# 5-YEAR REVIEW

Short Form Summary

**Species Reviewed**: Pe`e pe`e maka`ole or Kauai Cave Wolf Spider (*Adelocosa anops*)

**Current Classification**: Endangered

**Federal Register Notice announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2015. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 133 species in Hawaii, Oregon, Idaho, and Washington. Federal Register 80(30): 8100–8103.

**Lead Region/Field Office:**

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii

**Name of Reviewer(s):**

Adam Griesemer, Biologist, PIFWO
Megan Laut, Animal Recovery Coordinator, PIFWO
Greg Koob, Conservation and Restoration Team Manager, PIFWO

**Methodology used to complete this 5-year review:**

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (USFWS) beginning in January, 2016. The review was based on a review of current, available information since the last 5-year review for Pe`e pe`e maka`ole or Kauai Cave Wolf Spider, (*Adelocosa anops*) (USFWS 2006a). The evaluation by the Biologist was reviewed by the Animal Recovery Coordinator and Conservation and Restoration Team Manager.

**Background:**

For information regarding the species' listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species (*http://ecos.fws.gov/tess_public*).

**Review Analysis:**

Please refer to the previous 5-year review for Kauai Cave Wolf Spider (*Adelocosa anops*) published in the Federal Register on September 29, 2006 (USFWS 2006a, available at *https://ecos.fws.gov/docs/five_year_review/doc786.pdf*) for a complete review of the species' status, threats, and management efforts. No significant new information regarding the species' biological status have come to light since listing to warrant a change in the Federal listing status of the Kauai cave wolf spider.

This obligate cave-dwelling arthropod in the wolf spider Lycosidae family is endangered and endemic to the island of Kauai. The current status and trends for the Kauai cave wolf spider are provided in Table 1 below.

New Status Information:

In addition to those populations cited in the previous 5-year review, new observations include the following:

- Individual spiders were observed for the first time in Cave 3075C (USFWS, unpublished data 2006 through 2016). Juvenile spiders were found in the cave in 2006, 2007, 2013, and 2015. Adult spiders were observed in the cave in 2007 and 2013. A population of the Kauai cave wolf spider was not detected in this cave until air blocks were installed to increase humidity in the cave as part of a cave preservation management plan in cooperation with Kukuiula Development Company (Hawaii), LLC. In 2006, when critical habitat was designated for this species, two of the four caves had verified occurrences of the Kauai cave wolf spider. These recent observations increase the number of caves with verified occurrences from two to three in critical habitat unit number 2.

New Management Actions:

- Cave climate manipulation - Air blocks to increase humidity were installed in four caves (Cave 3179, Cave 1927C, Cave 3075B, and Cave 3075C within critical habitat unit #2) as part of a cave preservation management plan in cooperation with Kukuiula Development Company (Hawaii), LLC. The air-blocks are constructed of metal, plastic sheeting, and foam (as an edge insulator) each with a plastic sheet entrance that can be lifted for human passage (W. Kishida, pers.comm.). The air blocks are temporary, requiring regular maintenance for the structures to last over longer periods. Installation of the air blocks was an important step in testing equipment to determine if manipulation of the cave climate can be used to improve habitat for endangered cave arthropods, including the Kauai cave wolf spider and the Kauai Cave Amphipod (*Spelaeorchestia koloana*) (under recovery priority 3, action 3.6; USFWS 2006b).
- Habitat and natural process management and restoration – Out-planting of native plants and irrigation to enhance habitat at the above four caves under the above cave preservation management plan as well as at Kiahuna Mauka Cave (in cooperation with Kiahuna Golf Course) was carried out to enhance habitat (W. Kishida, unpublished data). This work was an effort toward planting and maintaining surface vegetation that provides root systems for endangered cave arthropods which is a food resource (under recovery priority 2, action number 2.1; USFWS 2006b) and helps maintain a consistent high humidity environment (under recovery priority 1, action 2.2; USFWS 2006b).
- Surveys / monitoring – Surveys, ranging from monthly to annually, have been conducted at Koloa Cave 1 and 2, Cave 1927C, Cave 3179, Cave 3075B and Cave 3017C (within critical habitat unit #2), Kiahuna Mauka Cave, and the Quarry Cave from 2006 to 2009 and 2013 to 2016 (USFWS, unpublished data 2006 through 2016). This monitoring was primarily carried out to assess population trends in caves and assess recovery actions (under recovery priority 1, action 3.1; USFWS 2006b). It also provided valuable information to determine if manipulation of cave climate can be used to improve habitat (under recovery priority 3, action 3.6; USFWS 2006b). Surveys have not been conducted in the Kiahuna Makai Cave since 2004, when the new landowner denied permission to the Service to monitor the cave due to liability concerns.
- Protect caves from unauthorized human entry – Maintenance (e.g., painting, replacing locks) of the locking gates at Koloa Cave 1 and 2, Kiahuna Mauka Cave, and Quarry Cave (under recovery priority 1, action 1.1; USFWS 2006b).

**Synthesis:**
Surveys conducted since completion of the last 5-year review for this species reconfirm that the Kauai cave wolf spider is only known to be regularly observed in a single cave system. In this cave, referred to here as Koloa Cave 2, up to 41 individuals have been found in one survey (USFWS, unpublished data 2006 through 2016). Both sub-adult and adult spiders are regularly observed and females with egg sacs are occasionally seen. These observations suggest this cave and the surrounding cave-bearing rock contains a healthy breeding population of Kauai cave wolf spiders. In an adjacent Koloa Cave 1, about 260 to 390 feet away, adult cave wolf spiders are occasionally present (USFWS, unpublished data 1996-2016). This is likely due to the drier conditions of the latter cave. Koloa Caves 1 and 2 are lava tubes that parallel one another and which are likely connected by small mesocaverns inaccessible to humans.

A small, but persistent population of Kauai cave wolf spiders is known to be present in a third cave, the Kiahuna Mauka Cave. One to four individuals were observed per visit during the monitoring period, 2006-2016. Prior to 2006, there was an absence of spiders, in this case during the 1999 through 2003 surveys, which may be in response to a noticeable decrease in humidity levels within the cave. The above ground restoration at this cave (out-planting of native plants and irrigation) has contributed to increasing plant roots in the cave (USFWS, unpublished data 2006 through 2016). Although no measurements of humidity have been recorded in this cave, it is likely that the restoration has affected the climate in the cave and increased the humidity. The reappearance of the Kauai cave wolf spiders in this cave suggests the ability of these spiders to recolonize caves when conditions become suitable.

Predation by non-native species appears to be seriously impacting the Kauai cave wolf spider in at least three of the caves where these spiders have not been detected during the survey period, 2006-2016. In Cave 3075B and Cave 3179, the web-building brown violin spider (*Loxosceles rufescens*) has been observed, including up to 6 violin spiders observed in one survey at Cave 3075B in February 2007. Wolf spiders are not adapted to web-building predators such as the violin spider (Howarth 1981). The non-native lesser brown scorpion (*Isometrus maculatus*), whose generalized diet may include wolf spiders, has also been found in cave 3179. Further, cane toads (*Bufo marinus*) that are known to feed on mainland cave-dwelling species (USFWS 1994) continue to be observed in Cave 1927C.

The observation of Kauai cave wolf spiders in Cave 3075C for the first time is likely a direct result of the air blocks installed near the entrance of the cave. The restriction of the air flow from the entrance into the cave resulted in an increase in relative humidity and a significant decrease in the potential evaporation rate (W. Kishida, unpublished data). This work conducted as part of the cave preservation management plan, in cooperation with Kukuiula Development Company (Hawaii), LLC, has proven the use of air blocks as a short-term management tool to enhance cave habitat for the Kauai cave wolf spider.

**Recommendations for Future Actions:**

- Above ground plant restoration – Out-planting of native plants to provide roots and irrigate surface. Control established ecosystem-altering non-native invasive plant species around all caves.
- Control non-native predator species around entrance and outside of caves.

- Enhance habitat by sealing currently non-occupied caves with temporary air blocks – Increase relative humidity by restricting air flow through cave entrances.
- Design permanent air blocks (e.g., walls) and develop plans to replace temporary air blocks.

**Table 1. Status and trends of *Adelocosa anops* from listing through current 5-year review**.

| Date | No. wild individuals | No. Released | Downlisting Criteria identified in Recovery Plan | Downlisting Criteria Completed? |
|---|---|---|---|---|
| 2000 (listing) | Unknown | NA | Nine self-sustaining, stable or increasing populations over 10-year period | No |
| | | | All threats to nine populations are controlled | Partially |
| | | | Habitat associated with nine populations is conserved | No |
| 2003 (critical habitat) | Unknown | NA | Nine self-sustaining, stable or increasing populations over 10-year period | No |
| | | | All threats to nine populations are controlled | Partially |
| | | | Habitat associated with nine populations is conserved | Partially |
| 2006 (Recovery plan & 5-year review) | Unknown | NA | Nine self-sustaining, stable or increasing populations over 10-year period | No |
| | | | All threats to nine populations are controlled | Partially |
| | | | Habitat associated with nine populations is conserved | Partially |
| 2016 (5-year review) | Unknown | NA | Nine self-sustaining, stable or increasing populations over 10-year period | No |
| | | | All threats to nine populations are controlled | Partially |
| | | | Habitat associated with nine populations is conserved | Partially |

**Table 2. Threats to *Adelocosa anops* and ongoing conservation efforts**.

| Threat | Listing factor | Current Status | Conservation/ Management Efforts |
|---|---|---|---|
| Agricultural and urban development loss or degradation of habitat | A | Ongoing | Partial – continued cave preservation management through partnerships with private landowners; |
| Climate change loss or degradation of habitat – prolonged drought | A | Ongoing | None |
| Invasive plant species degradation of habitat | A | Ongoing | Partial - continued maintenance of above ground native plant restoration at the Quarry Cave and Kiahuna Mauka Cave in partnership private landowners |
| Predation by non-native species | C | Ongoing | Partial - monitor occurrence of predators in caves |
| Human visitation to and use of caves | A, E | Ongoing | Partial - maintain locking gate at Koloa Cave 1 and 2, Kiahuna Mauka Cave, and Quarry Cave |
| Bio-control agents – living organisms used to control pests | A | Ongoing | None |
| Environmental contamination – runoff and recharge containing pesticides | E | Ongoing | None |
| Stochastic events—Reduced numbers due to flooding | E | Ongoing | None |

**References:**

See previous 5-year review for a full list of references (USFWS 2006). Only references for new information are provided below.


Howarth, F.G. 1981. Community structure and nice differentiation in Hawaiian lava tubes. Pages 318-336 in D. Mueller-Dombois, K.W. Bridges, and H.L. Carson (editors), Island ecosystems: biological organization in selected Hawaiian communities. Hutchinson Ross Publishing Company, Stroudsburg, Pennsylvania.

[USFWS] U.S. Fish and Wildlife Service. 1994. Recovery plan for endangered karst invertebrates (Travis and Williamson Counties, Texas). U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 162 pages.

[USFWS] 2006a. Kauai Cave Wolf Spider *(Adelocosa anops)* 5-year review: summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[USFWS] 2006b. Recovery Plan for the Kauai Cave Arthropods: the Kauai Cave Wolf Spider *(Adelocosa anops)* and the Kauai Cave Amphipod (*Spelaeorchestia koloana*). U.S. Fish and Wildlife Service. Portland, Oregon. 64 pp.

**U.S. FISH AND WILDLIFE SERVICE**
SIGNATURE PAGE for 5-YEAR REVIEW of Pe`e pe`e maka`ole or
Kauai Cave Wolf Spider (*Adelocosa anops*)

**Current Classification** Endangered

**Recommendation resulting from the 5-year review**:

| | |
|---|---|
| _____ | Delisting |
| _____ | Reclassify from Endangered to Threatened status |
| _____ | Reclassify from Threatened to Endangered status |
| X | No Change in listing status |

**Field Supervisor, Pacific Islands Fish and Wildlife Office**

_____ Date 9/5/17