauai cave amphipod.

The presence of septic tanks and leaching fields associated with urban development in cave-bearing rock is likely of mixed benefit to the Kauai cave amphipod. Leaching fields would increase soil moisture levels and elevate the relative humidity within local caves, and could result in increased food import (*i.e.*, detritus). However, they are equally likely to be a source of toxic and caustic wastes in the form of household cleaners such as drain-cleaners, bleach, and other discarded chemicals.

Bio-control agents (living organisms used to control pests) may attack species other than their intended targets and have caused or contributed to the decline and extinction of several Hawaiian insects (Howarth 1983, 1991). Several entomopathogens (including nematodes, fungi, and bacteria) are available or are under development for use as biological pesticides. They are isolated from moist soil and would likely survive and do well in subterranean environments. The native Hawaiian cave fauna would be highly susceptible to this threat (Howarth 1991; Howarth *et al.* 2003). Should they become established, entomopathogens may also spread to new areas with suitable host arthropods, and become impossible to eliminate.

All of the caves may be threatened by prolonged drought, brought about either by global climatic changes or by local alteration of the vegetation that may reduce rainfall or otherwise result in reduced soil moisture content. Prolonged drought may desiccate the cave interior, making it less accommodating to cave-dwelling animals (Howarth 1983). As a result of reduced humidity, Dark and Stagnant Air Zones may become more prone to invasion by damaging, non-native species such as the brown violin spider.

Small populations are demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio and

to catastrophes such as hurricanes (Soulé 1983; Gilpin and Soulé 1986). In addition, the low reproductive potential of this cave species (less than 10 percent of its surface relatives) means that it requires more time and space to recover from a disturbance than would similar animals living on the surface (F. Howarth, *in litt.* 2001).

D. Synthesis

In the 6 years since the Kauai cave amphipod has been listed, information does not indicate that threats to the species have been alleviated to the level that the protections of the Endangered Species Act are no longer necessary. No new information has become available since development of the final recovery plan for the Kauai cave arthropods. The small numbers of this species and the continuing threats to their limited habitat indicate that the Kauai cave amphipod is still in danger of extinction and warrants the classification of endangered status.

III. RESULTS

A. Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change

B. New Recovery Priority Number: NA

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Funding is needed for surveys for additional occupied caves or restorable cave systems, equipment for maintaining consistent high humidity within the Dark Zone and for increasing relative humidity within Stagnant Air Zones, for restoring land above caves, and for additional monitoring of known caves.

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Kauai Cave Amphipod (*Spelaeorchestia koloana*)

Current Classification E

Recommendation resulting from the 5-Year Review

- Downlist to Threatened
 Uplist to Endangered
 Delist
 No change is needed

Appropriate Listing/Reclassification Priority Number N/A

Review Conducted By:

Gina Shultz, Assistant Field Supervisor for Endangered Species
Marilet A. Zablan, Recovery Program Leader
Lorena Wada, Fish and Wildlife Biologist

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date June 30, 2006
Patrick Leonard

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other field offices is required.

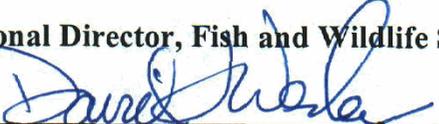
Cooperating Field Supervisor, Fish and Wildlife Service

Signature N/A Date _____ Concur _____ Do Not Concur _____

REGIONAL OFFICE APPROVAL:

The Regional Director must sign all 5-year reviews, unless the authority has been delegated by the Regional Director to the Assistant Regional Director of Ecological Services.

Lead Regional Director, Fish and Wildlife Service

Approve  Date 9/29/06
Acting

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.