

Interim Core Map Documentation for Riverside Fairy Shrimp

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Interim Core Map Developer: U.S. Environmental Protection Agency (EPA), Office of Pesticide Programs

Species Summary

The Riverside fairy shrimp (*Streptocephalus woottoni*; Entity ID 492) is an endangered aquatic invertebrate. The U.S. Fish and Wildlife Service (FWS) designated a critical habitat for the Riverside fairy shrimp in 2012. This species is found in southern California and requires vernal pools to grow and reproduce. The Riverside fairy shrimp is currently found in the counties of Ventura, Riverside, Orange, and San Diego of southern California. The historical distribution also extended into Los Angeles County and northwestern Baja California, Mexico. Additional information on the species is provided in **Appendix 1**.

Description of Core Map

The core map for the Riverside fairy shrimp is based on biological information, specifically vernal pools areas found within the species range or within a FWS known location found outside of the range. FWS known location data are more recent than the range data. The range map and many of the known locations and species range are available from FWS. Known location geodata from FWS was available for roughly 30 of the 80 locations identified by FWS. Vernal pool habitat locations are taken from California Fish and Wildlife Services (CA FWS) Areas of Conservation Emphasis (ACE) habitat data, version 3.0. The outer extent of this core map is defined by vernal pool locations from the ACE dataset. The vernal pool locations are either within the species range or intersect with a FWS known location found outside of the range. Cultivated land was not removed from the core map because these areas are identified as potential locations for vernal pools, cultivated represent only 1% of the core map. Additional information on the data used is provided in **Appendix 2**.

Figure 1 depicts the resulting interim core map for the Riverside fairy shrimp. The size of this core map is approximately 245,000 acres. Landcover categories within the core map area include CA FWS identified known vernal pool habitats. Landcover categories within the core map area are included in **Table 1**. Landcover is predominantly grassland herbaceous and scrub/shrub habitats or developed areas.

The core map developed for the Riverside fairy shrimp is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the Riverside fairy shrimp. This core map incorporates information developed by FWS and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate species expert feedback from FWS. This interim core map has an "average" best professional judgment classification to describe major uncertainties/limitations. The map is based on known locations described by FWS, and EPA removed some additional areas based on biological needs of the species. This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.

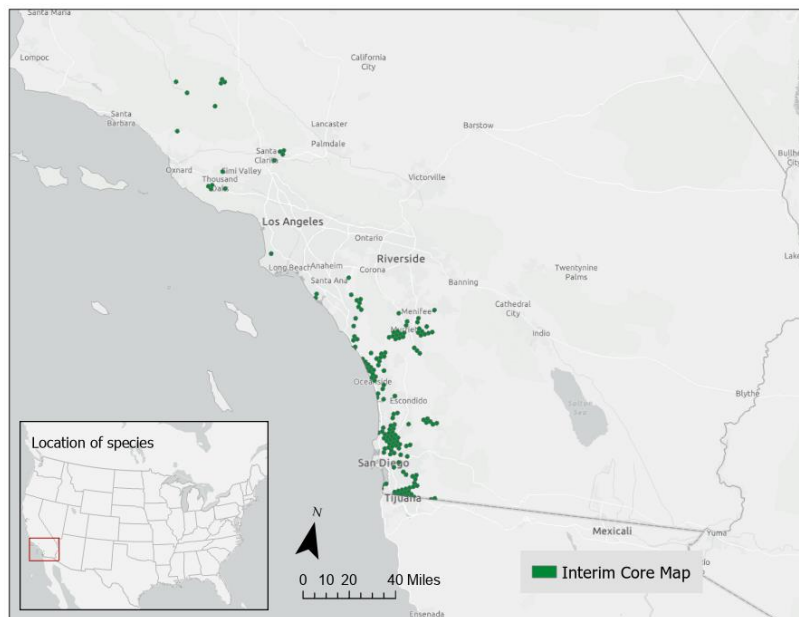


Figure 1. Interim core map for the Riverside fairy shrimp.

Table 1. Percentage of Interim Core Map Represented by NLCD¹ Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Landcover (Value)	% of core map represented by landcover	% of core map represented by example pesticide use
Forestry	Deciduous Forest (41)	0	2
Forestry	Evergreen Forest (42)	2	2
Forestry	Mixed Forest (43)	0	2
Agriculture	Pasture/Hay (81)	1	2
Agriculture	Cultivated Crops (82)	1	2
Mosquito adulticide, residential	Open space, developed (21)	8	35
Mosquito adulticide, residential	Developed, Low intensity (22)	8	35
Mosquito adulticide, residential	Developed, Medium intensity (23)	13	35
Mosquito adulticide, residential	Developed, High intensity (24)	5	35
Invasive species control	Woody Wetlands (90)	1	61
Invasive species control	Emergent Herbaceous Wetlands (95)	1	61

¹ Dewitz, J., 2023, National Land Cover Database (NLCD) 2021 Products: U.S. Geological Survey data release, <https://doi.org/10.5066/P9JZ7AO3>

Example pesticide use sites/types	NLCD Landcover (Value)	% of core map represented by landcover	% of core map represented by example pesticide use
Invasive species control	Open water (11)	1	61
Invasive species control	Grassland/herbaceous (71)	20	61
Invasive species control	Scrub/shrub (52)	38	61
Invasive species control	Barren land (rock/sand/clay; 31)	0	61
Total Acres	Interim Core Map Acres	~245,000	

Evaluation of Known Location Information

There are four datasets with known location information:

- Descriptions of locations provided by FWS;
- Occurrence locations in iNaturalist;
- Occurrence locations in the Global Biodiversity Information Facility (GBIF);
- Occurrence locations in NatureServe

EPA evaluated these occurrence data before selecting the type of and developing the core map. FWS appeared to have the finest resolution of the location information, providing a map that depicted the current known locations all in southern California. The locations occurred in the counties of Ventura, Riverside, Orange, and San Diego of southern California, and several locations are outside of the current species range. The historical distribution also extended into Los Angeles County and northwestern Baja California, Mexico. (**Figure A1-3 in Appendix 1**). Occurrences in iNaturalist, GBIF, and NatureServe did not support further expanding the core map outside of the FWS range, the occurrences from the database aligned with those from FWS. **Appendix 1** includes more information on the available known location information.

Approach Used to Create Core Map

The core map was developed using the “Process EPA Uses to Develop Core Maps for Draft Pesticide Use Limitation Areas for Species Listed by the FWS and their Designated Critical Habitats”² (referred to as “the process”). EPA developed the core map using the 4 steps described in the process document:

1. Compile available information for a species;
2. Identify core map type;
3. Develop the core map for the species; and
4. Document the core map.

For step 1, EPA compiled available information for the Riverside fairy shrimp from FWS, as well as observation information available from various publicly available sources (including iNaturalist, GBIF, and

² Dated 2024, available online at: <https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas>

NatureServe). The information compiled for the Riverside fairy shrimp is included in **Appendix 1**. Influential information that impacted the development of the core map included:

- Range, occurrences, and known locations of the Riverside fairy shrimp are in southern California. Several known locations from FWS are found outside of the current species range.
- The species require vernal pool habitat to grow and reproduce.

For step 2, EPA used the compiled information to identify the core map type including species range and known location information. The extant populations are located near either the species' range or known locations identified by FWS and require vernal pools to grow and reproduce. Therefore, EPA based the core map on the vernal pool habitats from the CA FWS that intersect with/are near the species' range or known locations identified by FWS. The entire range of the species was not used as the core map because the range contains habitats where the species does not occur, and several known locations are found outside of the species range.

For step 3, EPA used the best available data sources to generate the core map. Data sources are discussed in the process document, including the state dataset from California identifying vernal pool complexes. For this core map, EPA used the vernal pool habitats identified by CA FWS that intersect within the species' range or known locations identified by FWS. **Appendix 2** provides more details on the GIS analysis and data used to generate the core map.

Discussion of Approaches and Data that were Considered but not Included in Core Map

The species range was considered but was not selected as the core map because the range map includes substantial habitats in addition to vernal pools. Additionally, the range map was last updated in 2018 and does not include some areas with known populations as of the Five-Year Review (2021). These known locations identified in the 2021 Five-Year Review are included in the core map.

Critical habitat was considered but was not selected as the core map because it does not reflect changes to the observed species distribution and habitats since the "Revised Critical Habitat for the Riverside Fairy Shrimp; Final Rule (2012)" and species populations have shifted over time as Riverside fairy shrimp are introduced to new vernal pools and other vernal pools became unable to support populations due to environmental pressures (Five Year Review 2021). The "Revised Critical Habitat for the Riverside Fairy Shrimp; Final Rule (2012)" only mentions nine vernal pool complexes with known Riverside fairy shrimp populations while the Five-Year Review (2021) describes 40 vernal pool locations or complexes with populations. Additionally, the critical habitat coverage excludes some areas with known populations of Riverside fairy shrimp that were covered by local management plans or were near areas of national security concern. The critical habitat areas are found within the core map.

Appendix 1. Information Compiled for the Riverside Fairy Shrimp During Step 1

1. Recent FWS documents/links and other data sources

- Five Year Review (2021) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3502.pdf)
- Recovery Plan Clarification for the Vernal Pools of Southern California (2019) (https://ecos.fws.gov/docs/recovery_plan/Vernal%20Pools%20of%20Southern%20California%20Clarification.pdf)
- Revised Critical Habitat for the Riverside Fairy Shrimp; Final Rule (2012) (referenced as Revised Critical Habitat; Final Rule 2012) (<https://www.fws.gov/policy/library/2012/2012-28250.pdf>)
- Five year review (2008) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1297.pdf
- Vernal Pools of Southern California Recovery Plan (1998) (https://ecos.fws.gov/docs/recovery_plan/980903a.pdf)

2. Background information

- **Status:** Federally listed as endangered in 1993
- **Resiliency, redundancy, and representation** (the 3Rs)
 - Resiliency: Many life history factors make it difficult to measure population size of the Riverside fairy shrimp. Short pool inundation times may also affect the population size in a given year. Therefore, resiliency information is not available. (Five Year Review 2008)
 - Redundancy: Since listing more than 50 new occupied complexes have been identified improving the species ability to recover from disturbance. (Five Year Review 2008)
 - Representation: Riverside fairy shrimp are restricted to certain pool types within a narrow geographic region but have been observed to move into new habitat such as a cattle pond. (Five Year Review 2008)
- **Habitat**
 - Riverside fairy shrimp require vernal pool habitat to grow and reproduce. Their life cycle requires periods of inundation as well as dry periods. (Revised Critical Habitat; Final Rule 2012)
 - Habitats (ephemeral wetlands) that provide space for growth and persistence of Riverside fairy shrimp include areas that generally pond for 2 to 8 months and dry down for a period during the late spring to summer months. (Revised Critical Habitat; Final Rule 2012)
 - Habitats include natural and created pools (usually greater than 12 inches (in) (30 centimeters (cm)) deep) that support these longer inundation periods; some of these habitats are artificial pools (cattle watering holes and road embankments) that have been modified or deepened with berms. (Revised Critical Habitat; Final Rule 2012)
 - Intact vernal pool hydrology (including the seasonal filling and drying down of pools) is the essential feature that governs the life cycle of the Riverside fairy shrimp. (Revised Critical Habitat; Final Rule 2012)

- Space for the Riverside fairy shrimp's normal growth and behavior requires an underlying soil series (typically clay soil inclusions with a subsurface claypan or hardpan component), which forms an impermeable layer that sustains appropriate inundation periods. (Revised Critical Habitat; Final Rule 2012)
- **Diet**
 - Many fairy shrimp species are filter feeders with a diet that consists mostly of algae, bacteria, and other microorganisms. In a natural vernal pool setting, these food items are readily available.
- **Taxonomy**
 - Aquatic invertebrate (Family: Streptocephalidae)
- **Relevant Pesticide Use Sites**
 - Herbicides used within the species habitat for enhancement and restoration projects, specifically called out Roundup. Mosquito control efforts, specifically called out larvicides. (Five Year Review 2008)
- **Recovery Criteria/Objectives (from 1998 Vernal Pools of Southern California Recovery Plan)**
 - Existing vernal pools currently occupied by Riverside fairy shrimp and their associated watersheds should be secured from further loss and degradation in a configuration that maintains habitat function and species viability.
 - Remaining vernal pools and their associated watersheds contained within the complexes identified in Table 4 of the recovery document must be secured in a configuration that maintains habitat function and species viability (as determined by prescribed research tasks).
 - The existing vernal pools and their associated watersheds contained within the complexes identified in Table 5 of the recovery document are secured in a configuration that maintains habitat function and species viability (as determined by recommended research).
 - Secured vernal pools are enhanced or restored such that population levels of existing species are stabilized or increased.
 - Population trends must be shown to be stable or increasing for a minimum of 10 consecutive years prior to consideration for reclassification. Monitoring should continue for a period of at least 10 years following reclassification to ensure population stability.
 - All 74 geographic areas and associated vernal pool complexes as identified in Appendices F and G of the 1998 Recovery Plan under each of the specific management areas are protected and managed to ensure long-term viability.
 - FWS must determine that the following factors are no longer present, or continue to adversely affect ... the Riverside ... fairy shrimp: (1) the present or threatened destruction, modification, or curtailment of their habitat range; (2) over utilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; and (5) other natural and manmade factors affecting their continued existence (50 CFR 424.11).

- Population trends for [Riverside fairy shrimp] continue to be stable or increasing for 10 consecutive years after threats have been sufficiently ameliorated or managed (completion of delisting criterion 2) prior to consideration for delisting.
- **Recovery Actions (from 1998 Vernal Pools of Southern California Recovery Plan)**
 - Conduct surveys and research essential to the conservation of Riverside fairy shrimp.
 - Secure the existing vernal pools and their associated watersheds.
 - Where necessary reestablish vernal pool habitat to the historical structure.
 - Manage and monitor habitat and listed species.

3. Description of Species Range

- **Figure A1-1** depicts the FWS range. The range was last updated on March 27, 2018. The total acreage of the range is around 1,775,500 acres.
- The species is generally restricted to vernal pools and other non-vegetated ephemeral (i.e., lasting a short time) pools in Ventura, Riverside, Orange, and San Diego counties of southern California. The historical distribution also extended into Los Angeles County and northwestern Baja California, Mexico. (Five Year Review 2021).

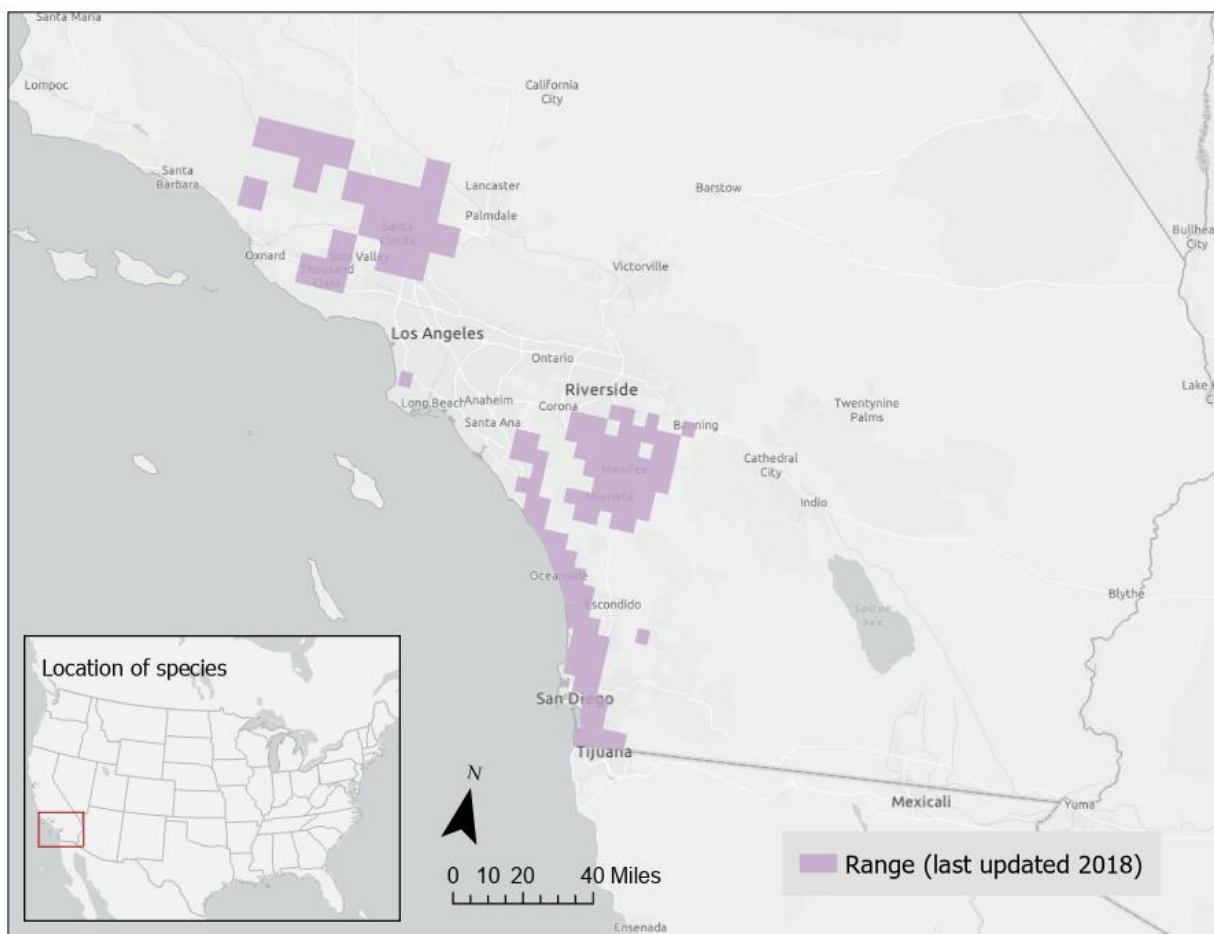


Figure A1-1. FWS range for the Riverside fairy shrimp. The total acreage of the range is around 1,775,500 acres.

4. Critical Habitat

- **Figure A1-2** depicts the FWS critical habitat. The critical habitat was revised in 2012 and included approximately 1,700 acres. (Revised Critical Habitat; Final Rule 2012)
 - Some areas with existing populations of Riverside fairy shrimp were excluded from the critical habitat under Section 4(b)(2) of the ESA, which allows for exclusions due to economic impacts or impacts to national security.
 - 40 acres excluded for national security reasons.
 - Other areas with active populations were excluded because redundant local management plans for their conservation were already in place.



Figure A1-2. Critical habitat location (Revised Critical Habitat; Final Rule 2012)

5. Known Locations

- Known Locations Described in FWS Recovery Documents
 - The species is generally restricted to vernal pools and other non-vegetated ephemeral (i.e., lasting a short time) pools in Ventura, Riverside, Orange, and San Diego of southern California. The historical distribution also extended into Los Angeles County and northwestern Baja California, Mexico (Five Year Review 2021)
 - In 2021, Riverside fairy shrimp were known to occur in 40 vernal pool locations or complexes. (Five Year Review 2021)
 - **Figure A1-3** depicts known locations of vernal pools containing Riverside fairy shrimp in 2008 and 2021. (Five Year Review 2021)
 - Several of these known locations are found outside of the current species range.

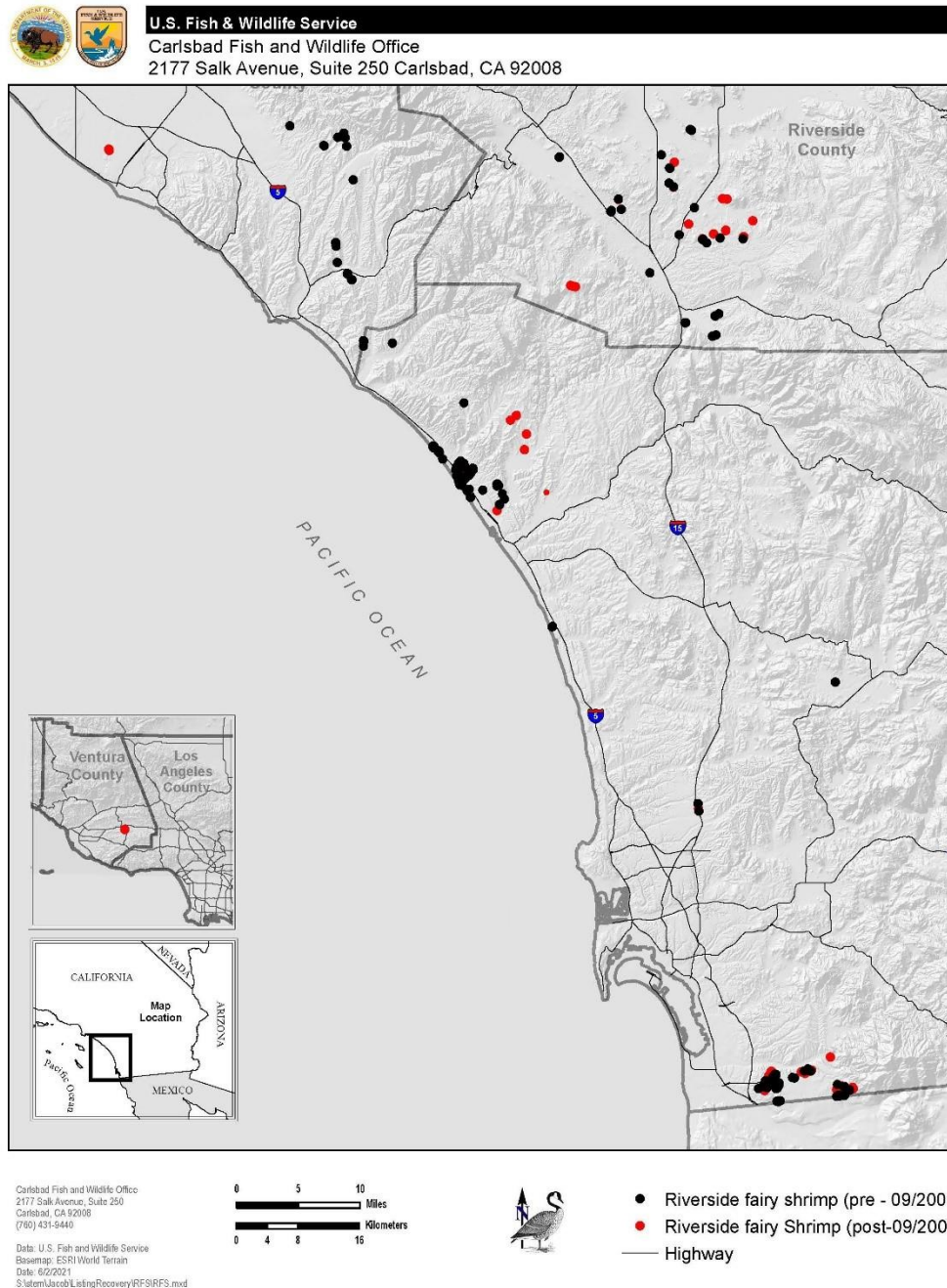


Figure A1-3. Known location information from FWS. Map extracted from most recent FWS Five Year Review 2021.

- **Occurrences Included in Public Databases**
 EPA queried iNaturalist, GBIF, and NatureServe.

iNaturalist (available [here](#)) included three research grade observations from January 2017-March 2024. One observation in San Diego County and two in Riverside County, all consistent with FWS known location and range data.

GBIF (available [here](#)) included roughly 20 georeferenced occurrences. Nineteen observations recorded in southern California between (from 1985-2024). The three research grade observations are duplicates from iNaturalist and are from, 2017, 2023 and 2024. These locations align with the known locations from FWS. The remaining georeferenced occurrences are either preserve specimens or material sample.

NatureServe (available [here](#)) was searched and all occurrences appeared in the general area as the other public datasets and FWS datasets.

Appendix 2. GIS Data Review and Method to Develop Core Map (Step 3)

This core map was created based on biological information, including range, known location, and species habitat (vernal pool). EPA used FWS known location and range data and the CA FWS vernal pools (habitat type) data. The initial PULA consists of vernal pools that intersects with/is near species range or those that intersect with/is near the known locations given by FWS.

1. Dataset References and Software

- Software used: R
- FWS Species Range – last updated on January 27, 2018
- FWS known locations (available [here](#))-last updated on December 16, 2024
 - Does **not** include all known locations found in Figure 1 and Table 1 of FWS' Five-Year Review (2021) due to data agreements between FWS and various organizations responsible for most of the data. Those organizations include: California Natural Diversity Database (CNDDDB), Western Riverside MSHCP's species monitoring database, and species data provided by Marine Corps Base Camp Pendleton and Marine Corps Air Station Miramar (email correspondence with Jacob Weiss, cartographer - GIS Branch at Palm Springs Fish and Wildlife Office).
 - Geodata available for roughly 30 out of 80 locations
- CA FWS vernal pools habitats (available [here](#))-last updated on July 29, 2024
 - Vernal Pools, Areas of Conservation Emphasis (ACE), version 3.0, last updated on July 29, 2024.

2. Datasets Used in Core Map Development

The CA FWS habitat data set used to identify vernal pool habitats was used and can be found [here](#) (also linked above). All other datasets used in core map development, including this CA dataset, are described in EPA's process document.

3. Core Map Development

- EPA started with the range data from FWS and filtered for the Riverside fairy shrimp.
- FWS known location data was imported as a layer and filtered for the Riverside fairy shrimp. Several of these known locations are found outside of the current range.
- The CA FWS habitat data was imported as a layer and filtered for vernal pools (habitat type) in Southern California (using filters "Southern California Mountains and Valleys" or "Southern California Coast").
 - a) See Figure A2-1 below for results of above three bullets.
- Finally, the map was selected to keep all vernal pools (in eco-regions southern CA coast and southern CA mountains & valleys) that are east of longitude -119.6088925645217 (see figure 1 in "Description of Core Map" section above for result). Core map name: riverside_fairy_shrimp_core_map.
 - a) Selection of all vernal pool east of this longitude includes the known location areas outside of the current range. These areas are also accounted for in either the available known location data or printed map from FWS. The printed map from the Five-Year review (2021) is more recent than the range file (2018), and for this reason, these vernal pool areas outside of the range were included in the core map.
 - i) All known locations from sources from public databases were accounted for in the FWS occurrence data or printed map.

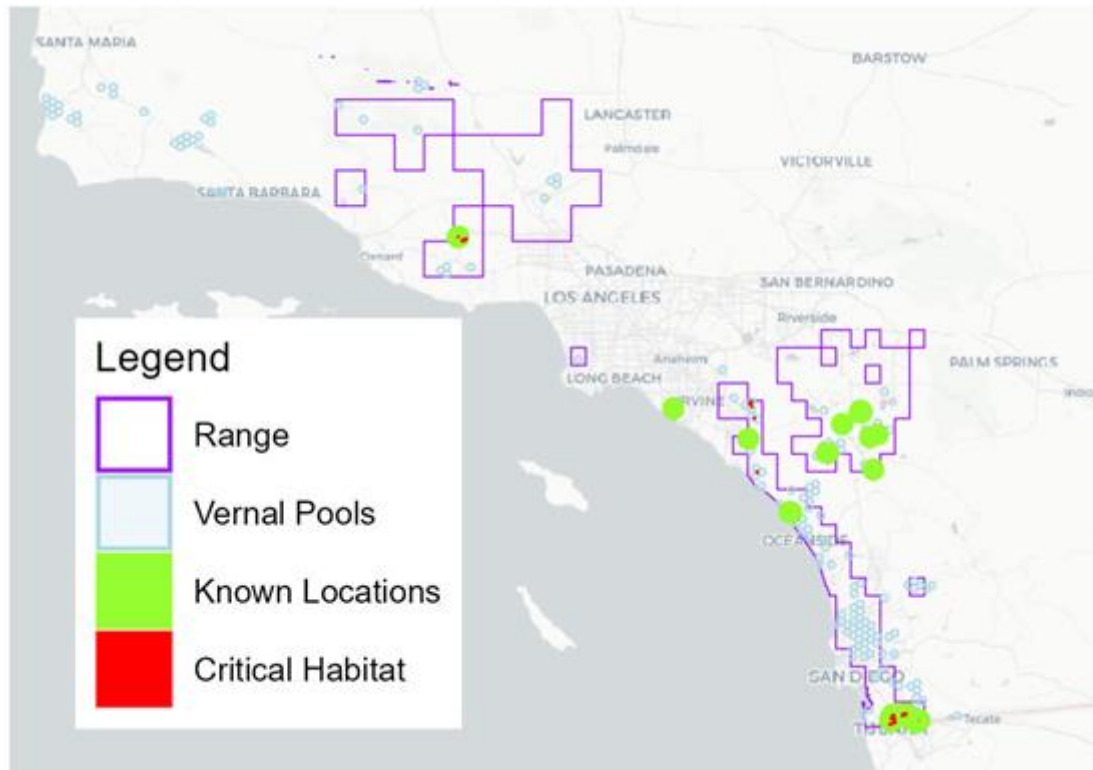


Figure A2-1. Result of overlapping FWS range and known locations with The CA FWS known vernal pools (habitat type) in Southern California.