Santa Fe Cave Crayfish

Procambarus erythops

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Species Overview

Status: Listed as state Threatened on Florida's Endangered and Threatened Species List.

Current Protections

- 68A-27.003(a), F.A.C. No person shall take, possess, or sell any of the endangered or threatened species included in this subsection, or parts thereof or their nests or eggs except as allowed by specific federal or state permit or authorization.
- 68A-27.001(4), F.A.C. Take – to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. The term "harm" in the definition of take means an act which actually kills or injures fish or wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. The term "harass" in the definition of take means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering.
- Florida Statutes XLVI, Chapter 810.13 (b), defines cave life as any life form indigenous to a cave or cave ecosystem. 810.13(3) It is unlawful to remove, kill, harm, or otherwise disturb any naturally occurring organism within a cave, except for safety or health reasons. The provisions of this subsection do not prohibit minimal disturbance or removal of organisms for scientific inquiry.
- Florida Statutes XLVI, Chapter 810.13 (4), Pollution and Littering. —It is unlawful to store in a cave any chemical or other material which may be detrimental or hazardous to the cave, to the mineral deposits therein, to the cave life therein, to the waters of the state, or to persons using such cave for any purposes. It is also unlawful to dump, litter, dispose of, or otherwise place any refuse, garbage, dead animal, sewage, trash, or other similar waste materials in a cave. This subsection shall not apply to activity which is regulated pursuant to s. 373.106, regarding the intentional introduction of water into an underground formation, or chapter 377, regarding the injection of fluids into subsurface formations in connection with oil or gas operations.

Biological Background

This section describes the biological background for this species and provides context for the following sections. It focuses on the habitats that support essential behaviors for the Santa Fe cave crayfish, threats faced by the species, and what constitutes significant disruption of essential behaviors.

The Santa Fe cave crayfish was first described in 1975 and many specimens have a red pigment spot in the eye, accounting for a common name attributed to this species, the red-eyed crayfish. It is also known as the Sims Sink crayfish in reference to the type locality designated by Relyea and Sutton (1975). The Santa Fe cave crayfish is a medium-sized (body length to 9 cm [3.5 in]) species that has an unpigmented body and reduced eyes, each of which has a reddish or brown pigment spot (Franz 1982, 1994; P. Moler, FWC, personal communication). A great deal remains to be learned about the natural history and extent of distribution of this crayfish. A determination of how closely known sites are connected through the aquifer will provide information about the species' vulnerability, genetic variation, and population size.

It can be challenging to ascertain a species' presence or absence, and it may be impossible to directly assess population size. The study of these crayfish depends on the few karst "windows" (sinkholes and caves) that can be accessed by researchers, so a complete picture of their life history is difficult to piece together. With regard to food habits, Santa Fe cave crayfish appear to behave similarly to surface crayfish, by feeding on whatever organic matter is readily available. Streever (1996) reported crayfish in Sims Sink feeding on detritus, nuts, insects, fungi, and leaves and described crayfish consuming 75% of a mouse carcass in less than 1 hour. Within large flooded sinkholes with little or no water flow, such as Sims Sink, Santa Fe cave crayfish are typically seen occupying the "debris cones" beneath the sinkhole opening (Franz 1994). In Sims Sink, this species has been found in association with 2 other troglobitic crustaceans, the spider cave crayfish (*Troglocambarus maclanei*) and Hobb's cave amphipod (*Crangonyx hobbsi)*, which are both species that have been petitioned for federal listing.

Habitat Features that Support Essential Behavioral Patterns

The Santa Fe cave crayfish is found in a very small portion of North Central Florida and only in flooded sinkholes and caves in Suwannee and Colombia Counties (Franz 1994, Franz et al. 1994, NatureServe 2010; T. Morris, Karst Environmental Services, Inc., personal communication). In the type locality, Sims Sink, the water temperature is approximately 21°C (69°F) throughout the year, with water depths ranging down to 12.5 m (41 ft), and no discernible water flow (Streever 1996). Specific associations of water quality characteristics and the presence of Santa Fe cave crayfish have not been reported.

Sims Sink, where Santa Fe cave crayfish are often found. A wooden platform partially covers the sink. Photograph by Paul Moler.

Proactive partnerships with public and private landowners and land managers will be critical to ensure that the few sensitive karst features known to harbor Santa Fe cave crayfish remain suitable and as undisturbed as possible.

Threats

The key to the long-term survival of the Santa Fe cave crayfish is the protection of the aquifer and the karst features that are exposed to land-borne threats. It is presumed that this species is dependent on groundwater of adequate quantity and quality, and that it requires a relatively predictable source of food. Potential threats include changes in hydrology and in the input of detritus and other organic material to the subterranean ecosystem (Franz 1982, Franz 1994, NatureServe 2010). Primary threats to this species include changes in water quality and quantity, point source and non-point source pollution, groundwater extraction, and mining.

Due to the limited range of the crayfish and the limited number of sites, it is critical that FWC staff continue working to develop site-specific management plans, working one on one with landowners to safeguard sites and minimize changes to the uplands surrounding the sinks.

Potential to Significantly Impair Essential Behavioral Patterns

Since this species is only found in a limited geographic range and within a single watershed (Santa Fe River

watershed), the potential area where incidental take could occur is limited. While pollution and littering directly into caves is prohibited by Florida Statute, Chapter 810.13(4), other forms of input such as excess organic matter, runoff from surrounding uplands, or non-point sources of pollution that move into the caves or surrounding karst may cause take of this crayfish and other cave life. Two of the sites/caves are publicly owned but may still be impacted by upland contamination and other sites that are privately owned may be subject to dumping or contamination.

Distribution and Survey Methodology

The range map (right) represents the principal geographic range of the Santa Fe cave crayfish, including intervening areas of unoccupied habitat. This map is for informational purposes only and not for regulatory use.

Counties: Colombia, Gilchrist, Lafayette and Suwannee.

Recommended Survey Methodology

Surveys are not recommended to determine if Santa Fe cave crayfish are present in an area. Surveys are not required, and due to the limited range and difficulty detecting this species, they may not be helpful in project planning. Surveys that collect, handle or remove crayfish from the water require a scientific collecting permit. Historically, this species has been observed in wells, captured using hand operated bottle traps, or observed by divers in caves. The FWC continues to work with partners to develop more standardized monitoring techniques and to reduce risk to divers conducting surveys in subterranean environments. If Santa Fe cave crayfish are found on site, FWC coordination is needed.

Recommended Conservation Practices

Recommendations are general measures that could benefit the species but are not required. No FWC permit is required to conduct these activities.

- Secure sinks or caves containing Santa Fe cave crayfish using fencing and/or signage to prevent vandalism, dumping, or damage to cave life.
- Avoid causing changes that would degrade aquatic habitats inhabited by Santa Fe cave crayfish. Minimize activities that degrade water quality in waterways inhabited by crayfish. Guidelines for minimizing erosion and runoff can be found in the State of Florida Best Management Practices (BMPs) for stormwater runoff and within the Florida Department of Agriculture Consumer Services (FDACS) silviculture BMPs.
- Avoid activities that would artificially remove excess water from the aquifer, especially during times

of drought.

- Install siltation fencing or hay bales to divert erosion from foot traffic or activities near sinks.
- Minimize contaminants from machinery operating near sinkholes and caves containing Santa Fe cave crayfish.
- Avoid application of herbicides or pesticides within 61 m (200 ft) of sinkholes or caves containing Santa Fe cave crayfish (U.S. Fish and Wildlife Service [USFWS 2001]).
- Locate specific stormwater management areas to provide a zone of treatment for potential inputs into potentially occupied karst systems.
- Establish management buffers similar to those recommended by USFWS (2001). The Natural Resources Conservation Service (NRCS) and Florida Department of Agricultural and Consumer Services (NRCS 2012, FDACS 2008) describe a riparian forest buffer as "a multipurpose practice designed to accomplish one or more of the following:
  - Provide a source of debris necessary for healthy robust populations of aquatic organisms and wildlife.
  - Act as a buffer to filter out sediment, organic material, fertilizer, pesticides, and other pollutants that may adversely impact the water body, including shallow groundwater."

Measures to Avoid Take

Avoidance Measures that Eliminate the Need for FWC Take Permitting

This section describes all measures that would avoid the need for an applicant to apply for an FWC take permit.

- Avoid activities that diminish water flow, or degrade water quality (i.e., siltation) in sinks or caves inhabited by Santa Fe cave crayfish.
- Avoid activities that degrade riparian zones. A 61 m (200 ft) buffer on both sides of Outstanding Florida Waters, like the Santa Fe River Basin, is sufficient to avoid degradation (FDACS 2008, Florida Department of Environmental Protection [DEP] 2011).
- Bridge/culvert work that follows standard road construction BMPs and does not have impacts to sinks or caves in the range of the Santa Fe cave crayfish.

Examples of Activities Not Expected to Cause Take

This list is not an exhaustive list of exempt actions. Please contact the FWC if you are concerned that you could potentially cause take.

- Activities that occur in watersheds or on lands not adjacent to Santa Fe cave crayfish habitat.
- Silvicultural or agricultural activities that follow the agricultural BMPs for streamside management zones (SMZ) in the Santa Fe River basin.

Florida Forestry Wildlife BMPs and Florida Agricultural Wildlife BMPs

- Agriculture, as defined in Section 570.02, F.S., conducted in accordance with Chapter 5I-8, F.A.C., and the wildlife best management practices (BMPs) adopted in Rule 5I-8.001 and 5M-18.001, F.A.C., by the Department of Agriculture and Consumer Service pursuant to Section 570.94, F.S., is authorized and does not require a permit authorizing incidental take despite any other provision of Rule 68A-27.007 or 68A-27.005, F.A.C.
- Participation in the Florida Forestry Wildlife BMP's and Florida Agricultural Wildlife BMP's program and implementation of these BMP's provides a presumption of compliance for incidental take of the Santa Fe cave crayfish.
- Florida Department of Agriculture Consumer Services Florida Forestry Wildlife Best Management Practices apply to this species through the application of Streamside Management Zones.

Other authorizations for Take

- As described in Rule 68A-27.007(2)(c), F.A.C., land management activities (e.g., wetland restoration, prescribed fire, mechanical removal of invasive species, and herbicide application) that benefit wildlife and are not inconsistent with FWC Management Plans are authorized and do not require a permit authorizing incidental take.
- Emergency water management actions for human health and safety, such as flood control.

Coordination with Other State and Federal Agencies

The Santa Fe cave crayfish is an example of a species dependent on the integrity of the aquifer and the karst windows that expose it to aboveground habitats. Ensuring the long-term survival of the crayfish will require communication and coordination with the multiple entities at the state, local, and private level. These are entities that can help regulate, ameliorate, or avoid potential threats, and whose responsibilities, policies, and actions directly or indirectly impact the Santa Fe cave crayfish and its subterranean habitat. The DEP coordinates the development and implementation of basin management action plans (BMAPs) to assess, monitor, and improve the water quality of water bodies in the basin that are considered "impaired" by pollution (DEP 2010). A BMAP prepared for Santa Fe River (DEP 2012) addresses water quality issues for some drainages in or near the range of the Santa Fe cave crayfish.

The FWC participates in other state and federal regulatory programs as a reviewing agency. During review, FWC identifies and recommends measures to address fish and wildlife resources to be incorporated into other agencies' regulatory processes. FWC provides recommendations for addressing potential impacts to state listed species in permits issued by other agencies. If permits issued by other agencies adequately address all requirements for issuing a State-Threatened species take permit, the FWC will consider these regulatory processes to fulfill the requirements of Chapter 68A-27, F.A.C., with a minimal application process. This may be accomplished by issuing a concurrent take permit from the FWC, by a memorandum of understanding with the cooperating agency, or by a programmatic permit issued to another agency. These permits would be issued based on the understanding that implementation of project commitments will satisfy the requirements of Rule 68A-27.007, F.A.C.

Review of Land and Water Conversion projects with State-Listed Species Conditions for Avoidance, Minimization and Mitigation of Take

- FWC staff, in coordination with other state agencies, provide comments to federal agencies (e.g., the Army Corps of Engineers) on federal actions, such as projects initiated by a federal agency or permits being approved by a federal agency.
- FWC staff works with landowners, local jurisdictions, and state agencies such as the Department of Economic Opportunity on large-scale land use decisions, including long-term planning projects like sector plans, projects in Areas of Critical State Concern, and large-scale comprehensive plan amendments.
- FWC staff coordinates with state agencies such as the DEP and the five Water Management Districts on the Environmental Resource Permitting (ERP) program, which regulates activities such as dredging and filling in wetlands, flood protection, stormwater management, site grading, building dams and reservoirs, waste facilities, power plant development, power and natural gas transmission projects, oil and natural gas drilling projects, port facility expansion projects, some navigational dredging projects, some docking facilities, and single-family developments such as for homes, boat ramps, and artificial reefs.
- Sector plans, developments of regional impacts, and county comprehensive plans are all reviewed currently and FWC provides conditions that would be beneficial to the Santa Fe cave crayfish.
- The Santa Fe River basin is listed as Outstanding Florida Waters (OFWs) in Rule 62-302.700(9), F.A.C.

FWC Permitting: Incidental Take

As defined in Rule 68A-27.001, F.A.C., incidental take is take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. An FWC permit should be obtained for activities that result in take of Santa Fe cave crayfish (see above for actions that do not require a permit). Permits may be issued when there is a scientific or conservation benefit to the species and only upon showing by the applicant that that the permitted activity will not have a negative impact on the survival potential of the species. Scientific benefit, conservation benefit, and negative impacts are evaluated by considering the factors listed in Rule 68A-27.007(2)(b), F.A.C. These conditions are usually accomplished through a combination of avoiding take when practicable, minimizing take that will occur, and mitigating for the permitted take. This section describes the minimization measures and mitigation options available as part of the Incidental Take Permit process for take of this species. This list is not an exhaustive list of options.

Minimization Options

The options below are intended to address the evaluation factors required for consideration when issuing an incidental take permit. These options can lessen the impact of activities, and ultimately may reduce what is needed to achieve a conservation or scientific benefit.

Seasonal, Temporal, and Buffer Measures

- Upland activities that have the potential to disturb riparian zones should follow Outstanding Florida Waters recommendations and minimize activities within 61-91 m (200-300 ft) of the waterway (DEP 2011, Wegner 1999). For upland activities not in Outstanding Florida Waters maintaining a minimum of 15.2 m (50 ft) up to 304 m (1,000 ft) buffer from the edge of the sinkhole or cave will minimize impacts (USFWS 2001).

Design Modification

- Avoid activities in priority watersheds or sensitive areas – specific cave locations identified in A Species Action Plan for the Santa Fe Cave Crayfish.
- Place roads at least 61 m (200 ft) from caves or sinks occupied by Santa Fe cave crayfish and have specific stormwater treatment systems for any potential runoff into the system.
- Minimize the amount of sedimentation and erosion to waterways by using turbidity and sediment screens and by following guidelines described within the Silviculture BMP Manual.
- Following buffer measures (above) would limit the amount of runoff entering waterways.
- No underground storage tanks (USTs) in the cave watershed.
- Installation of leak sensors for any petroleum or fuel storage tanks.
- If possible, avoid any intrusive activities into the karst system such as the installation of underground columns for support pilings.

Method Modification

- Use sediment screens, bales, other methods to limit sedimentation from upland site activity.
- Stage construction materials at least 91.4 m (300 ft away) from the mouth of the cave or sinkhole.
- When creating waterway crossings, top down bridge construction would minimize impacts to Santa Fe cave crayfish and other aquatic species. Specific project guidance can be obtained by contacting the Florida Department of Transportation.

Mitigation Options

Mitigation is scalable depending on the impact, with mitigation options for significant impairment or disruption of essential behavioral patterns constituting take. Potential options for mitigation are described below.

Scientific Benefit

This section describes research and monitoring activities that provide scientific benefit, per Rule 68A-27.007, F.A.C. Conducting or funding these activities can be the sole form of mitigation for a project.

- Surveys on private lands with caves or sinks within the watershed, surveying a minimum of 30 caves or sinks with at least three visits over a two-year period, using FWC-approved methodology. Contact FWC for specifications of these surveys and to secure appropriate permissions from private landowners.
- Scientific studies can help address life history questions. These projects should be conducted with input from FWC and can be found in the Species Action Plan for the Santa Fe Cave Crayfish.

Habitat

Habitat acquisition or management may be a mitigation option.

- Easements or acquisitions of sites containing Santa Fe cave crayfish.
- Easement or acquisition near existing conservation lands, or adjacent to sites with Santa Fe cave crayfish.
- Protecting caves or sinks through Critical Wildlife Area designation.
- Restoration of natural hydrology or forested buffer around caves or sinks containing Santa Fe cave crayfish.
- Securing access or preventing damage to cave or sink features through fencing and/or signage.

Funding

- No funding option has been identified at this time. However, funding options as part of mitigation will be considered on a case-by-case basis.

Information

- Mitigation can be used to support research projects consistent with actions in the Species Action Plan for the Santa Fe cave crayfish.
- Access to private properties to allow surveys to occur.
- Surveys using survey methodology in nearby caves (described above), and providing to FWC documentation and locality data for Santa Fe cave crayfish encountered.

Programmatic Options

- Multi-year or long-term permits are possible and will be considered on a case-by-case basis. Examples include, but are not limited to, large-scale ecological restoration projects or public works projects.

Multispecies Options

- This species has been found to inhabit the same caves as the spider cave crayfish and Hobb's cave amphipod, which have been petitioned for federal listing but no multi-species permitting options have been identified at this time.

FWC Permitting: Intentional Take

Intentional take is not incidental to otherwise lawful activities. Per Chapter 68A-27, F.A.C., intentional take is prohibited and requires a permit. For state-Threatened species, intentional take permits may only be considered for scientific or conservation purposes (defined as activities that further the conservation or survival of the species taken). Permits are issued for state-Threatened species following guidance in Rule 68A-27.007(2)(a), F.A.C.

Intentional take for human safety

- There are no circumstances for which Santa Fe cave crayfish may be taken for human safety.

- Permits will be issued only under limited and specific circumstances, in cases where there is an immediate danger to the public's health and/or safety, including imminent or existing power outages that threaten public safety, or in direct response to an official declaration of a state of emergency by the Governor of Florida or a local governmental entity. Applications submitted for this permit must include all information that is required from any other applicant seeking a permit, along with a copy of the official declaration of a state of emergency, if any. This permit process may be handled after the fact or at least after construction activities have already started. An intentional take permit may be issued for such purposes.

Aversive Conditioning

- Not applicable for the Santa Fe cave crayfish.

Permits Issued for Harassment

- Not applicable for the Santa Fe cave crayfish.

Scientific Collecting and Conservation Permits

- Scientific collecting permits may be issued for the Santa Fe cave crayfish using guidance found in Rule 68A-27.007(2)(a), F.A.C. Activities requiring a permit include any research that involves capturing, handling, or marking wildlife; conducting biological sampling; or other research that may cause take. Santa Fe cave crayfish that are used for education and outreach events should have a Scientific Collecting permit.

Considerations for Issuing a Scientific Collecting Permit

1) Is the purpose adequate to justify removing the species (if the project requires this)?
    - Permits will be issued if the identified project is consistent with the goal of the Species Action Plan (i.e., improvement in status that leads to removal from Florida's Endangered and Threatened Species List), or addresses an identified data gap important for the conservation of the species.
2) Is there be a direct or indirect effect of issuing the permit on the wild population?
3) Will the permit conflict with program intended to enhance survival of species?
4) Will purpose of permit reduce likelihood of extinction?
    - Projects consistent with the goals of the Species Action Plan or that fill identified data gaps in species life history or management may reduce the likelihood of extinction. Applications should clearly explain how the proposed research will provide a scientific or conservation purpose for the species.
5) Have the opinions or views of other scientists or other persons or organizations having expertise concerning the species been sought?
6) Is applicant expertise sufficient?
    - Applicants must have prior documented experience with this or similar species; applicants should have met all conditions of previously issued permits.

Relevant to all Scientific Collecting for Santa Fe Cave Crayfish

- All scientific collecting surveys require a permit.
- FWC permit conditions will describe disposition of vouchered specimens and coordination on genetic and disease studies.
- Spreadsheet and electronic submission is allowed. As a minimum, GPS coordinates (DD), habitat, date, time of day, number collected, disposition of specimens.

- Any mortality should be reported immediately to the FWC at the contact information below. The FWC will provide guidance on proper disposition of specimens.
- Geographical or visual data gathered must be provided to FWC in the specified format.
- A final report should be provided to the FWC in the format specified in the permit conditions.

Additional information

Information on the Economic Assessment of these guideline can be found at http://myfwc.com/wildlifehabitats/imperiled/management-plans/, within the Environmental Economics, Inc. reference, "Economic analysis for the Imperiled Species Management Plan with statement of estimated regulatory costs." The Santa Fe cave crayfish is specifically mentioned in Table 3b, pp. 10 and 13.

Contact

For more species-specific information or related permitting questions, contact the FWC at (850) 921-5990 or WildlifePermits@myfwc.com. For regional information, visit http://myfwc.com/contact/fwc-staff/regional-offices.

Literature Cited

Florida Department of Agriculture and Consumer Services [FDACS]. 2008. Silvicultural best management practices handbook. http://freshfromflorida.s3.amazonaws.com/Media%2FFiles%2FFlorida-Forest-Service-Files%2Fsilvicultural_bmp_manual.pdf. Accessed 23 August 2017.

Florida Department of Environmental Protection [DEP]. 2011. Outstanding Florida waters fact sheet. https://floridadep.gov/dear/water-quality-standards/content/outstanding-florida-waters-fact-sheet. Accessed 23 August 2017.

Florida Department of Environmental Protection [DEP]. 2012. Basin Management Action Plan for the Implementation of Total Daily Maximum Loads for Nutrients Adopted by the Florida Department of Environmental Protection in the Santa Fe River Basin. https://floridadep.gov/sites/default/files/sfr-nutrient-bmap-final.pdf Accessed 7 October 2017.

Florida Natural Areas Inventory. 2001. Santa Fe cave crayfish, *Procambarus erythrops*. Field guide to the rare animals of Florida. Florida Natural Areas Inventory, Tallahassee.

Florida Springs Task Force. 2000. Florida's springs – strategies for protection and restoration. Florida Springs Task Force report, November 2000. Florida Department of Environmental Protection, Tallahassee, http://www.dep.state.fl.us/springs/reports/files/SpringsTaskForceReport.pdf. Accessed 28 September 2013.

Franz, R. 1982. Species of Special Concern: Red-eyed cave crayfish. Pages 112-113 *in* R. Franz, editor. Rare and endangered biota of Florida. Volume VI. Invertebrates. University Press of Florida, Gainesville.

Franz, R. 1994. Rare: Santa Fe cave crayfish. Pages 195-197 *in* M. Deyrup and R. Franz, editors. Rare and endangered biota of Florida. Volume IV. Invertebrates. University Press of Florida, Gainesville.

Franz, R., J. Bauer, and T. Morris. 1994. Review of biologically significant caves and their faunas in Florida and South Georgia. Brimleyana 20:1-109.

Franz, R., and D. S. Lee. 1982. Distribution and evolution of troglobitic crayfishes of Florida. Bulletin of the Florida State Museum 28:53-78.

Hobbs, H. H., Jr. 1972. The subgenera of the crayfish genus *Procambarus* (Decapoda: Astacidae). Smithsonian Contributions to Zoology Number 117:1-22.

Natural Resources Conservation Service [NRCS]. 2012. Conservation practice standard overview. United States Department of Agriculture. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255022.pdf. Accessed July 17, 2017.

U.S. Fish and Wildlife Service [USFWS]. 2001. Buffers: an efficient tool for watershed protection. http://fwcg.myfwc.com/docs/Wetland_Buffers_USFWS.pdf. Accessed July 17, 2017.

Wegner, S. 1999. A review of the scientific literature on riparian buffer width, extent and vegetation. Office of Public Service and Outreach, Institute of Ecology, University of Georgia, Athens.