

Core Map Documentation for the Vernal Pool Fairy Shrimp

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Draft Interim Core Map Developer: Center for Biological Diversity

Species Summary

The vernal pool fairy shrimp (*Branchinecta lynchi*; Entity ID 493) is a freshwater crustacean found in California and southern Oregon. The vernal pool fairy shrimp inhabit a wide variety of vernal pools and other ephemeral wetlands and are the most adaptable of the four vernal pool shrimp in California and Oregon. They spend most of their life as eggs or cysts in the dry sediment at the bottom of the vernal pools. They emerge and become active during wet periods when their vernal pools become inundated and feed mostly on detritus or other small animals in the pool. Their vernal pools historically existed throughout the Central Valley and in surrounding areas, but most have been lost to agricultural development and disruptions to natural flooding in the Valley and elsewhere. Vernal pool fairy shrimp are vulnerable to pesticides that can runoff into fields and urban areas where pesticides can remain in the pools for extended periods of time. Additional information on the species is provided in **Appendix 1**. This species is currently in the Herbicide Strategy and Insecticide Strategy.

EPA Review Note

The developers created this core map using EPA's process available at: <https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas>. EPA reviewed the draft interim map and documentation and evaluated if: (1) the map and documentation are consistent with the agency's process; (2) areas included or excluded from the interim core map are consistent with the biology, habitat, and/or recovery needs of the species; (3) data sources are documented and appropriate; and (4) the GIS data and mapping process are consistent with the stated intention of the developer. EPA agrees that this map is a reasonable depiction of core areas for this species and was consistent with the agency's mapping process. This documentation was not prepared by EPA, but EPA may have edited this documentation for clarity or other purposes. Some views in this documentation may not necessarily be the views of EPA or its staff.

The core map developed for this species is considered interim and can be used to develop pesticide use limitation areas (PULAs). This core map incorporates information developed by the U.S. Fish and Wildlife Service (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 expert feedback from FWS.

This core map does not replace or revise any range or designated critical habitat developed by FWS.

Description of Core Map

The core map is biological information type, based on a combination of critical habitat and the species' known locations. The outer extent of this core map is defined by the species critical habitat. There are 13

geographically isolated areas that are considered occupied with a total of 1,038 extant occurrences (**Figure A1-4**). This species relies on vernal pools in California and southern Oregon that have a distribution that is reasonably well understood and mapped. The combination of critical habitat, areas of public lands with current populations, and generalized locations of vernal pools that are considered occupied by the vernal pool fairy shrimp constitute the basis for the core map.

Figure 1 depicts the resulting interim core map for the vernal pool fairy shrimp. The size of this core map is approximately 1,251,198 acres. Landcover categories within the core map are included in **Table 1**. Landcover is predominantly grassland/herbaceous areas.

The core map developed for the vernal pool fairy shrimp is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the vernal pool 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 has an “average” best professional judgement classification to describe major uncertainties/limitations. This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.

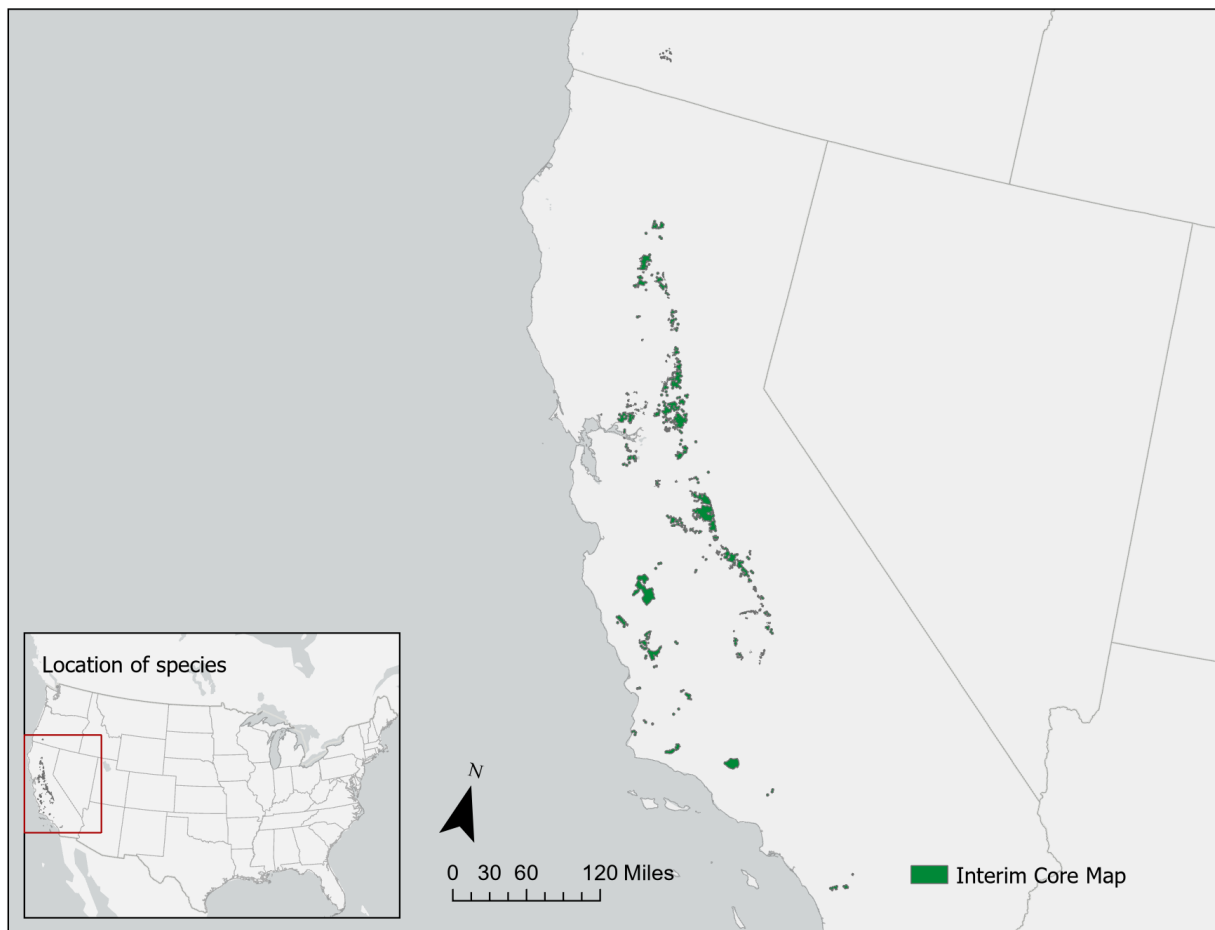


Figure 1. Interim core map for vernal pool fairy shrimp. The interim core map is approximately 1,251,198 acres.

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%	3%
Forestry	Evergreen Forest (42)	2%	3%
Forestry	Mixed Forest (43)	1%	3%
Agriculture	Pasture/Hay (81)	2%	8%
Agriculture	Cultivated Crops (82)	6%	8%
Mosquito adulticide, residential	Open space, developed (21)	4%	9%
Mosquito adulticide, residential	Developed, Low intensity (22)	2%	9%
Mosquito adulticide, residential	Developed, Medium intensity (23)	2%	9%
Mosquito adulticide, residential	Developed, High intensity (24)	1%	9%
Invasive species control	Woody Wetlands (90)	0%	80%
Invasive species control	Emergent Herbaceous Wetlands (95)	3%	80%
Invasive species control	Open water (11)	1%	80%
Invasive species control	Grassland/herbaceous (71)	65%	80%
Invasive species control	Scrub/shrub (52)	11%	80%
Invasive species control	Barren land (rock/sand/clay; 31)	1%	80%
Total Acres	Interim Core Map Acres	1,251,198	

Evaluation of Known Location Information

CBD evaluated three sources of known location information:

- General occurrence information and survey results presented in the 2024 5-year review
 - The 2024 5-year review presents a table summary of the number of presumed extant occurrences and a map of those occurrences (**Figure A1-4**). The occupied areas are not identified by name because there are too many occurrences to name in the species review. The review presents location information as points (**Figure A1-4**). This location information presents the most up to date data on the species and is much more refined than the ECOS range map for the species.
- California Department of Fish and Wildlife (CDFW) vernal pools geodatabase
 - Vernal pools are an Area of Conservation Emphasis for the CDFW and have received special attention that has resulted in a statewide geodatabase¹ of the known locations of vernal pools that can be filtered for the presence of the vernal pool fairy shrimp. The geodatabase presents hexagonal regions with occupied vernal pool(s) located somewhere within the hexagonal area. This dataset was produced and verified by the CDFW and presents a reliable source of location information for the vernal pool fairy shrimp.

¹ <https://gis.data.ca.gov/search?q=vernal%20pool>

- California Natural Diversity Database (CNDDB)
 - The CNDDB presents 804 occurrences records dated from 1965 to 2022. Of these, 189 could be considered recent (newer than 2010). This dataset presents spatial information for occupied pools at various spatial scales. This dataset contains a subset of the locations that were surveyed as described in the 2024 5-year review. This source of information is referenced in FWS documents and is considered very reliable.

EPA evaluated an additional three datasets with known location information:

- Occurrence locations in iNaturalist
- Occurrence locations in NatureServe; and
- Occurrence locations in the Global Biodiversity Information Facility (GBIF).

Occurrences in iNaturalist, NatureServe, and GBIF did not support expanding the core map developed by CBD. **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 U.S. Fish & Wildlife Service (FWS) and their Designated Critical Habitats”³ (referred to as “the process”). CBD 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.

The core map for the vernal pool fairy shrimp was based on critical habitat and occupied hexagonal areas identified by the CDFW in their vernal pool geodatabase.

Critical habitat areas are all considered currently occupied and were added to the core map.

The core map was further expanded to include hexagonal areas from the CDFW vernal pool data layer. The vernal pool data layer was filtered to only include hexagonal areas with current known locations based on a query of the CNDDB. If a hexagonal area had an occurrence of the vernal pool fairy shrimp then the entire hexagonal area was included.

Using the EPA’s cultivated lands layer, we removed areas that were considered cultivated. Neither the Recovery Plan nor the 5-year review indicate that the vernal pool fairy shrimp can survive in cultivated fields once they are established.

Considering the available location information includes critical habitat and other occupied areas of varying precisions we judge the uncertainty score of this core map to be 3. Substantial additional areas were added to the core map outside of the critical habitat to expand the core map. Locations of occupied pools was available through the CDFW’s vernal pool geodatabase, but with limited precision. No habitat modeling was required.

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

Range Map Approach for Core Map

A core map based on the species range was rejected because the ECOS range map is overly broad and contains large areas of unoccupied habitat. The 2024 5-year review shows that the extant range does not include any areas of the coast range and a much smaller area of the Central Valley.

Critical Habitat Approach for Core Map

A core map based on critical habitat was rejected because, of the known populations, only a subset is on the designated critical habitat.

Habitat Modeling Approach for Core Map

A core map based on modeled habitat was rejected because sufficient location information was available to describe the known locations. The 2024 5-year review notes that a predictive habitat model was created for the vernal pool fairy shrimp in 2013, but only included a subset of extant counties. This modeling is insufficient and outdated to be used as the basis for a core map.

Other sources of information reviewed but not included

Location information from the CNDDDB was evaluated, but these locations were not included in the core map. The CNDDDB data included only a subset of currently occupied areas, but a sufficient subset to be used as a filter step to select occupied hexagonal areas within the vernal pool data layer. The Center has also made a conscious effort to not rely on CNDDDB data to create core maps when other data is available. Sharing CNDDDB data on Bulletins Live Two has not been cleared under the terms of use of CNDDDB data. The vernal pool dataset was judged to be of adequate resolution to form the basis of the core map.

Appendix 1. Information compiled for species during Step 1

1. Recent FWS documents

- Recovery Plan (2005)
https://ecos.fws.gov/docs/recovery_plan/Vernal%20Pool%20Ecosystem%20Final%20Recovery%20Plan.pdf.
- Five Year Review (2024) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/13113.pdf

2. Background information

Status: THREATENED

Resiliency, redundancy, and representation (the 3Rs):

Resiliency – FWS has not formally assessed resiliency in the 2005 Recovery Plan or 2024 5-year review.

Redundancy – FWS has not formally assessed redundancy in the 2005 Recovery Plan or 2024 5-year review.

Representation – FWS has not formally assessed representation in the 2005 Recovery Plan or 2024 5-year review.

Habitat, Life History, and Ecology

Habitat:

The vernal pool fairy shrimp lives in ephemeral, freshwater wetlands often called vernal pools. Vernal pools and other ephemeral wetlands vary depending on topology, soil type, and climate. Vernal pool fairy shrimp can inhabit pools that range in size from small, clear, sandstone rock pools to large, turbid, grassland valley floor pools. Most are found in pools less than 0.05 acres in size. Vernal pool habitats are part of complex, ephemeral drainage systems that develop and change during times of heavy precipitation in the winter and spring. Upland habitat also plays an important role in the ecological function of the pools. The vernal pools are dynamic and harsh ecosystems with highly variable amounts of water followed by drying and long periods of desiccation. The vernal pool fairy shrimp is adapted to this harsh environment by being active and reproduces when water levels are high and lay eggs, or cysts, that remain dormant in the soil at the bottom of the pool or wetland until wet conditions return.¹

Diet:

When active, their diet consists mostly of detritus, but they will opportunistically consume algae, bacteria, protozoa, rotifers, aquatic earthworms, aquatic insects, other fairy shrimp, frog eggs, and tadpoles.²

Taxonomy:

The longhorn fairy shrimp (*Branchinecta lynchi*) is classified as a crustacean in the Branchinectidae family (Order:Anostraca). The species was named to honor James B. Lynch, a North American fairy shrimp taxonomist. The type specimen was collected in 1982 at the Souza Ranch in Contra Costa County, California.³

² Helm BP, Vollmar JE. 2002. Large branchiopods. Wildlife and Rare Plant Ecology of Eastern Merced County's Vernal Pool Grasslands. University of California at Merced:151–190. Page 168.

³ FWS 2005 p. II-196

Taxonomic Hierarchy

Kingdom	Animalia – Animal, animaux, animals
Subkingdom	Bilateria – triploblasts
Infrakingdom	Protostomia
Superphylum	Ecdysozoa
Phylum	Arthropoda – artrópode, arthropods, arthropods
Subphylum	Crustacea Brunnich, 1772 – curtacés, crustáceo, crustaceans
Superclass	Alto crustacea
Class	Branchiopoda Latreille, 1817 – branchiopods, branchiopodes
Order	Anostraca G. O. Sars, 1867 – brine shrimp, fairy shrimp
Suborder	Anostracina
Family	Branchinectidae Daday, 1910
Genus	Branchinecta Verrill, 1869
Species	<i>Branchinecta lynchi</i> Eng, Belk and Eriksen, 1990- vernal pool fairy shrimp

Figure A1-1. Taxonomy from ITIS.

Relevant Pesticide Use Sites:

Agricultural fields
Urban/residential areas

Relevant Recovery Criteria and Actions:

Objective:

From the 2005 Recovery Plan Page viii

The overall goals of this recovery plan are to:

- Achieve and protect in perpetuity self-sustaining populations of each species.
- Delist the 20 federally listed plant and animal species.
- Ensure the long-term conservation of the 13 species of special concern.

Interim goals of this recovery plan are to:

- Stabilize and protect populations to prevent further decline of each species.
- Conduct research necessary to refine reclassification and recovery criteria.
- Reclassify to threatened status those species listed as endangered

The overall objectives of this recovery plan are to:

- Ameliorate or eliminate the threats that caused the species to be listed as federally endangered or threatened, and to ameliorate any newly identified threats, to be able to delist or downlist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any newly identified threats to conserve these species.
- Confirm the status of *Plagiobothrys hystriculus*, a species of concern that is currently presumed extinct. If extant populations are discovered, the ultimate goal would be to ensure the long-term conservation of this species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes.

Criteria:

From the 2024 5-Year Review Page 100-118

Recovery criteria for the three shrimp species are as follows:

1. Habitat protection: Accomplish habitat protection that promotes vernal pool ecosystem function sufficient to contribute to population viability of the covered species.
 - 1A. Suitable vernal pool habitats within each prioritized core area for the species is protected. Downlisting criteria 1A.
 - 1B. Species occurrences distributed across the species geographic and genetic range are protected. Protection of extreme edges of populations protects the genetic differences that occur there.
 - 1C. This is a general criterion for reintroductions and introductions that must be carried out and meet success criteria. However, for downlisting the longhorn fairy shrimp, no reintroductions or introductions are described. Reintroductions and introductions are described for delisting the species.
 - 1D. Additional occurrences (i.e., localities) identified through future site assessments, GIS and other analyses, and status surveys that are determined essential to recovery are permanently protected.
 - 1E. Habitat protection results in protection of hydrology essential to vernal pool ecosystem function, and monitoring indicates that hydrology that contributes to population viability has been maintained through at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of five years of post-drought monitoring.
2. Adaptive habitat management and monitoring:
 - 2A. Habitat management and monitoring plans that facilitate maintenance of vernal pool ecosystem function and population viability have been developed and implemented for all habitat protected in 1A–E above.
 - 2B. Mechanisms are in place to provide for management in perpetuity and long-term monitoring of 1A–E above (i.e., funding, personnel, etc.).
 - 2C. Monitoring indicates that ecosystem function has been maintained in the areas protected under 1A–D for at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of five years of post-drought monitoring.
3. Status surveys:
 - 3A. Status surveys, 5-year status reviews, and population monitoring show populations within each vernal pool region where the species occur are viable (e.g., evidence of reproduction and recruitment) and have been maintained (stable or increasing) for at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of five years of post-drought monitoring.
 - 3B. Status surveys, status reviews, and habitat monitoring show that threats identified during and since the listing process have been ameliorated or eliminated. Site-specific threats identified through standardized site assessments and habitat management planning also must be ameliorated or eliminated.
4. Research:
 - 4A. Research actions necessary for recovery and conservation have been identified (these are research actions that have not been specifically identified in the recovery actions but for which a process to develop them has been identified). Research actions (both specifically identified in the recovery actions and determined through the process) on species biology and ecology,

habitat management and restoration, and methods to eliminate or ameliorate threats that have been completed and incorporated into habitat protection, habitat management and monitoring, and species monitoring plans, and refinement of recovery criteria and actions.

4B. Research on genetic structure has been completed for reintroduction and introduction efforts and results incorporated into habitat protection plans to ensure that within and among population genetic variation is fully represented by populations in 1A–E above.

4C. Research necessary to determine appropriate parameters to measure population viability for each species have been completed.

5. Participation and outreach:

5A. Recovery Implementation Team is established and functioning to oversee rangewide recovery efforts.

5B. Vernal pool regional working groups are established and functioning to oversee regional recovery efforts.

5C. Participation plans for each vernal pool region have been completed and implemented.

5D. Vernal pool region working groups have developed and implemented outreach and incentive programs that develop partnerships contributing to achieving recovery criteria 1–4.

Recovery Actions:

A variety of recovery actions have taken place since the species' listing in 1994 and cannot be described adequately here. An accounting of recovery actions and progress toward recovery criteria can be found in the 2022 5-year review (pages 100-118).

Recommendations for Future Actions:

From 2024 5-Year Review Page 119

1. Conduct large-scale mapping studies outside of the Central Valley to catalog all vernal pool complexes that were present in 2005 and how much still exists today.
2. Create a comprehensive database of all protected lands outside of the Central Valley and update the Central Valley database with newly protected lands since 2017.
3. Establish a Recovery Implementation Team and regional Vernal Pool Working Groups.
4. Assess how many occurrences of each species are still extant and how many are sufficiently protected to contribute to recovery criterion 1B.
5. Conduct genetics studies for the Conservancy fairy shrimp to assess the rangewide phylogeography of all known populations of the species.
6. Establish monitoring and management protocols on all protected lands to collect data that are necessary to assess if vernal pool hydrology, ecosystem function, and population viability of the three shrimp species are being maintained in perpetuity. Research may be needed to determine what data is needed to assess population viability for the three shrimp species.

3. Description of Species Range:

The vernal pool fairy shrimp historically inhabited vernal pools, also known as playas, from the Klamath River and Rogue River watersheds of southern Oregon, south throughout the Central Valley of California to as far south as Los Angeles.

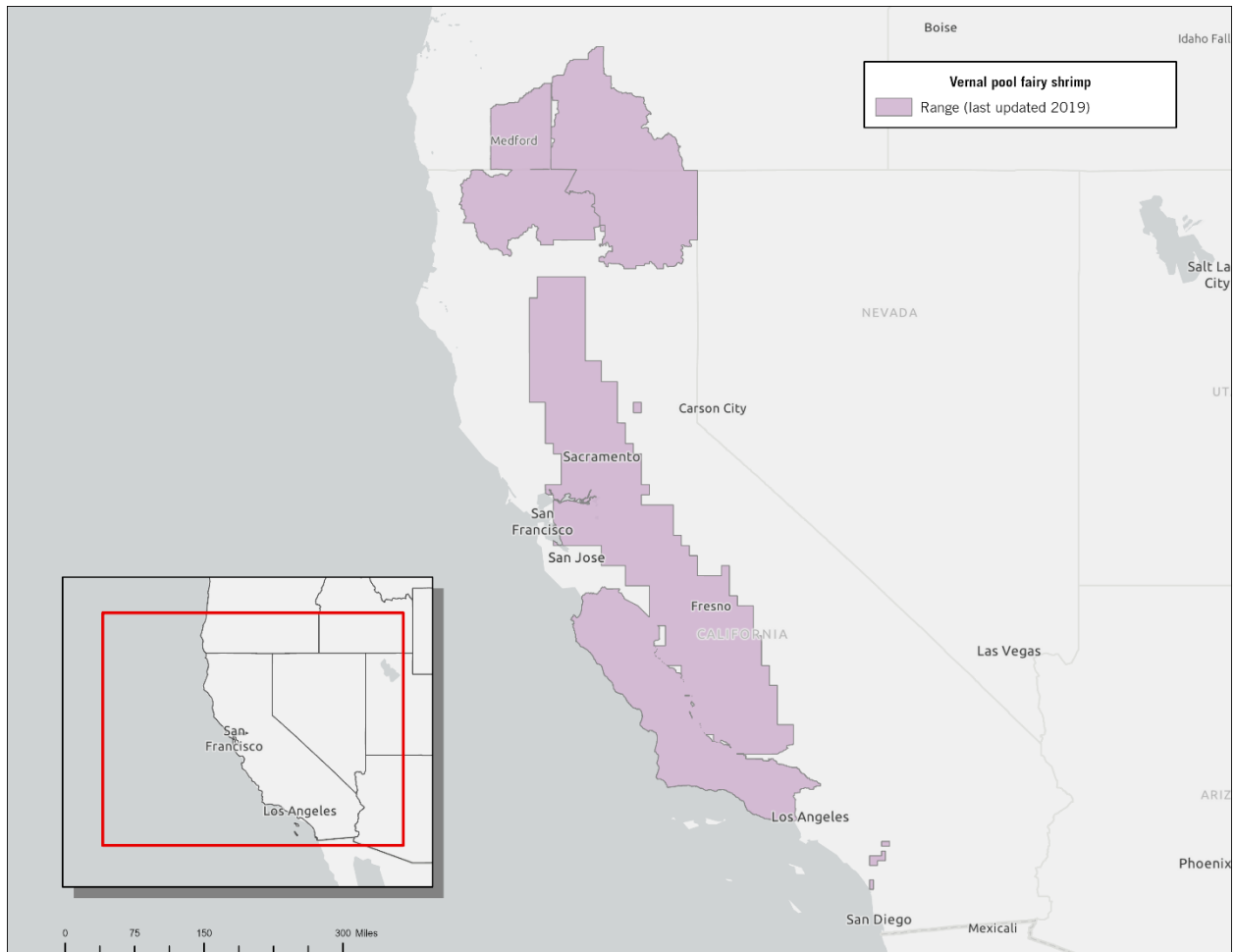


Figure A1-2. FWS range for the vernal pool fairy shrimp from last updated on Dec. 17, 2019. The range is approximately 40,340,362 acres.

4. Critical Habitat:

FWS designated critical habitat for the species in 2006.

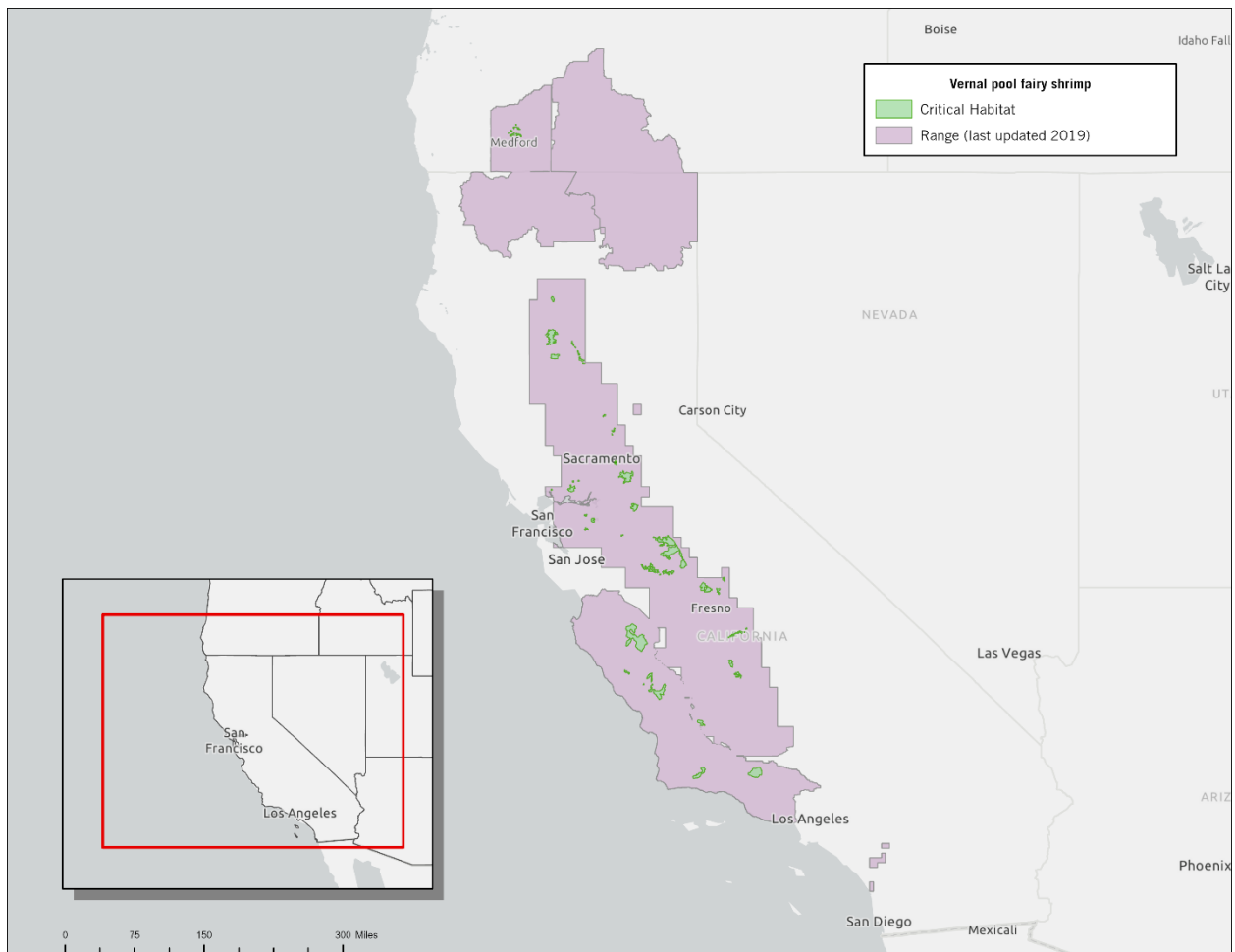


Figure A1-3. Critical Habitat for the vernal pool fairy shrimp. Total acreage of the critical habitat is approximately 597,821 acres.

5. Known Locations

• Known Locations Described in FWS Documents

- The 2024 5-year review of the status of the vernal pool fairy shrimp indicates that based on CNDDDB data and other data sources there are 1038 total occurrences.⁴ Broadly there are 13 distinct vernal pool regions.⁵ The FWS does not provide greater detail on the locations of these occurrences beyond what is depicted in **Figure 2** from the 2024 5-year review. This map (**Figure A1-4**) represents the best available source of location for the species because it incorporates multiples sources of data and is more comprehensive than CNDDDB and has been verified by the FWS.

⁴ FWS 2024 p. 17

⁵ FWS 2024 p. 20

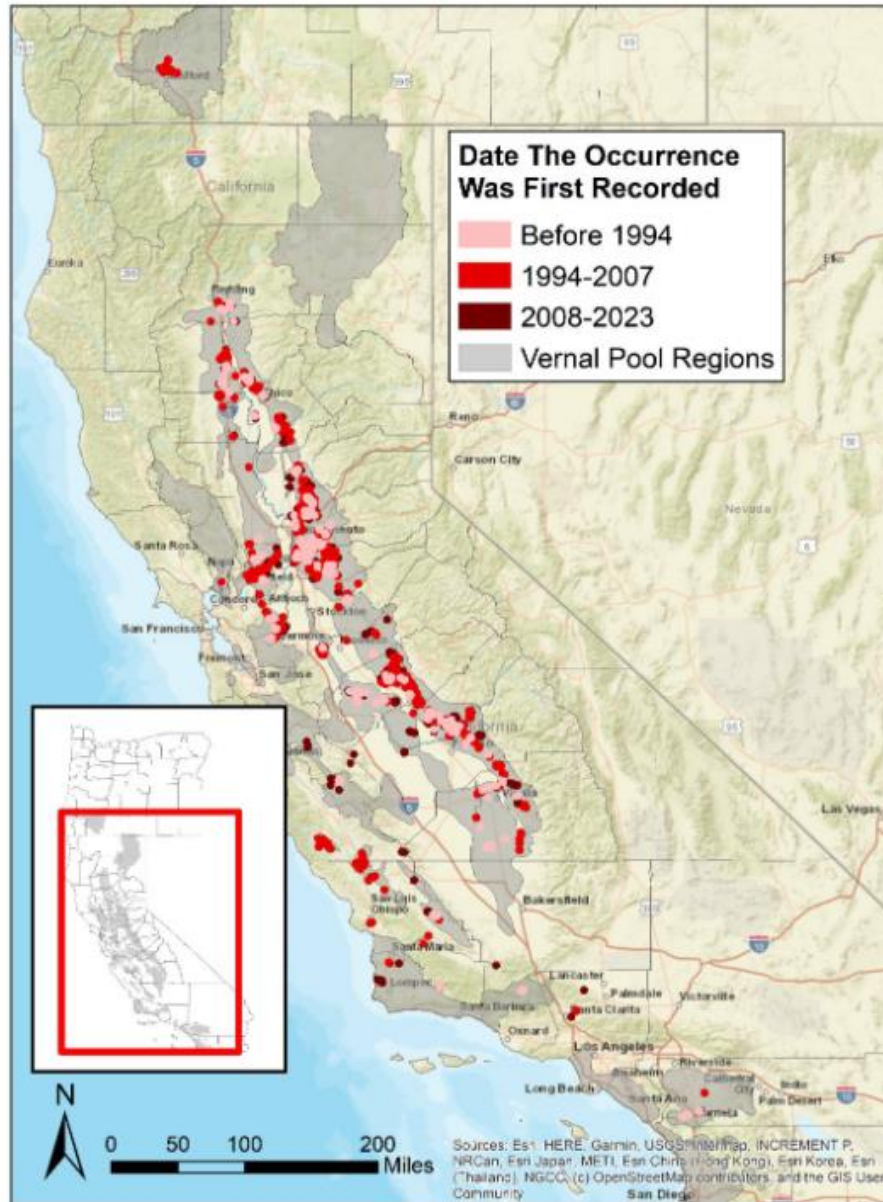


Figure A1-4. Vernal pool fairy shrimp occurrences in California and Oregon as presented in Figure 2 from the 2024 5-year review.

- The CNDDDB had some precise species location information. As of March 2025, the CNDDDB presents 804 occurrences records dated from 1965 to 2022. Of these, 189 could be considered recent (newer than 2010). These occurrences use polygons or points to represent occupied areas.
- **Occurrences Included in Public Databases**
 - EPA queried iNaturalist, GBIF, and NatureServe. Collectively, the occurrence data are consistent with the interim core map.
 - iNaturalist (available [here](#)) had 26 research grade observations for this species in the last 15 years, 13 of which appear to fall outside of the core map; however, the positional accuracy of the points do not allow EPA to determine if these occurrences were in or out of the core

- map.
- GBIF (available [here](#)) included 174 occurrences and human observations in the last 15 years. All of these observations are also included in iNaturalist or NatureServe. GBIF points largely coincide with the interim core map but those that fall outside of the core map can also be accounted for by the resolution of the location data.
 - Occurrences in NatureServe were consistent with other occurrence data (linked [here](#)).

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

The core map type for this species is based on known California Natural Diversity Database (CNDDDB) locations and the 2006 USFWS Critical Habitat shapefile.

The Center for Biological Diversity developed the interim core map by taking all critical habitat units to represent some areas of the core map. Any remaining CNDDDB polygons not already covered by either the critical habitat, yet spatially coincident vernal pool hexagons were used to represent areas of the core map. Some CNDDDB polygons that extend outside the critical habitat polygon less than 100 meters and since these will be covered by the PULA a vernal pool was not used in the core map. Any CNDDDB polygons that extend greater than 100 meters a vernal pool was used in the core map.

This section details the data and steps used to create the core map for the Conservancy fairy shrimp based on this biological information.

1. References and Software

- World UTM Grid:
https://services.arcgis.com/P3ePLMYs2RVChkIx/arcgis/rest/services/World_UTM_Grid/FeatureServer
- Modified Cultivated Layer (Downloaded 01/27/2025)
<https://cdn.arcgis.com/home/item.html?id=159e70ce4c284f5b972c687037f8a668>
- BIOS California Natural Diversity Database (CNDDDB) Government [ds45] Cnddb.shp
- BIOS Vernal Pools - ACE [ds2732] ds2732.shp
- FWS Species critical habitat:
https://ecos.fws.gov/docs/crithab/zip/FCH_Branchinecta_lynchi_20060210.zip
- FWS Species range:
https://ecos.fws.gov/docs/species/shapefiles/usfws_K03G_I01_Branchinecta_lynchi_current_range.zip
- Software used: ArcGIS Pro version 3.2

2. Datasets and Procedures Used in Core Map Development

2.1. Create copy of template EPA polygon and project FWS Critical Habitat shapefile

1. In ArcPro, create a copy of the template EPA polygon shapefile for the vernal pool fairy shrimp, named "Vernal_pool_fairy_shrimp_Poly" (core map shapefile).
2. Select all the records from the "FCH_Branchinecta_lynchi_20060210" (Critical Habitat) shapefile. Copy and paste them into the newly created Vernal pool fairy shrimp shapefile from step 1. (**Figure A2-1**)

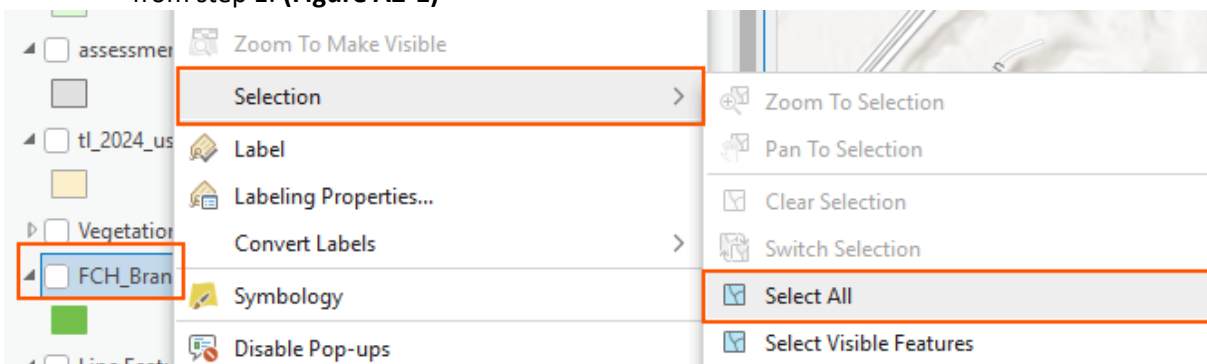


Figure A2-1. Screenshot of steps to select all records in a shapefile

3. Set the definition query in the BIOS California Natural Diversity Database (CNDDDB) Government [ds45] shapefile where “SNAME” = “Branchinecta lynchi”. This filter will show only polygons for vernal pool fairy shrimp and can be used to identify known locations. **(Figure A2-2)**

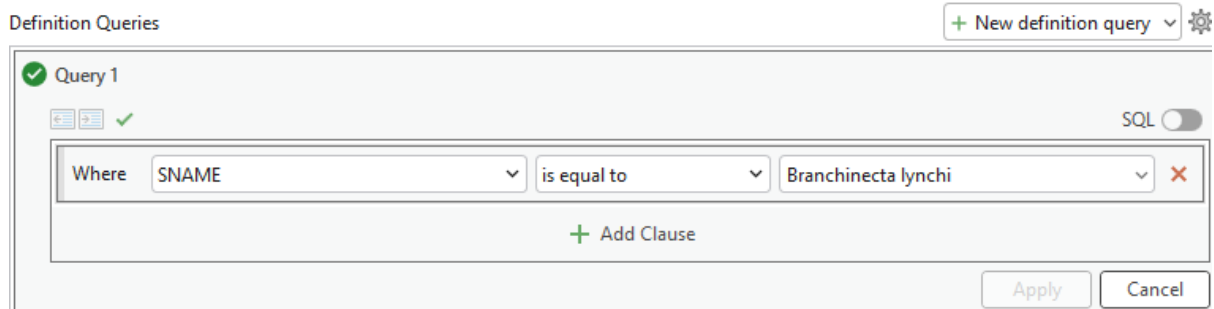


Figure A2-2. Screenshot of definition query

4. A definition query was assigned in the BIOS Vernal Pools - ACE [ds2732] shapefile to only show hexagons that are assigned to contain a vernal pool. **(Figure A2-3)**

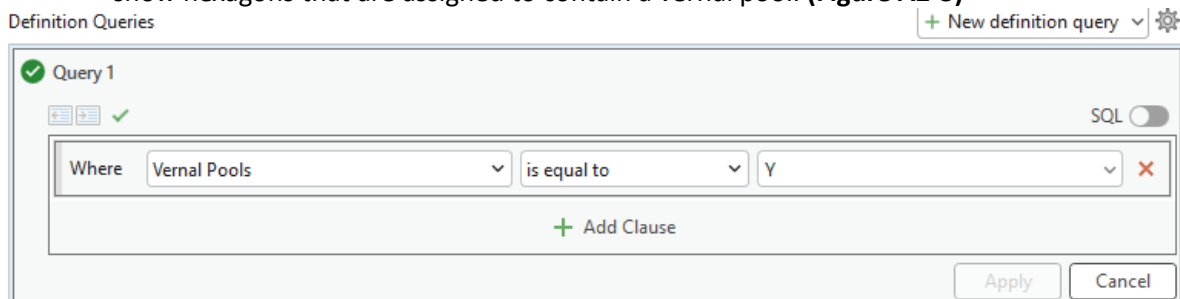


Figure A2-3. Screenshot of definition query

5. Pan and zoomed to remaining delta CNDDDB polygons (CNDDDB polygons minus any areas where they do not intersect with vernal pools). Because there are sources that indicate presence and suitable habitat for the vernal pool fairy shrimp, the vernal pools were copied and pasted into the core map shapefile.
6. For CNDDDB polygons that were partially inside and outside critical habitat, the “Measure” tool was used to determine how far the polygon existed outside these areas. If the measurement was 100 meters or greater and a vernal pool existed in the area, then that vernal pool was added to the core map. If it was less than 100 meters, the core map was left as is.
7. To confirm that all CNDDDB polygons have core map polygons that intersect them, use the “Select by Location” tool, with CNDDDB as the input feature, “Intersect” as the relationship, “Vernal_pool_fairy_shrimp_Poly” and the selecting feature, search distance is blank, and the “Invert Spatial Relationship” box is checked. If non CNDDDB polygons are selected, then all CNDDDB polygons have a “Vernal_pool_fairy_shrimp_Poly” that covers it. **(Figure A2-4)**
(Figure A2-5)

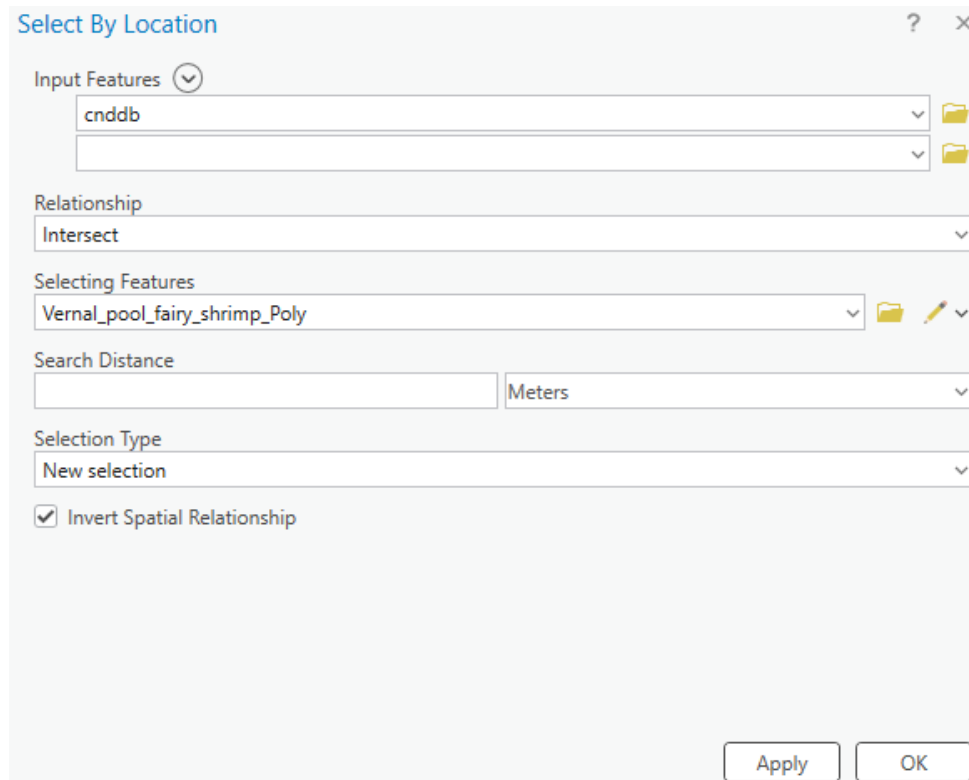


Figure A2-4. Screenshot of “Select by Location” tool

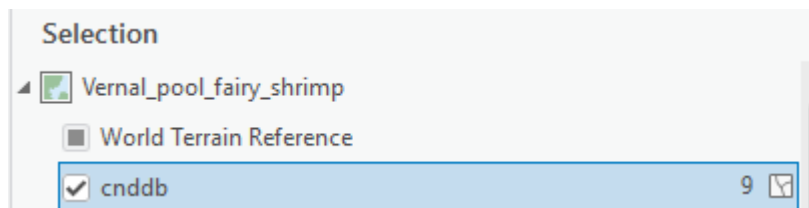


Figure A2-5. Screenshot of Result and “Select by Location tool is applied

8. There were 9 CNDDDB polygons selected. Turned on the BIOS Vernal Pools - ACE [ds2732] shapefile that has a definition query to show only hexagons that have “Y” in the vernal pool field. Zoomed to each selected record and find that a spatially coincident hexagon does not exist. Since there is no “Vernal pool”, the “Vernal_pool_fairy_shrimp_Poly” was not updated.

2.2. Use EPA’s “CultivatedAreas_Over25acres” to “Pairwise Erase” Vernal _pool_fairy_shrimp_Poly

1. When testing “Pairwise Erase” process to refine the core map boundaries, it showed that a unit in the critical habitat was significantly erased. So, to ensure that this does not happen, a definition query on “Vernal_pool_fairy_shrimp_Poly” was used to exclude them. “Description” does not begin with “Vernal pool fairy shrimp final critical habitat”. **(Figure A2-6)**

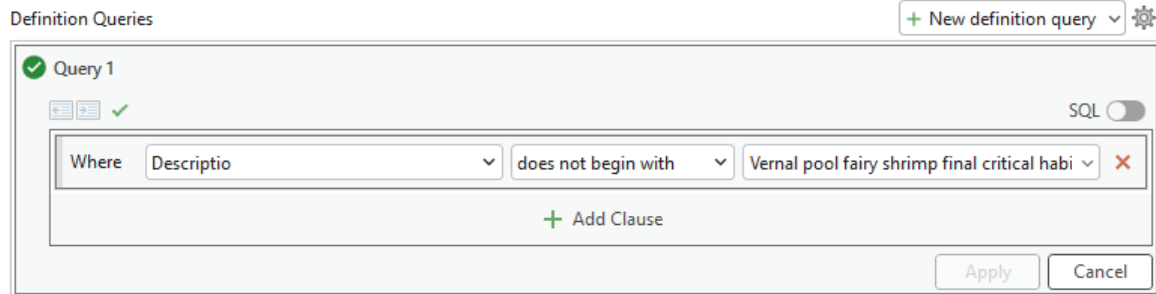


Figure A2-6. Screenshot of Definition Query

2. As an effort to refine the core map boundaries, use “Pairwise Erase” to erase the core map “Veranl_pool_fairy_shrimp_Poly” by “CultivatedAreas_Over25acres”. The resulting layer is named, “Vernal_pool_fairy_shrimp_NoCultLand”. **(Figure A2-7)**



Figure A2-7. Screenshot of “Pairwise Erase” tool

3. A new definition query is set in the “Vernal_pool_fairy_shrimp_Poly”. “Descriptio” begins with “Vernal pool fairy shrimp critical habitat”. **(Figure A2-8)** Select all the “Vernal_pool_fairy_shrimp_Poly” records, copy and paste them into “Vernal_pool_tadpole_shrimp_NoCultLand”.

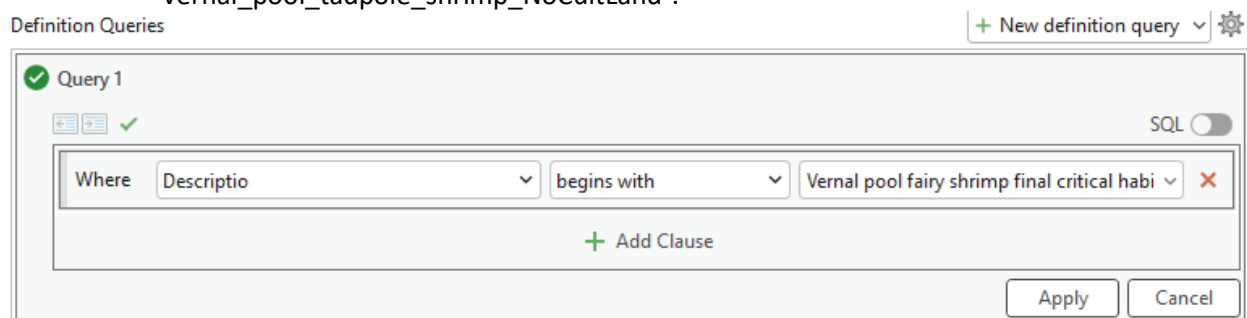


Figure A2-8. Screenshot of Definition Query

4. Use the “Select by Location” tool with the “Invert Spatial Relationship” to check to see if any CNDDDB polygons were now not covered after the “Pairwise Erase” tool. The result is 27 of 804 CNDDDB polygons were selected. This is an acceptable low percentage. **(Figure A2-9)**
(Figure A2-10)

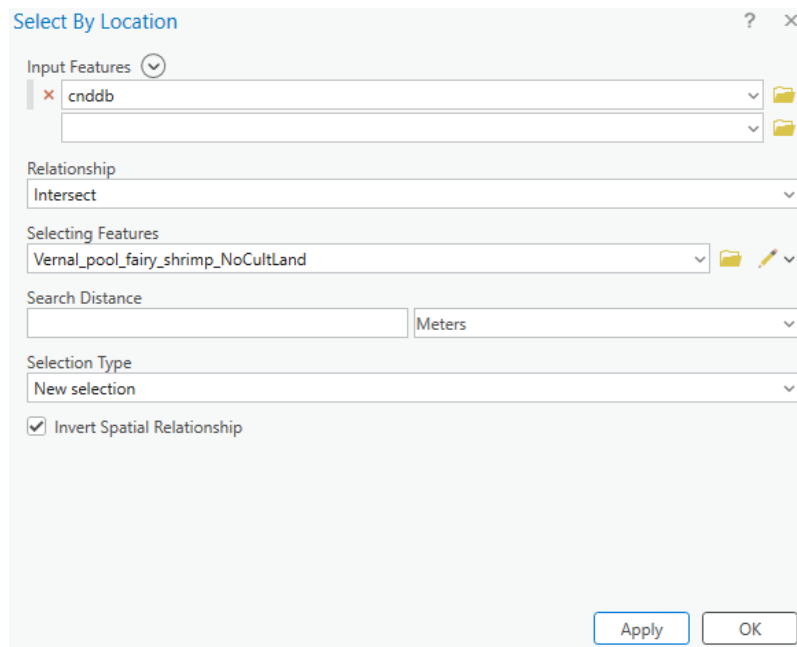


Figure A2-9. Screenshot of “Select by Location” tool

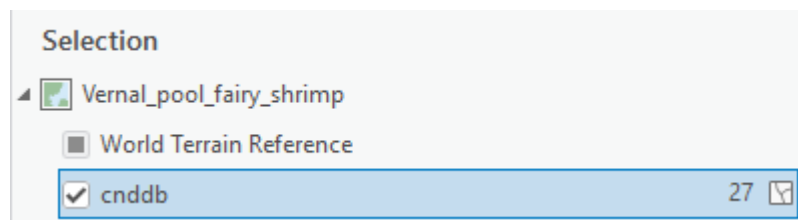


Figure A2-10. Screenshot of Results from “Select by Location” tool

2.3. Use EPA’s QA/QC process to remove small, disconnected patches less than 2 acres

1. Buffer “Vernal_pool_fairy_shrimp_NoCultLand” by 1,000 US survey feet, with the option “Dissolve all output features into a single feature” choice. The output feature class is named, “Vernal_pool_fairy_shrimp_NoCultLand_Buffer”. **(Figure A2-11)**

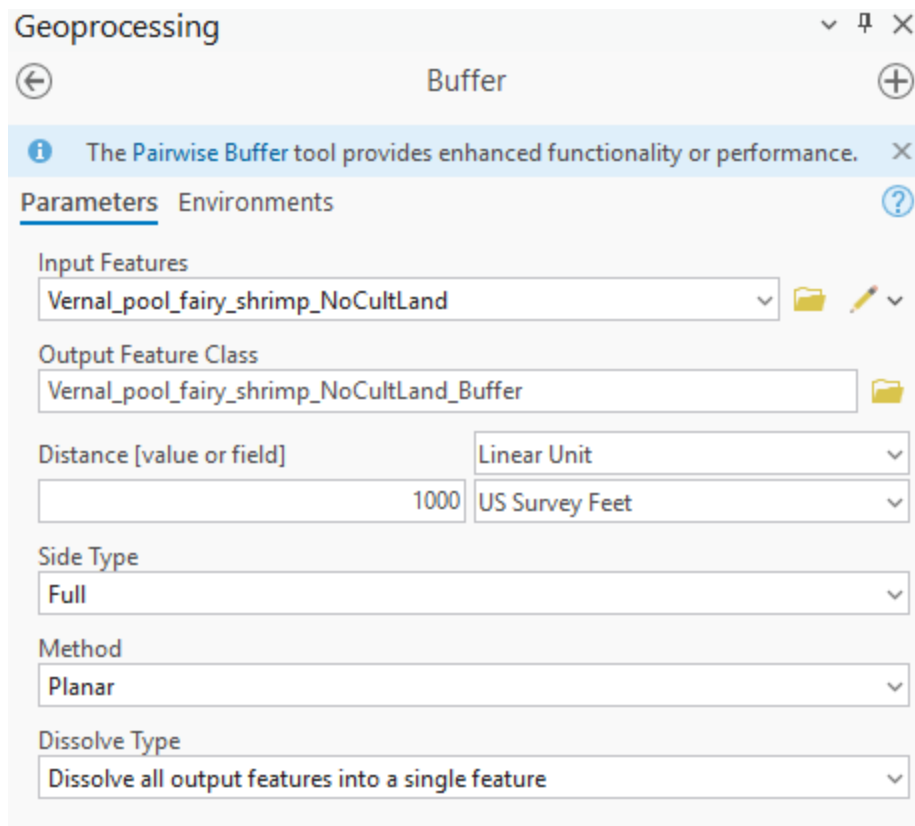


Figure A2-11. Screenshot of “Buffer” tool

2. Use the “Eliminate Polygon Part” tool as step 1 to eliminate polygon parts that are less than 2 acres and more than 1,000 feet away from another polygon. The resulting output is named, “Vernal_pool_fairy_shrimp_No2Acre”. **(Figure A2-12)**

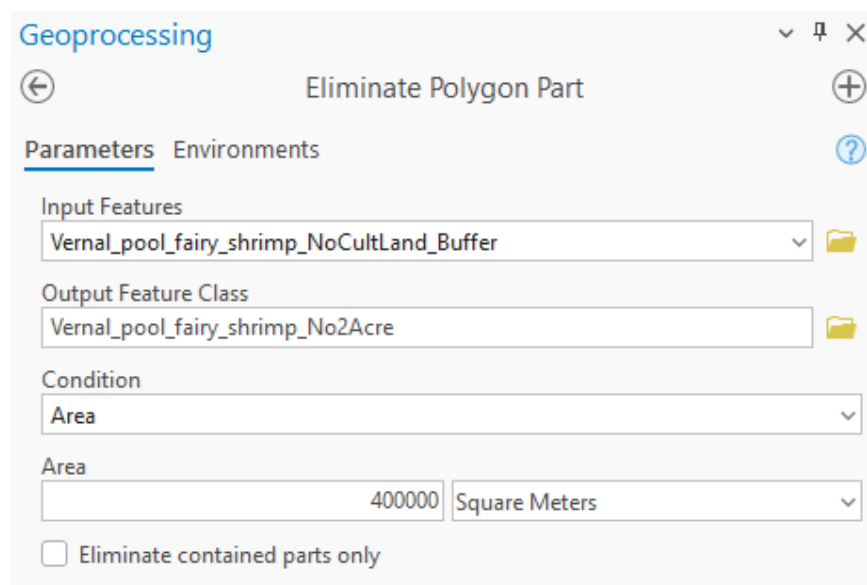


Figure A2-12. Screenshot of “Eliminate Polygon Part” tool

3. Use “Pairwise Clip” tool as step 2 to remove any polygon parts that are less than 2 acres and more than 1,000 feet away from another polygon. The resulting output is named, “Vernal_pool_fairy_shrimp_Poly_Clip”. **(Figure A2-13)**

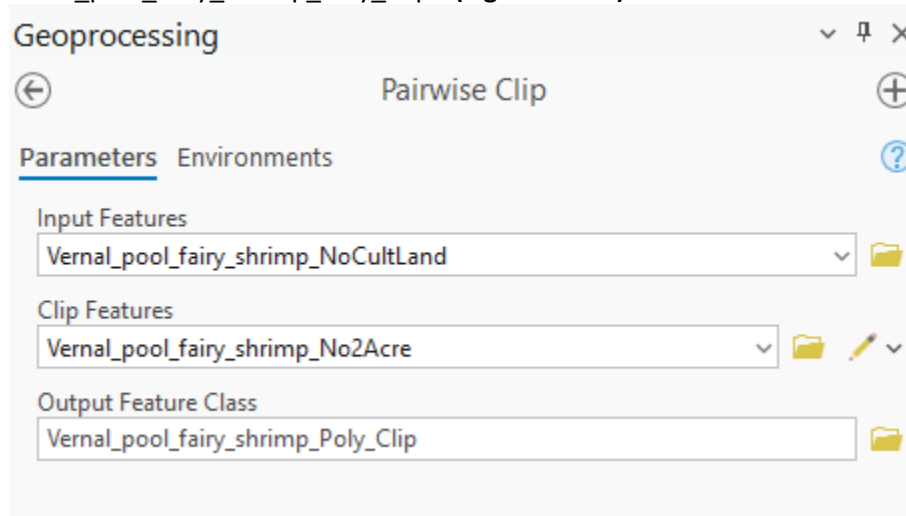


Figure A2-13. Screenshot of “Pairwise Clip” tool

2.4. Use EPA’s QA/QC process to “smooth” by filling in gaps or holes and update attributes

1. Use the “Dissolve” tool to merge polygons from “Vernal_pool_fairy_shrimp_Poly_Clip” into one polygon. The resulting output is named, “Vernal_pool_fairy_shrimp_Poly_Dissolve” **(Figure A2-14)**

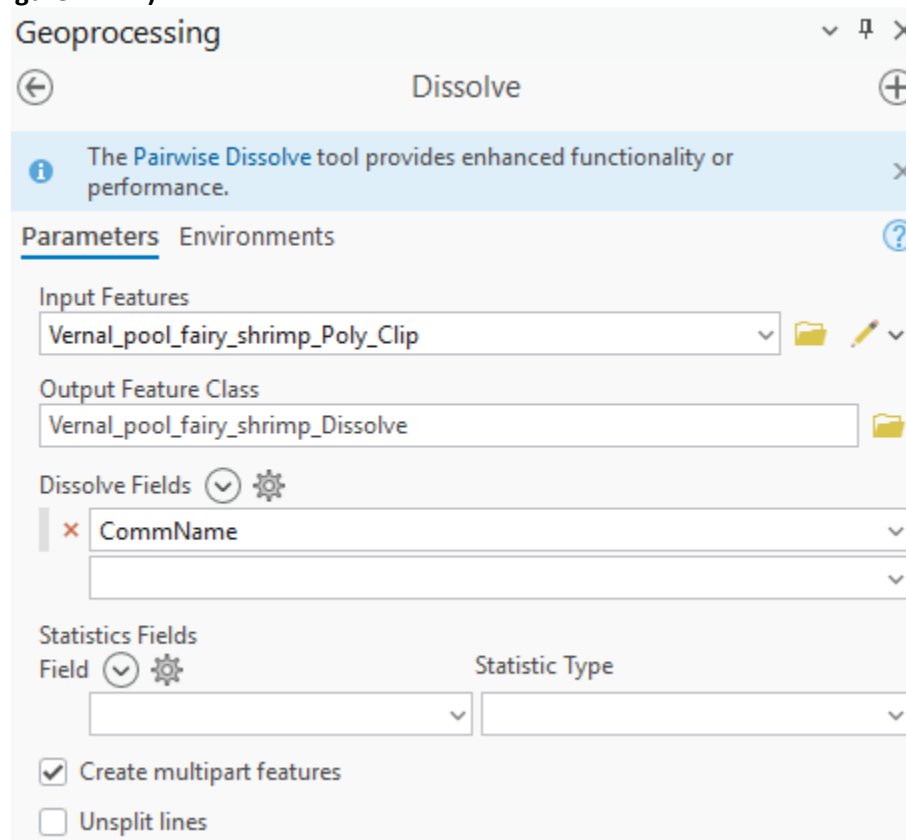


Figure A2-14. Screenshot of “Dissolve” tool

2. Use the “Eliminate Polygon Part” tool to fill in gaps and holes less than 25 acres. Resulting output is named, “Vernal_pool_fairy_shrimp_Poly_smooth”. (Figure A2-15)

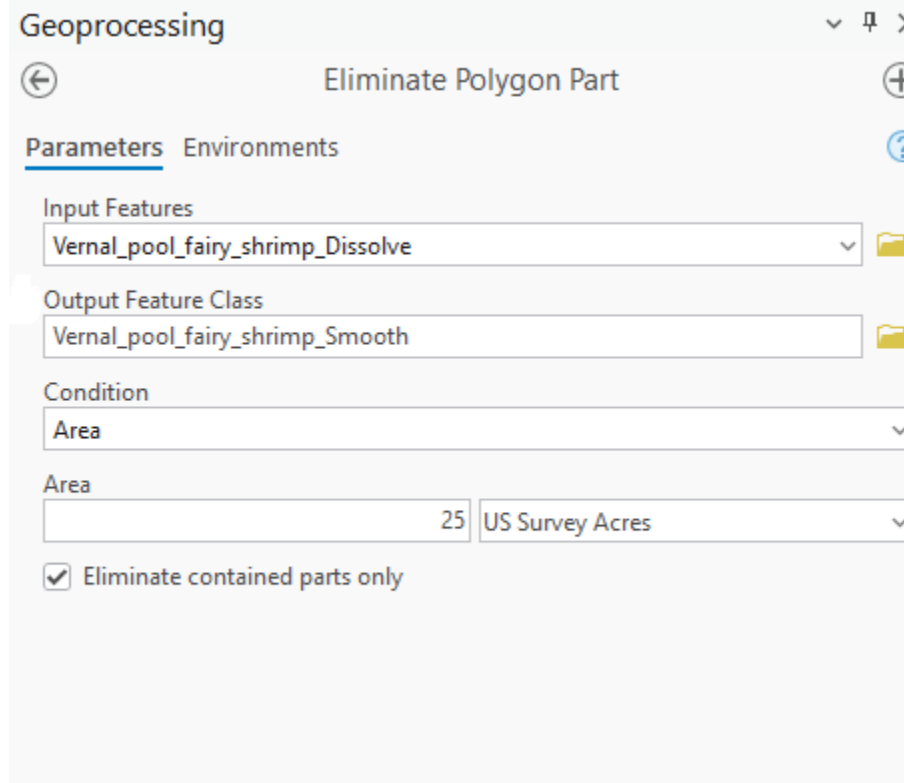


Figure A2-15. Screenshot of “Eliminate Polygon Part” tool

4. Although the “Eliminate Polygon Part” tool can remove internal gaps and holes less than 25 acres, it is possible that narrow strips that are less than 2 meters wide that will not be removed. The layer was reviewed manually. In this case, no narrow strips existed.

2.5. Update Attributes and “Calculate Geometry”

1. Create a copy of the template EPA polygon shapefile for Vernal pool fairy shrimp, named “Vernal_pool_fairy_shrimp_Poly_Final” (core map shapefile). Copy and paste from “Vernal_pool_fairy_shrimp_Poly_smooth” to “Vernal_pool_fairy_shrimp_Poly_Final”.
2. Since there is only one record in “Vernal pool fairy shrimp”, update each field manually with:
 - a. CommName = " Vernal pool fairy shrimp"
 - b. SciName = “Branchinecta lynchi”
 - c. Description = “Areas of USFWS Vernal pool fairy shrimp (VPFS) critical habitat and CDFW Vernal pool hexagons overlapping CNDDDB occurrences outside of critical habitat. All clipped by EPA Cultivated Land.”
 - d. Category = “Area of occupancy”
 - e. EPA_Code = “493”
 - f. FWS_Code = " K03G"
 - g. CBD_Code = " 2860"
 - h. Heritage = “0”
 - i. ECOS_WebPg = <https://ecos.fws.gov/ecp/species/498>

2. Turned on the “World UTM Grid” layer and identified the UTM zone as “10”. Right-clicked on the “Acres” field and left-clicked on “Calculate Geometry”. “Calculate Geometry” dialog box appears. Selected “Area” under “Property”, “US Survey Acres” in “Area Unit” and “NAD_1983_UTM_Zone_10N” in the Coordinate System” boxes. Click Apply. Click OK. (Figure A2-16)

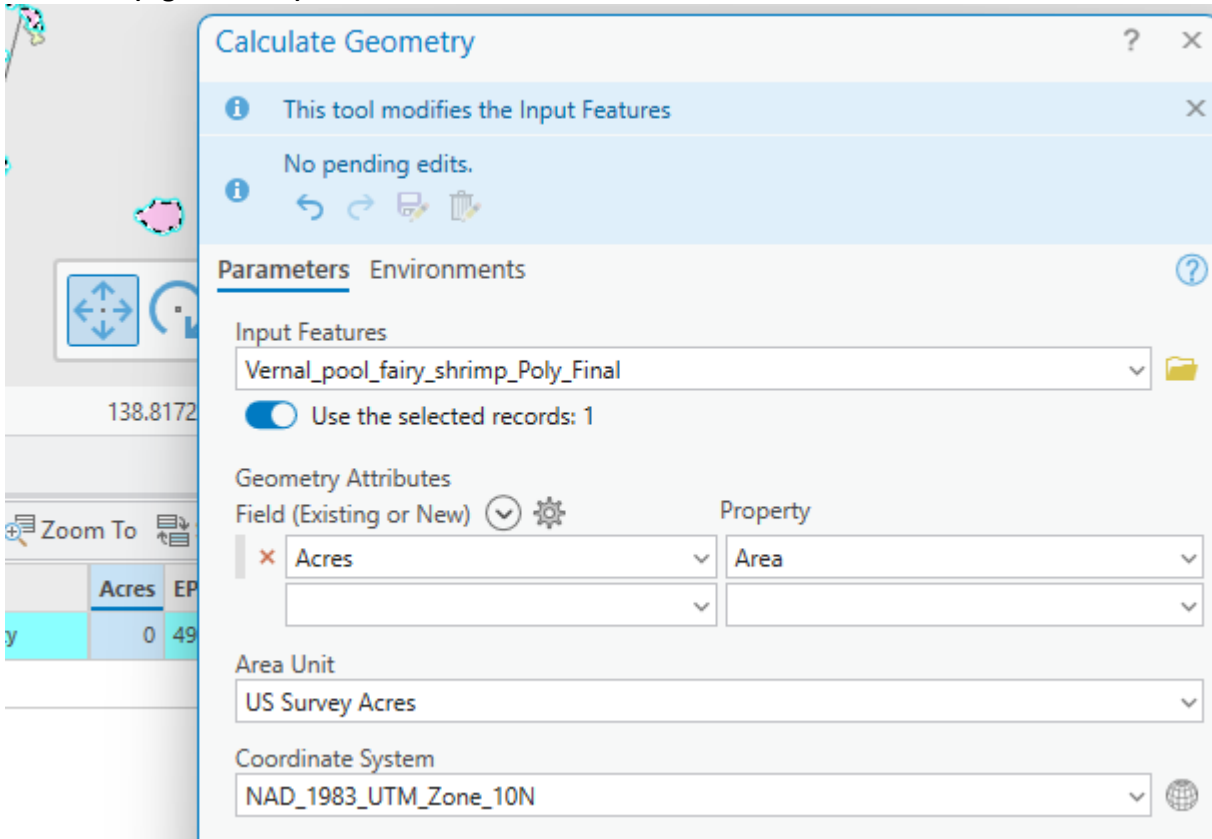


Figure A2-16. Screenshot “Calculate Geometry”

2.6. Use Download USA NLCD Land Cover raster process to determine Percentage of Interim Core Map Represented by NLCD Land Covers

1. Using the MRLC viewer (<https://www.mrlc.gov/viewer/>) and uploaded a shapefile of area to use as an extent to download the NLCD that covers all the “Vernal_pool_fairy_shrimp_Poly” records. (Figure A2-17) The file was downloaded and added to ArcPro and renamed, “NLCD_VPFS_Area.tiff”.

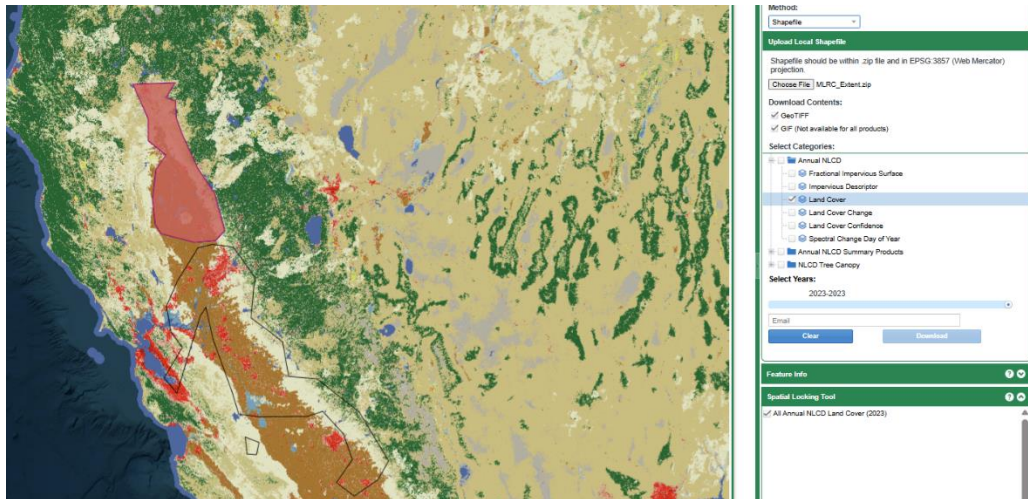


Figure A2-17. Screenshot MRLC Viewer with Shapefile extent

2. The “Extract by Mask” tool was used with “NLCD_CFS_Area.tiff” filtered by the same area within “Vernal_pool_fairy_shrimp_Poly” as the extent. (Figure A2-61) In the “Environments” tab, changed the output coordinate system to match “Vernal_pool_fairy_shrimp_Poly”, which in this case is “USA_Contiguous_Albers_Equals_Area_Conic_USGS_version”. The output was named, “NLCD_MaskArea1”. **(Figure A2-18) (Figure A2-19)**

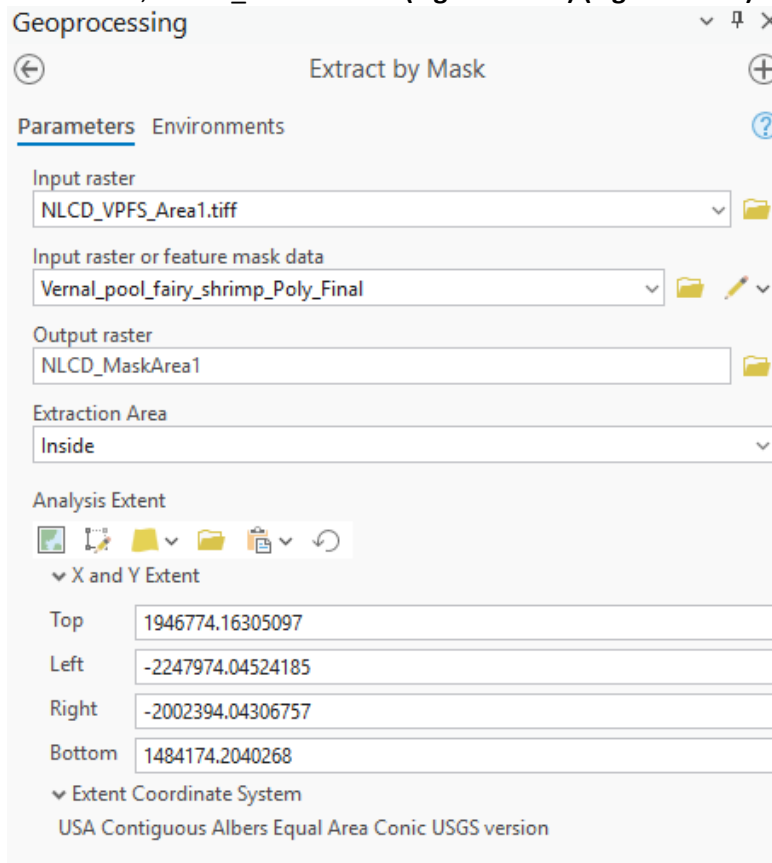


Figure A2-18. Screenshot “Extract by Mask” tool Parameters

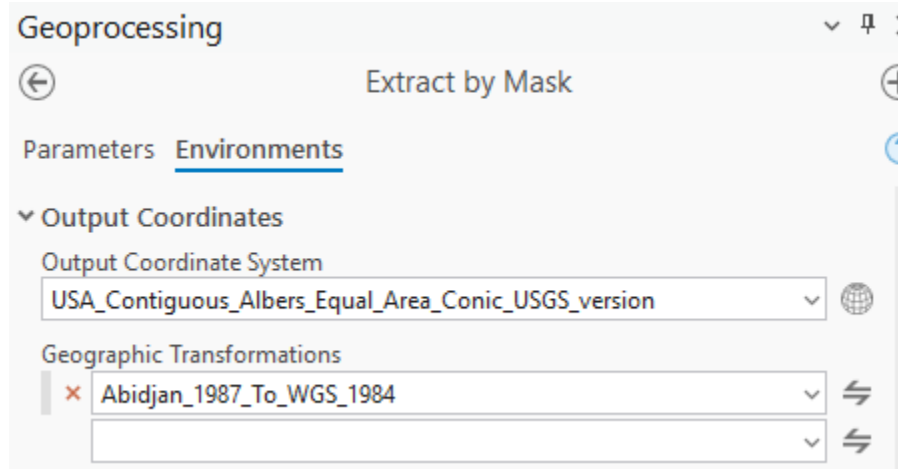


Figure A2-19. Screenshot “Extract by Mask” tool Environment

3. Use the “Mosaic To New Raster” tool to gather all five into one output. **(Figure A2-20)**

Geoprocessing ⌵ 📌 ✕

⬅️ Mosaic To New Raster ➕

Parameters Environments ?

Input Rasters ⌵

NLCD_MaskArea1	⌵	📁
NLCD_MaskArea2	⌵	📁
NLCD_MaskArea3	⌵	📁
NLCD_MaskArea4	⌵	📁
✕ NLCD_MaskArea5	⌵	📁
	⌵	📁

Output Location

EPA_Vernal_pool_fairy_shrimp.gdb 📁

Raster Dataset Name with Extension

NLCD_1_2_3_4_5

Spatial Reference for Raster

USA_Contiguous_Albers_Equal_Area_Conic_USGS_version ⌵ 🌐

Pixel Type

8 bit unsigned ⌵

Cellsize

Number of Bands 1

Mosaic Operator

Last ⌵

Mosaic Colormap Mode

First ⌵

Figure A2-20. Screenshot “Mosaic To New Raster”

4. Used the “Tabulate Area” tool to determine the count of area for each NLCD code. **(Figure A2-21)**

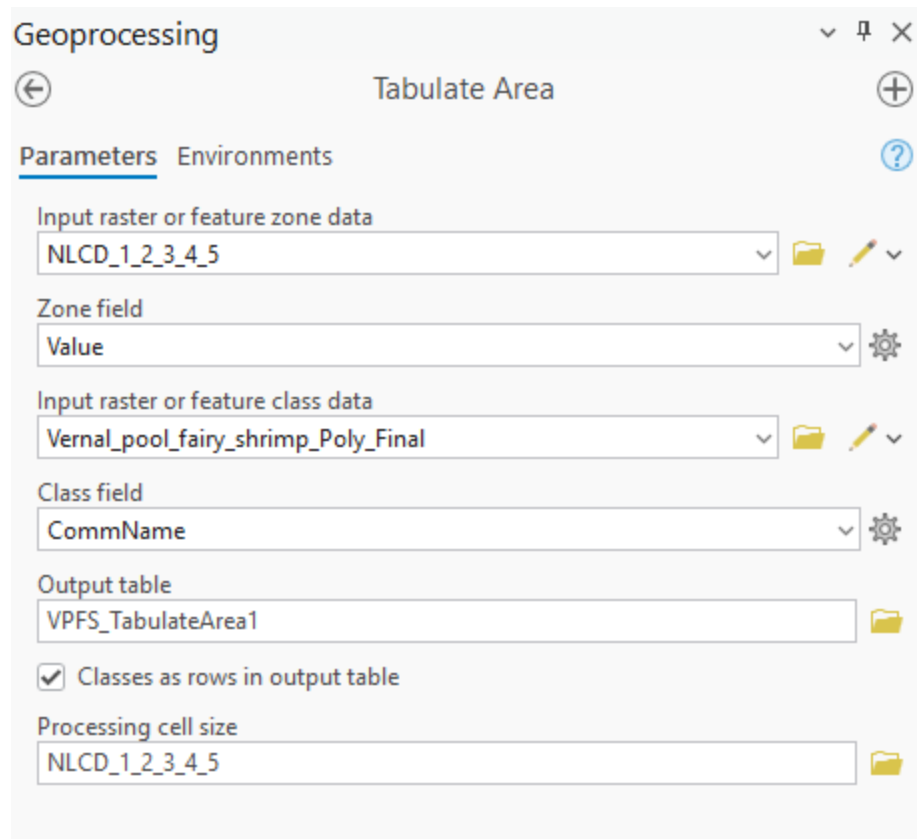


Figure A2-21. Screenshot “Tabulate” tool

5. Add a double field named, “Per” to the “CFS_TabulateArea1” table. Right clicked on field and selected “Calculate Field”. Entered the formula “(!Count!/ 5625914)*100”. This calculates the percentage of NLCD within the core map area. **(Figure A2-22)** Review results and input into (Table 1. Percentage of Interim Core Map Represented by NLCD Land Covers and Associated Example Pesticide Use Sites/Types.)

118.0657416°W 35.

Attributes Zoom To Switch

CODE	Count	Area	Per
1	35449	31904100	<Null>
1	249323	224390700	<Null>
1	184823	166340700	<Null>
1	224897	202407300	<Null>
1	37735	33961500	<Null>
1	28927	26034300	<Null>
1	3015	2713500	<Null>
1	46892	42202800	<Null>

Expression

Fields

Helpers

OBJECTID
Value
CommName
CLASS_CODE
Count
Area
Per

.as_integer_ratio
.capitalize()
.center()
.conjugate()
.count()
.decode()
.denominator()

Insert Values

Per =

(!Count!/5625914)*100

Code Block

Figure A2-22. Screenshot “Tabulate” tool