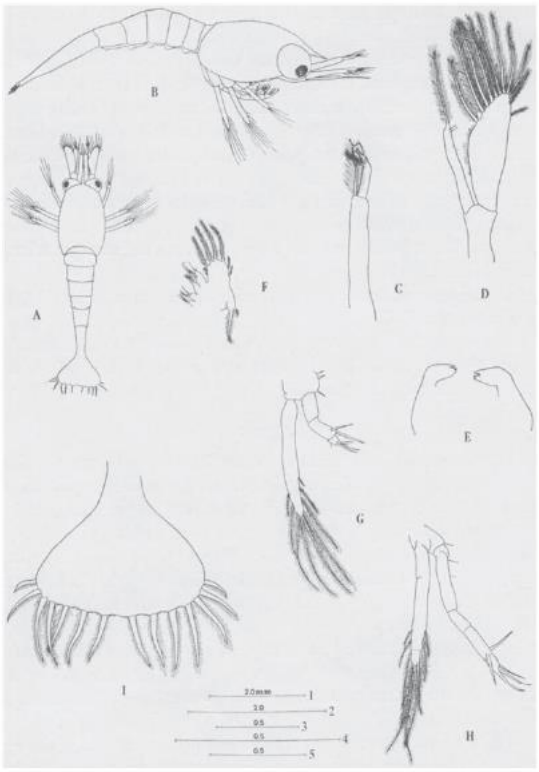
Squirrel Chimney Cave Shrimp
(*Palaemonetes cummingi*)

5-Year Review:
Summary and Evaluation



Source: Dobkin (1971) Crustaceana, Vol. 20, No. 3, p. 288.

U.S. Fish and Wildlife Service
Southeast Region
Jacksonville Ecological Services Field Office
Jacksonville, Florida

5-YEAR REVIEW
Squirrel Chimney Cave Shrimp/*Palaemonetes cummingi*

I. GENERAL INFORMATION

A. Methodology used to complete the review: The U.S. Fish and Wildlife Service's North Florida Ecological Services Office completed this review of the Squirrel Chimney cave shrimp (*Palaemonetes cummingi*) (SCCS). All literature and documents used for this review are on file at the Jacksonville Field Office and are cited in the References section. We used published literature; technical reports; data and information on the Internet; unpublished data; and personal communications with biologists and researchers. Public notice of this review was given in the Federal Register on September 23, 2014, with a 60-day public comment period (79 FR 56821). No public comments were received for this review. None of this review was contracted to outside parties. The draft of this document was distributed for peer review (see Appendix A) and comments received were addressed.

B. Reviewers

Lead Region - Southeast Region: Kelly Bibb, 404-679-7132

Lead Field Office - Jacksonville, FL, Ecological Services: Bill Brooks, 904-731-3136

C. Background

1. FR Notice citation announcing initiation of this review: 79 FR 56821; September 23, 2014

2. Species status: Unknown. The last surveys of the Squirrel Chimney were conducted between 1994 and 1996. Surveys of nearby cave systems were also conducted in 1995 and 1996. There are no more than a dozen collections of the SCCS recorded since its discovery in 1953 and the most recent documentation was in 1973. The Squirrel Chimney is a sinkhole in Alachua County, Florida. It is in private ownership and maintained as an oak hammock and pine plantation. The area immediately surrounding the Squirrel Chimney is pasture, agriculture and planted pine plantation. With its close proximity to the City of Gainesville and Interstate 75, planned neighborhoods are to the east of the Squirrel Chimney and there are also a series of industrial mineral extraction pit mines located 3 miles to the west of Squirrel Chimney.

3. Recovery achieved: 1 (0-25% recovery objectives achieved)

4. Listing history:
Original listing

FR notice: 55 FR 25588
Date listed: June 21, 1990
Entity listed: species
Classification: Threatened

5. Associated rulemakings: None

6. Review history:

A 1991 5-year review for SCCS was noticed on November 6, l991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors as they pertained to the individual species. The notice summarily listed the species and stated that no changes in the designation of any of the species were warranted at that time. In particular, no changes were proposed for the status of the SCCS in that review.

A *Federal Register* notice (63 FR 67618) of a 90-day finding on a petition to delist the species was published on December 8, 1998. The Service found that the petition did not present substantial scientific or commercial information indicating that delisting this species due to extinction may be warranted.

The 2007 5-year review was noticed April 26, 2007 (72 FR 20866) and was completed June 28, 2008. In this review, we determined that no change was required to the threatened classification for the SCCS.

Each year the Service reviews and updates listed species information to conform the required Recovery Report to Congress. Through 2013, we did recovery data calls that included showing recommendations describing the status as "Unknown" for this shrimp. We continue to show that species status recommendation in 5-year reviews, including the most recent one in 2015.

7. Species' Recovery Priority Number at start of review (48 FR 43098): 5c (the 5 indicates a high degree of threat and low recovery potential; the "c" reflects a high degree of conflict).

8. Recovery Plan or Outline

Recovery Plan: Exempted. On August 4, 1993, the Jacksonville Field Office determined that a recovery plan for the SCCS would not further the conservation of the species for the following reason: This species is only known from the Squirrel Chimney, a small sinkhole near Gainesville, Alachua County, Florida; and the site is privately owned. Preparation of a recovery plan would not further the conservation of the species.

Recovery Outline: On March 3, 2004, the Jacksonville Field Office drafted a Recovery Outline for the SCCS species file.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population of a species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is an invertebrate, and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? No. SCCS was exempted from developing a recovery plan.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends, demographic features, or demographic trends: The SCCS was discovered in 1953 and described in 1954 (Chace 1954). It measures about 30 millimeters (1.2 inches) in total length and is transparent. The body and eyes are unpigmented and the eyes are reduced in size in comparison to surface dwelling species of Polaemonetes. The rostrum is long and serrated and the first and second pairs of legs are of nearly equal length. This species is only known from the Squirrel Chimney near Gainesville, Alachua County, and is the only cave shrimp in Florida. *Walsh (2001) notes that nearly one third of the endemic stygobitic fauna found in Florida karst habitat are only known from one cave system.*

No more than a dozen collections of the SCCS have been made since its discovery in 1953; its last observation was in 1973 (Franz 1982). The most recent status surveys were conducted between 1994 and 1996 (Doonan 2001). The Squirrel Chimney was surveyed eight times. Potentially occupied sites including nearby Cherry Pits Cave, Herzog Cave and Hog Sink were each surveyed twice; and Bat Cave was surveyed once. No SCCS or evidence (e.g., shed exoskeletons) were collected or observed during these surveys. Other potentially occupied sites were identified but were not surveyed because either the land owner would not allow access, sites had become degraded and ephemeral, or sites could not be located (Doonan 2001). There have been no surveys of Squirrel Chimney in recent years. Opportunistic surveys of nearby cave systems have not documented the presence or evidence of SCCS (Paul

Moler, Florida Fish and Wildlife Conservation Commission-retired, personal communication, 2007).

Based upon the aforementioned findings from the 1994-1996 surveys, no documentation of SCCS in recent years, and the discovery of a predatory fish species within the Squirrel Chimney, the redeye chub (*Notropis harperi*, a small predatory fish) (Morris and Butt 1992), *the Florida Game and Freshwater Fish Commission, one of the predecessors to* the Florida Fish and Wildlife Conservation Commission, petitioned the Service in 1997 to reconsider the federal listing of the SCCS due to its potential extinction. The Service found that the petition did not present substantial information indicating that delisting this species due to extinction was warranted. The Service based its finding on the inadequacy of the existing information. The status surveys did not include a number of sink and cave systems within 5 miles that were ecologically similar to the Squirrel Chimney. These sinks and caves are all part of the Newberry Limestone Plain and characteristic of the karst (limestone) topography of this area and are likely interconnected through underground features (Williams et al. 1997, Doonan 2001). Such passageways may provide shelter and travel corridors for dispersal of the SCCS (USFWS 1998).

b. Genetics, genetic variation, or trends in genetic variation: No information is available regarding SCCS genetics.

c. Taxonomic classification or changes in nomenclature: The Integrated Taxonomic Information System (2016) was checked while conducting this review. There are no proposed changes in the taxonomic classification or in nomenclature.

d. Spatial distribution, trends in spatial distribution or historic range: The SCCS is only known from the Squirrel Chimney. This small, deep sinkhole leads to a flooded cave system formed within the Crystal River Formation of the Ocala Group limestone. This formation underlies the Newberry Limestone Plain and is characteristic of karst topography. This relatively flat karst plain has numerous sinks and caves and connections between underground features do occur. Caves in this area support a variety of terrestrial and aquatic habitats (Franz 1994b). Several of the sink and cave systems within 5 miles are ecologically similar to Squirrel Chimney. There are similar assemblages of cavern dwelling species in these nearby underground sites, but no SCCS have been documented. The discovery of the redeye chub (a small predatory fish capable of eating crustaceans the size of SCCS larvae) within the Squirrel Chimney system (Morris and Butt 1992) and its presence at other nearby underground sites indicate that fissures found at Squirrel Chimney may represent underwater connections to these other sites (Doonan 2001). The presence of the redeye chub may be one factor responsible for the apparent absence of the SCCS from the Squirrel Chimney system. However, this same

evidence suggests that passageways to nearby cave systems could shelter SCCS and provide for their dispersal. As noted above *in* ***a. Abundance, population trends, demographic features, or demographic trend*** *Walsh (2001) indicates that nearly one third of the endemic stygobite (aquatic) fauna of Florida karst habitat are only known from one cave system and two thirds of the taxa are reported from 10 or less localized aquatic caves, which indicate connectivity between sites.*

e. Habitat ecosystem conditions: The entrance to the Squirrel Chimney cave system is a steep to vertical sloped sink that leads to a shaft that is 3-6 ft wide and extends 14 m down to the water surface in the main cave (Doonan 2001). It is a typical vertical solution tube or shaft and thus referred to as a "chimney." The main cave is approximately 22 m wide and 34 m long with 15 m of water at the deepest point. Below the water's surface are bedding plane tunnels, ledges, a debris cone and an opening to an air chamber. Morris and Butt (1994) and Doonan (2001) provide a complete description of the Squirrel Chimney cave system. During the 1995 surveys of Squirrel Chimney, Doonan (2001) found that the water temperature remained constant at approximately 20^{o} C; the water level was stable at approximately the same level recorded in 1992; and that the water chemistry/quality was good (met Florida standards for drinking water; and was similar to samples collected in 1992). As described above, the Squirrel Chimney and other nearby cave systems support a variety of rare cave dwelling terrestrial and aquatic wildlife.

The Squirrel Chimney remains in private ownership and continues to be maintained as an oak hammock and pine plantation. The landscape immediately surrounding Squirrel Chimney appears to be stable and remains as a rural mixed-use area of pasture, agriculture and planted pine plantation. However, with its close proximity to the City of Gainesville and Interstate 75, the landscape appears to be changing with planned neighborhood developments increasing to the east of Squirrel Chimney. There are also several industrial mineral extraction pit mines within 3 miles. Other than an apparent drop in water levels between the 1970 surveys and 1990 surveys (Franz 1994a), there were no indications of any significant change in the physical environment at Squirrel Chimney (Doonan 2001).

Florida Wildlife Action Plan (2012) indicates that Florida's aquatic caves are in poor and declining condition. The plan ranks the threats to aquatic cave habitat as medium with the following as threats: habitat destruction or conversion; habitat degradation/disturbance; altered species composition/dominance, altered hydrologic regime; keystone species missing or lacking in abundance; erosion/sedimentation; altered water quality or surface water or aquifer: contaminants; and altered community structure. Recommended conservation actions for aquatic caves are intended to prevent harm to cave and other ecosystems influenced by groundwater by developing numeric nutrient criteria specific to cave systems and to prevent physical

destruction or degradation of cave habitat from recreational activities (e.g., diving) and through upgrading or retrofitting cave entrances and infrastructure for access (Florida Wildlife Action Plan 2012).

2. Five-Factor Analysis

a. Present or threatened destruction, modification, or curtailment of its habitat or range: The SCCS listing rule noted that potential residential development and changes in land use were the primary threats. As this species is known from only Squirrel Chimney, a small sinkhole that leads to a flooded cave system, any detrimental change to the sinkhole or the underlying aquifer has the potential to adversely affect or cause the extinction of the species. These factors continue as the primary threats to the SCCS.

b. Overutilization for commercial, recreational, scientific, or educational purposes: The SCCS listing rule stated that this species is known from one site that could be seriously damaged by a single act of vandalism. This is still a threat today; however, we have included it under Factor E below. The population size of the SCCS is unknown but is likely very small and vulnerable to impacts from scientific or other collecting.

c. Disease or predation: The 1990 listing noted that disease and predation were not known to be affecting the SCCS. However, Morris and Butt (1992) documented the presence of a new endemic fish species within the Squirrel Chimney, the redeye chub, a small predatory fish capable of eating crustaceans the size of SCCS larvae. In the 1997 petition to delist the SCCS due to extinction, the presence of the redeye chub was identified as a plausible explanation for the apparent absence and possible extinction of the SCCS from Squirrel Chimney. Therefore, predation has been identified as a threat since listing.

d. Inadequacy of existing regulatory mechanisms: The listing rule noted that no existing regulatory mechanisms apply to the SCCS. Since there is no information on the SCCS's sensitivity to common pollutants, Federal water quality laws (e.g., Clean Water Act) and those laws administered by the State, may or may not be protective of the SCCS, especially since limitations and monitoring of groundwater are not common regulatory practices.

The SCCS is listed by the State of Florida as a threatened species. Florida State Law (Chapter 68A-27.004, Florida Administrative Code) prohibits taking of individuals of state-listed threatened species, or parts thereof, except as authorized; however, the statute does not prohibit destruction or modification of habitat occupied by threatened species. Because the SCCS is listed by the State of Florida, these protective regulations apply to this species on State properties and private properties.

e. Other natural or manmade factors affecting its continued existence: The listing rule noted that other natural or manmade factors were not known to be affecting the SCCS at the time of listing. However, natural droughts, as well as water withdrawals for human use, can impact cave water levels. *Predicted increases in drought frequency, intensity, and duration could be a threat. Prolonged drought conditions could impact water levels and chemistry. Water in aquatic caves is generally high in mineral content depending on the source. Species like the SCCS may have adapted to specific water chemistry endemic to that aquatic cave system. Changes in land use in the recharge area can accelerate pollutant delivery to the aquifer system associated with the Squirrel Chimney system.* Other potential threats include contaminant spills in the recharge area. Also, a single act of vandalism could seriously damage the only known site of occurrence.

D. Synthesis

The Squirrel Chimney cave shrimp, Florida's only cave shrimp, is known from one location, the Squirrel Chimney near Gainesville, Alachua County. There are no more than 12 records of this species dating from its discovery in 1953 to and its last collection in 1973. The last status survey of the Squirrel Chimney and several nearby cave systems (1994-1996) did not document the SCCS or find evidence of the SCCS. A 1992 survey documented the presence of a new fish species within the Squirrel Chimney, the redeye chub. This fish is a small predator capable of eating crustaceans the size of SCCS larvae and may explain the apparent absence of the SCCS from the Squirrel Chimney. In 1997, the Service was petitioned to reconsider the federal listing of the SCCS due to its potential extinction. The Service found that the petition did not present substantial information indicating that delisting this species due to extinction was warranted. The Service based its finding on the inadequacy of the existing information, as the status surveys did not include a number of sink and cave systems within 5 miles that are ecologically similar to the Squirrel Chimney. These sinks and caves are all characteristic of the karst topography of this area and are likely interconnected through underground features. These features likely provided the travel corridors that allowed the redeye chub to establish a population within the Squirrel Chimney. Such passageways could also provide shelter and travel corridors for dispersal of the SCCS (USFWS 1998).

The current status of the SCCS *remains* unknown. Until a survey of the Squirrel Chimney and all nearby ecologically similar cave systems is conducted, we will not know if the SCCS still occurs within this system of connected caves and underground passageways. Therefore, the Service recommends that the SCCS remain classified as threatened until such a survey can be conducted and its status reevaluated.

III. RESULTS

A. Recommended Classification: No change.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Work with private landowners regarding the protection and conservation of the Squirrel Chimney and other nearby ecologically similar caves and sink systems.

Acquire or obtain a conservation easement on Squirrel Chimney and other nearby ecologically similar caves and sink systems.

Conduct a survey to determine the status of the SCCS.

Evaluate and consider establishing a captive breeding program for the SCCS as a recovery tool if deemed appropriate after the recommended survey.

Monitor groundwater quality and water levels of Squirrel Chimney and other nearby ecologically similar caves and sink systems.

Determine the origin (age, source and recharge area) of the Squirrel Chimney and other nearby ecologically similar caves and sink systems.

Use existing regulatory mechanisms to protect the SCCS and its groundwater habitat.

Develop and distribute educational and technical information materials essential for cave, sink, and recharge area stewardship.

Evaluate potential use of eDNA to detect the presence of SCCS at the Squirrel Chimney and other nearby similar caves. Environmental DNA (eDNA) is a surveillance tool used to monitor for the genetic presence of an aquatic species.

Provide best management practices for the conservation of aquatic caves and the species dependent upon them to public and private land owners. Provide assistance, funding and conservation easements to landowners who participate. Per Walsh (2001), all counties with aquatic caves should be targeted with a priority on Alachua (47 caves), Suwannee (43), Jackson (34) and Marion (27) (Walsh 2001).

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of
Squirrel Chimney Cave Shrimp (*Palaemonetes cummingi*)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review: No change

Review Conducted By: Bill Brooks, Jacksonville Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Jay B. Herrington
Field Supervisor, NFESO Date 7/28/2016

APPENDIX A

Summary of peer review for the 5-year review of the Squirrel Chimney Cave Shrimp (*Palaemonetes cummingi*)

A. Peer Review Method: See B. below.

B. Peer Review Charge: On June 9, 2016, emails were sent to Dr. Terry Doonan (Florida Fish and Wildlife Conservation Commission), Dr. Kevin Enge (Florida Fish and Wildlife Conservation Commission, and Dr. Stephen J. Walsh (U.S. Geological Survey). They were asked if there was any new information since 2008 Review in regards to the SCCS and updating the current status.

C. Summary of Peer Review Comments/Report

A summary of email comments is provided below. The complete set of emails is available at the Jacksonville Ecological Services Field Office, U.S. Fish and Wildlife Service,

Dr. Terry Doonan, Florida Fish and Wildlife Conservation Commission: Dr. Doonan indicated the 2008 review covered the SCCS conservation work he had been involved with over 20 years ago and was not aware of any new information. Dr. Doonan checked with Jeanne-Marie Havrylkoff, the FWC Fish and Aquatic Invertebrate Conservation Coordinator, and she also responded that there was no additional information to provide for the review.

Dr. Kevin Enge, Florida Fish and Wildlife Conservation Commission: Dr. Enge was not aware of new information. He contacted Dr. Paul Moler (FWC retired) and Jonathan Mays (FWC) and neither responded with any new information.

Dr. Stephen J. Walsh, U.S. Geological Survey: Dr. Walsh provided a reference about Florida's Cave Species that was published in 2001 and was not included in the 2008 review suggesting it to be included as part Reference section. Dr. Walsh indicated that there was no new information that he was aware of. He also queried another colleague, John Morris (Karst Services) but did not provide any new information for consideration.

D. Response to Peer Review – The Service added a 2001 reference that was not included in the previous review and added a sentence to the biological background information per this reference (see 1.a. on page 3, and the bottom of page 4). Overall, the past reviewers agreed that there is no new information, nor has there been recent contact with the land owners by either the FWC or USFWS private lands conservation programs.