Core Map Documentation for the Mitchell's Satyr Butterfly (*Neonympha mitchellii mitchellii*)

Posted to EPA's GeoPlatform: July 2025

Interim Core Map Developer: Center for Biological Diversity

Species Summary

A widespread species, the Mitchell's satyr butterfly (entity ID: 424) is currently known from Alabama, Indiana, Michigan, Mississippi, and Virginia. This butterfly is associated with wetland fen habitat that contain its larval hostplants including tussock sedge and other sedges and grasses (*Carex stricta*, *Carex leptalia*, *Poa palustris*, *Panicum sp.*).[1] Location information comes from the 2021 5-year review indicates there are remaining populations in Michigan (9), Indiana (1), Alabama (28), Mississippi (15), and Virginia (11). Most sites are on public land, with some sites on private land. The wetland fen habitat for Mitchell's satyrs has been severely impacted by agriculture and urbanization. Pesticide drift and runoff from adjacent agricultural land especially of neonicotinoid insecticides is mentioned as a present threat to the species in the 2021 5-year review.

EPA Review Notes

The developers created this core map using the U.S. Environmental Protection Agency's (EPA) 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 EPA's mapping process. This documentation was not prepared by EPA, but EPA may have edited this documentation for clarity or other purposes.

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.

[1] FWS 1998 p. iii

Description of Core Map

The core map for Mitchell's satyr is biological information type based on known locations as described in published FWS documents. The species is found in five states and 19 counties. No precise map of known locations are available, but known locations are described in the 2021 5-year review (see Appendix 1). We used several different datasets (described in Appendix 2) to identify place names within counties described. The occupied locations were drawn based on available information such as national hydrology database polygons, public land polygons, private ownership parcels, species biological information, or a combination. The core map area in Floyd County, Virginia was based on a spatial distribution model provided with permission[2] by the Virginia Department of Conservation and Recreation, Natural Heritage Program.[3]

Mitchell's satyr is a wide-ranging species and with only general place names to describe the location the Center made assumptions about the location and size of occupied areas. These assumptions introduced further uncertainty. The Center used best professional judgement to map occupied areas based on named locations and biological information. Given the uncertainty in the map, we score this core map as a 4 ("moderate") for best professional judgement.

[2] Use license included in Appendix 3.
[3] Virginia DCR model is current as of 5/2025.

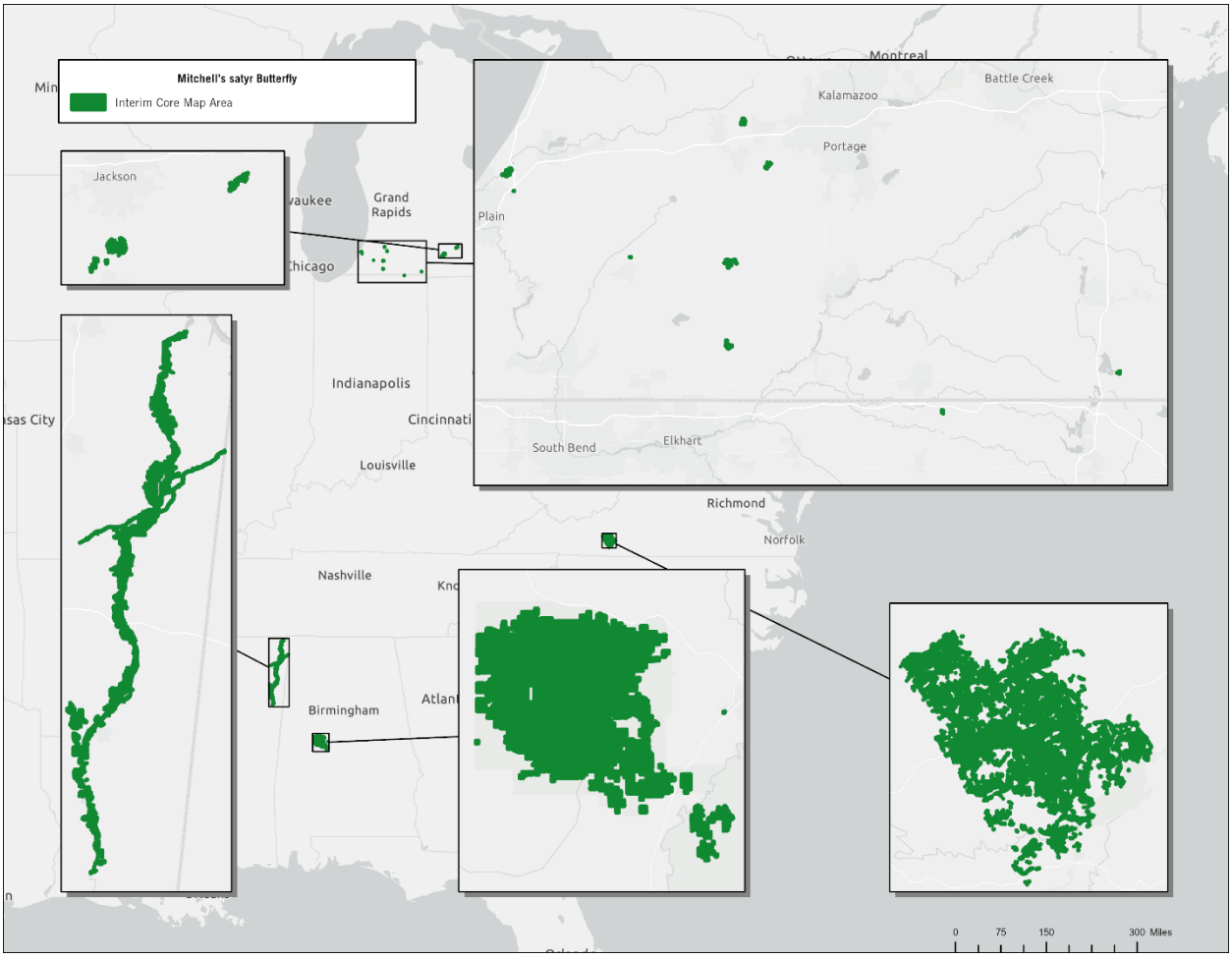

Figure 1. Mitchell's satyr interim core map. Total acreage of all Core Map area is approximately 198,400 acres.

Table 1. Percentage of Interim Core Map Represented by NLCD[1] 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)	17.2	55.7
Forestry	Evergreen Forest (42)	22.2	
Forestry	Mixed Forest (43)	16.3	
Agriculture	Pasture/Hay (81)	12.4	12.5
Agriculture	Cultivated Crops (82)	.1	

Example pesticide use sites/types	NLCD Landcover (Value)	% of core map represented by landcover	% of core map represented by example pesticide use
Mosquito adulticide, residential	Open space, developed (21)	5.3	6.3
Mosquito adulticide, residential	Developed, Low intensity (22)	.9	
Mosquito adulticide, residential	Developed, Medium intensity (23)	.1	
Mosquito adulticide, residential	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	20.2	25.5
Invasive species control	Emergent Herbaceous Wetlands (95)	.8	
Invasive species control	Open water (11)	.8	
Invasive species control	Grassland/herbaceous (71)	1.3	
Invasive species control	Scrub/shrub (52)	2.1	
Invasive species control	Barren land (rock/sand/clay; 31)	.3	

Evaluation of Known Location Information

- General occurrence information presented in the 2021 5-year review

FWS's 2021 5-year review is the best and most comprehensive source of information for this species. No Species Status Assessment has been completed for Mitchell's satyr. Precise location information was not presented in either the 5-year review or Recovery Plan, but general county-level location information and a broad scale range map were provided (see Appendix 1).

- Mitchell's Satyr Butterfly and Poweshiek Skipperling Habitat Conservation Plan (HCP)

The 2020 HCP provides additional overview and description of the species. This HCP was reviewed by FWS and is considered a reliable source of information that is supplemental to the 2021 5-year review. The HCP provides a table of known locations across the range.[4] The location names mention place names of specific natural and man-made features that will be used to refine the core map.

- iNaturalist, NatureServe, and Global Diversity Information Facility (GBIF)

GBIF had 50 records of Mitchell's satyr. Of these 8 were from iNaturalist, and 40 are also within the NatureServe records. iNaturalist had 52 research grade observations of Mitchell's satyr which aligned generally with the occupied areas identified in the core maps. No precise coordinates are available for any records. NatureServe contains general location information for the species in Michigan and Indiana only. Due to the generalized locations of the occurrences this data could only be used as a general way to reduce the amount of non-habitat within counties.

Approach Used to Create Core Map

The core map for Mitchell's satyr used place names, natural features, and species biological information to designate specific areas for the core map.

There is no comprehensive, precise map of delineated and occupied wetland habitat available to the public. The 2021 5-year review is the primary source of location information that we used to designate core map areas. This 5-year review provides only a county-level map of the current distribution. A county-level PULA would be very overly broad considering that the species is known to inhabit only specific fen wetlands. The 2021 5-year review indicates that occupied areas range in size from 5 acres to 192 acres.[5] The 2021 5-year review and 2020 HCP also provides general place names for occupied sites. The list of place names is included in Table 2 and in Table A1-1.

To narrow the core map to below county-level, we used various data sources (described in Appendix 2) to identify the most likely location of these named sites considering that the species requires specific wetlands and most likely persists on protected lands. Occupied sites are likely to be small. A minimum habitat size for a viable population is not defined in the recovery plan, but the Recovery Plan indicates that historic fens complexes could be as large as "several hundred acres".[6] For every named site, we searched for corresponding natural and anthropogenic features. Many fen wetland and other sites are identified by name in the National Hydrology Database (NHD) and when there was a matching entry in the NHD, the entire area of the NHD wetland was included in the core map. When site names did not match the NHD, conservation areas or private lands areas were included on a case-by-case basis. Some sites were refined with other information such as the Lower Paw Paw River site in Berrien County, Michigan that was refined to include only the Sarett Nature Center where Mitchell's satyr butterflies have been found.[7] When bodies of water were named as occupied areas and not conservation areas were present in the area, wetlands within 1 mile of an occupied stream, lake, or water feature were included to address uncertainty in the location and to include potential habitat for dispersal. A 1-mile buffer was used as a conservative distance that is likely to capture the habitat but is not more than 2X

[4] MDNR 2020 HCP pp. 20-21.
[5] FWS 2021 p. 11
[6] FWS 1998 p. 9
[7] https://www.mlive.com/galleries/U4DXSNILMBG4RLJ3VKT7W5WOXE/

the size of a large, occupied wetland adjacent to the named feature.[8] Only one site (Skiff Lake) used this approach.

Identifying occupied sites based on general place names will include some unoccupied and non-habitat areas. When uncertainty required the inclusion of additional area, nearby conservation lands[9] were preferentially added. Protecting these areas of valuable habitat from pesticide exposure can increase connectivity and the resilience, representation, and redundancy (3Rs) for the species. Habitat fragmentation and barriers to dispersal (including pesticides) have been highlighted as significant threats to the species.[10]
The core map area in Floyd County, Virginia was based on a spatial distribution model provided with permission[11] by the Virginia Department of Conservation and Recreation, Natural Heritage Program.[12]

Table 2. Place names for Michell's satyr from the 2021 5-year review with notes on core map creation for each site.

State	Location	Description of Mapped Area
Alabama	Oakmulgee Ranger District of the Talladega National Forest	Entire Oakmulgee Range District of the Talladega National Forest (Clipped by Range)
Indiana	LaGrange County	Indiana parcels purchased and set aside by Central Indiana Land Trust
Michigan	Berrien County	**Blue Creek Fen**: extracted from PAD-US **Paw Paw Prairie Fen**: extracted from PAD-US **Lower Paw Paw River Site**: considered to be located on the privately held lands of the Sarett Nature Center where the species has been found[13]
Michigan	Branch County	**Coldwater Lake Fen**: extracted from USGS PAD-US
Michigan	Cass County	**Cook Lake Rudy Rd. Fen:** extracted by PAD-US (Unit Name is Cook Lake Fen) **Tamarack Swamp:** extracted by PAD-US **Shavehead Lake**: Private lands see GIS data for further detail
Michigan	Jackson County	**Grand River Fen:** extracted by PAD-US **Skiff Lake**: extracted from NHD water bodies Skiff Lake, 1 mile buffer, clip intersected National Wetland Inventory
Michigan	Van Buren County	**Cedar Creek Fen**: extracted from PAD-US (Unit name is Portman)

[8] The 2013 5-year review indicates that occupied wetland habitats for the species range in size from 5-190 acres. A hypothetical, circular 200ac habitat would have a diameter of ~0.66mile.
[9] We define conservation lands very broadly to include both publicly and privately held lands with at least some conservation objective. This can include but is not limited to: National Wildlife Refuges, State Wildlife Management Areas, National Forests, BLM lands, Land Trust properties, Nature Conservancy properties and other lands held by Non-governmental organizations. Conservation lands should be protected from pesticide exposure and have little or no justification for the use of pesticides.
[10] FWS 2021 p. 20
[11] Use license included in Appendix 3.
[12] Virginia DCR model is current as of 5/2025.
[13] https://www.mlive.com/galleries/U4DXSNILMBG4RLJ3VKT7W5WOXE/

State	Location	Description of Mapped Area
Michigan	Washtenaw County	**Mill Creek-East Fen:** image from (https://defenders.org/sites/default/files/publications/pilot_projects_for_biodiversity_conservation.pdf) page 77 (Secondary conservation zone)
Mississippi	Alcorn, Itawamba, Monroe, Prentiss, and Tishomingo	Federal and state lands including: the Natchez Trace Parkway, the John Bell Williams Wildlife Management Area, BLM lands in Tishomingo County
Virginia	Floyd County	Habitat spatial model provided by the Virginia Department of Conservation and Recreation

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 county level and contains areas that are current considered extirpated or contain mostly non-habitat within the counties. Mitchell's satyr requires specific habitat that is relatively rare on the landscape and county level core maps would be too broad.

- Critical Habitat Approach for Core Map

A core map based on critical habitat was rejected because the species has no 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 in at least some areas. No habitat model exists for the species. In the states of Michigan and Virginia, there was no pre-existing dataset of fen wetlands that could have been used to refine the core map. Using only designated wetlands as a habitat model was judged to be inadequate to refine the core map below county level.

- Other sources of information reviewed but not included

The Global Biodiversity Information Facility (GBIF) did contain some observations of Mitchell's satyr, but the precision of the location information was too large to be useful.

NatureServe curates data for many rare and imperiled species that comes from reputable sources including universities, state and federal agencies, and citizen science surveys. We consider NatureServe data to be reliable. NatureServe contains general location information for the species in Michigan and Indiana only. Due to the generalized locations of the occurrences this data could only be used as a general way to reduce the amount of non-habitat within counties.

Appendix 1. Information compiled for species during Step 1

1. **Recent FWS documents**

FWS. 1998. Recovery Plan for Mitchell's Satyr Butterfly *Neonympha Mitchellii Mitchellii French (Lepidoptera: Nymphalidae: Satyrinae).* Available from https://ecos.fws.gov/docs/recovery_plan/980402.pdf.

Michigan Department of Natural Resources. 2020. Multi-State Mitchell's Satyr and Poweshiek Skipperling HCP. Available from https://ecos.fws.gov/ecp/report/conservation-plan?plan_id=4031.

FWS. 2021. Mitchell's Satyr Butterfly (Neonympha mitchellii mitchellii) 5-Year Review: Summary and Evaluation. Available from https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3237.pdf

2. Background information

Status: ENDANGERED

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

Resiliency – FWS has not formally assessed resiliency in the 1998 Recovery Plan or 2021 5-year review.

Redundancy – FWS has not formally assessed redundancy in the 1998 Recovery Plan or 2021 5-year review.

Representation – FWS has not formally assessed representation in the 1998 Recovery Plan or 2021 5-year review.

Habitat, Life History, and Ecology

Habitat:

Mitchell's satyr butterfly inhabits fen wetland that contain the larval host plants including tussock sedge and other sedges and grasses (*Carex stricta, Carex leptalia, Poa palustris, Panicum sp.*).[14] The fen habitats are dominated by sedges with occasional deciduous or coniferous trees. The vegetative structure of the fens seems to be important with patches of sedges important for larval growth, but adults are often observed in the shrubby edges and near trees that are indicative of a later succession of plant growth.[15]

Diet:

Larvae of the species feed only on sedges and grasses, particularly (*Carex stricta, Carex leptalia, Poa palustris, Panicum sp.*).[16] Adults consume nectar, but there appears to be no preference for nectar plant.

Taxonomy:

The listed entity referred to as the Mitchell's satyr butterfly is the nominal subspecies of brush-footed butterfly (family Nymphalidae) *Neonympha mitchellii mitchellii* and not the full species *Neonympha*

[14] FWS 1998 p. iii
[15] FWS 1998 p. 12
[16] FWS 1998 p. iii

mitchellii. Mitchell's satyr is easily identified in the field based on size, wind color pattern, and flight characteristics.[17]

[17] FWS 1998 p. 2

Taxonomic Hierarchy

Kingdom	Animalia – Animal, animaux, animals
Subkingdom	Bilateria – triploblasts
Infrakingdom	Protostomia
Superphylum	Ecdysozoa
Phylum	Arthropoda – artrópode, arthropods, arthropods
Subphylum	Hexapoda – hexapods
Class	Insecta – insects, hexapoda, inseto, insects
Subclass	Pterygota – insects ailés, winged insects
Infraclass	Neoptera – modern, wing-folding insects
Superorder	Holometabola
Order	Lepidoptera – butterflies, moths, papillons, pappillons de nuit, Borboleta, Mariposa
Superfamily	Papillionoidea Latreille, 1802 – butteflies, papillons
Family	Nymphalidae Rafinseque, 1815 – admirals, anglewings, brush-footed butterflies, checker-spots, crescent-spots, fritillaries, mourningclocks, purples, brushfoot butterflies, Brushfooted Butterflies
Subfamily	Satyrinae Boisduval, 1833 – Satyrs
Tribe	Satyrini Boisduval, 1833
Subtribe	Euptychiina Reuter, 1896
Genus	Neonympha Hubner, 1818
Species	Neonympha mitchelly French, 1889 – Mitchell's Satyr
Subspecies	Neonympha mitchellii mitchellii French, 1889 – Mitchell's satyr butterfly

Figure 1. Taxonomy of Mitchell's satyr from ITIS.

Relevant Pesticide Use Sites:

- Agricultural land immediately nearby to occupied areas where pesticide can drift or contaminate groundwater
- Urban or residential uses in nearby habitat
- Mosquito spray applications in wetlands or in areas after floods

Relevant Recover Criteria and Actions:

Objective:

From the 2021 5-Year Review Page 29

The objective of this recovery plan is to perpetuate viable populations of Mitchell's satyr throughout their former range thereby allowing reclassification, and ultimately removal, of this species from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12).

Criteria:

From the 1998 Recovery Plan Pages 29-31

Mitchell's satyr may be considered for reclassification from endangered to threatened when 16 geographically distinct, viable populations or metapopulations are established or discovered range wide. These 16 populations, or metapopulations, will include, at a minimum, 12 in southern Michigan; two in

Indiana; one in Ohio; and one in New Jersey. At least 50 percent of these sites will be protected and managed to maintain Mitchell's satyr habitat.

Delisting the species will be considered when nine additional, for a total of 25, geographically distinct, viable populations or metapopulations are established or discovered range wide and remain viable for five consecutive years following reclassification. A minimum of 15 of these sites will be protected and managed to maintain Mitchell's satyr habitat by state or federal agencies or by private conservation organizations before delisting will be considered.

Step-down Outline

1.0 Mitchell's satyr surveys.

1.1 Survey for previously unknown populations of Mitchell's satyr.

1.2 Monitor extant populations and determine precise distribution of Mitchell's satyr at known population sites.

2.0 Research needs.

2.1 Conduct cage studies of larval ecology.

2.2 Quantify habitat requirements and use.

2.3 Study response to habitat disturbance.

2.4 Determine minimum population viability.

2.5 Conduct captive rearing/reintroduction studies.

3.0 Protect all known occurrences, placing priority on achieving effective protection for the highest-ranking occurrences and essential habitat.

3.1 Identify populations vulnerable to poaching and provide protection during the flight season.

3.2 Protect essential habitats.

3.3 Provide and update current site occurrence information at least yearly.

3.3.1 Provide current site occurrence information at least yearly to all appropriate departments and divisions of pertinent Federal, State, and local public agencies.

3.3.2 Update FWS records.

3.3.3 Update State Land and Water Management Division records.

3.3.4 Update Michigan, Indiana, New Jersey, and Ohio Departments of Transportation rights-of-way records to ensure transfer of data to District Offices.

3.4 Develop habitat management plans.

3.5 Implement habitat management plans.

3.6 Develop written agreements and provide management plans for protection on public lands.

3.7 Promote protection of occurrences on privately owned land.

3.7.1 Continue private landowner contact.

3.7.2 Provide management guidelines to private landowners.

3.7.3 Promote private landowner involvement in a registry program.

3.8 Promote development of local zoning ordinances favorable to the protection of Mitchell's satyr and its habitat if existing laws are inadequate.

3.9 Recommend and support sites for potential State Natural Area designation.

3.10 Encourage land acquisition.

4.0 Develop an outreach program.

5.0 Reintroduce into suitable but unoccupied habitats.

5.1 Establish Mitchell's satyr breeding facilities.

5.2 Reestablish historical populations.

Recovery Actions:

Numerous recovery actions have taken place since listing. The 2021 5-year review describes the latest recovery actions[18] which include: working with the Great Lakes Recovery Initiative to improve habitat, developing Safe Harbor Agreements with landowners in Michigan and Indiana, developing habitat conservation plans and management plans in Michigan, beginning captive rearing and reintroductions in 2015, acquiring land at occupied locations in Indiana and Michigan.

3. Description of Species Range:

Mitchell's satyr butterflies have a broad range that historically likely extended across most of the eastern U.S. The extant range includes the states of Michigan, Indiana, Virginia, Mississippi, and Alabama.

[18] FWS 2021 pp. 5-11

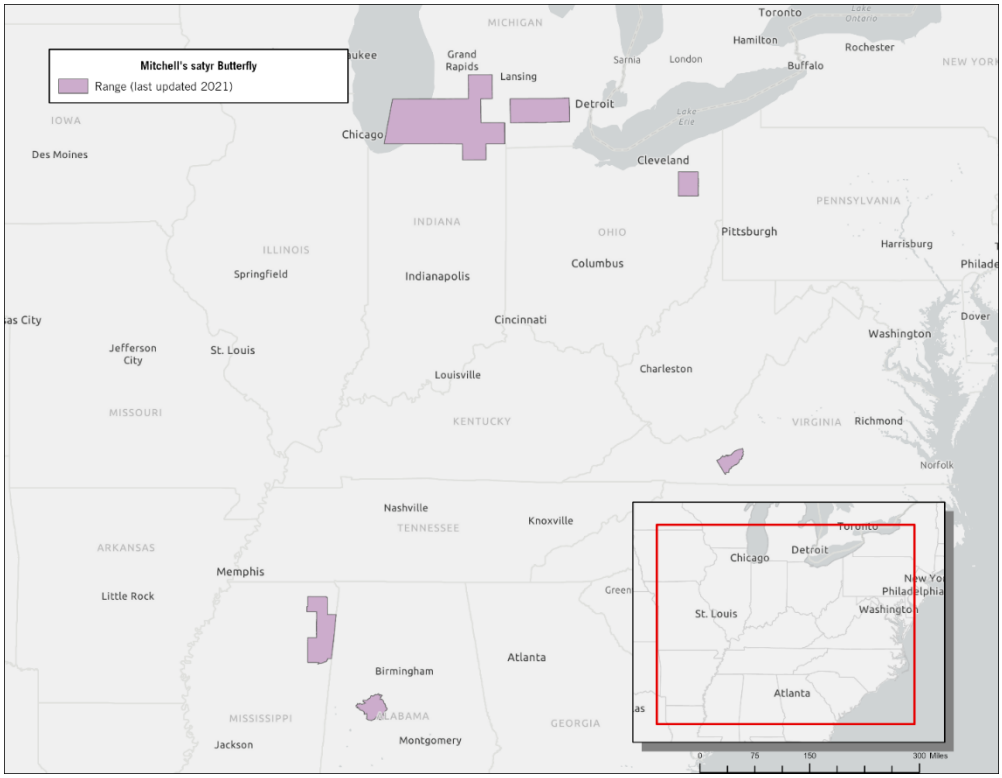

Figure A1-2. FWS range for the Mitchell's satyr from last updated on 2/24/2021.

4. Critical Habitat:

There is no designated critical habitat for Mitchell's satyr.

5. Known Locations

The Mitchell's satyr butterfly is currently known from Alabama, Indiana, Michigan, Mississippi, and Virginia.[19]

[19] FWS 2021 p. 13

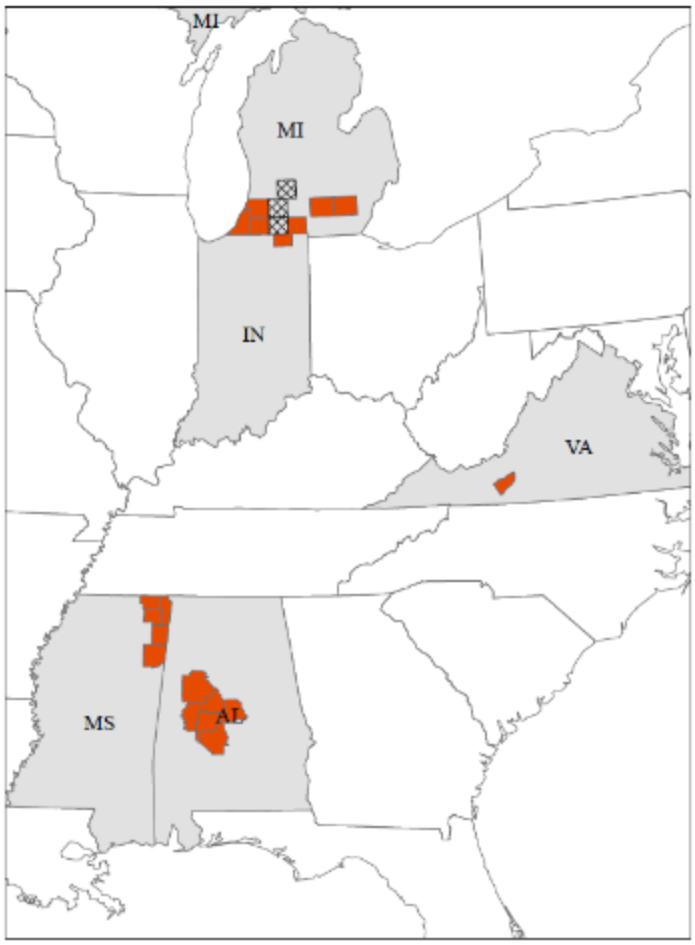

Figure A1-4. Current county distribution of Mitchell's satyr as presented in Figure 1 from the 2021 5-year review.

Table A1-1. Summary of known locations of Mitchell's satyr.

Location	Number of Populations	Notes
Alabama	28	
Oakmulgee Ranger District of the Talladega National Forest		All currently known sites are within this ranger district, but viability and management status is unknown[20]
Indiana	1	
LaGrange County		Occupied area recently acquired by FWS around Cedar Lake. Status unknown but presumed extant.[21]
Michigan	9**	**Most populations in all five counties are at least partially on private land and precise locations are not available. Refinement needed
Berrien County		Blue Creek Fen

[20] FWS 2021 p. 17
[21] FWS 2021 p. 11

		Lower Paw Paw River Site We considered this site to be located on the privately held lands of the Sarett Nature Center where the species has been found[22]
Branch County		Coldwater Lake Fen
Cass County		Cook Lake Rudy Rd. Fen, Tamarack Swamp, and Shavehead Lake
Jackson County		Grand River Fen and Skiff Lake
Van Buren County		Cedar Creek Fen
Washtenaw County		Mill Creek-East Fen
Mississippi	15	
Alcorn, Itawamba, Monroe, Prentiss, and Tishomingo		Located on federal and state lands that make up the Natchez Trace Parkway and at the John Bell Williams Wildlife Management Area
Virginia	11**	
Floyd County		**Precise location of sites unknown. Refinement needed. Majority on private property.[23]

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

The core map type for this species is based on known locations mentioned in the FWS 2021 5YR Mitchell's Satyr Butterfly Review that were extracted and compiled in Table A1-1 plus Results of Surveys for Mitchell's Satyr (Neonympha mitchellii) in Virginia, 2017, Natural Heritage Technical Report 18-07, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

This section details the data and steps used to create the core map for the Mitchell's Satyr Butterfly based on this known location and biological information

1. References and Software

- World UTM Grid: https://services.arcgis.com/P3ePLMYs2RVChkJx/arcgis/rest/services/World_UTM_Grid/FeatureServer
- FWS Species range:
- https://ecos.fws.gov/docs/species/shapefiles/usfws_I00K_I01_Neonympha_mitchellii_mitchellii_current_range.zip
- USGS (Protected Areas Database US) PAD-US file Version 4.0 https://www.usgs.gov/programs/gap-analysis-project/science/pad-us-data-download

[22] https://www.mlive.com/galleries/U4DXSNILMBG4RLJ3VKT7W5WOXE/

[23] Orcutt, E. C. 2018. Results of Surveys for Mitchell's Satyr (Neonympha mitchellii) in Virginia, 2017. Natural Heritage Technical Report 18-07. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 9 pp. plus appendix.

- National Hydrography Dataset Plus Version 2.0 file geodatabase with flowline, waterbodies and sinks feature classes
- FWS National Wetlands Inventory GIS download by State (Michigan)
  https://www.fws.gov/program/national-wetlands-inventory/download-state-wetlands-data
  https://services.arcgis.com/P3ePLMYs2RVChkJx/arcgis/rest/services/NHDPlusV21/FeatureServer
- USA county/parish boundaries of United States in the 50 states and the District of Columbia
  https://services.arcgis.com/P3ePLMYs2RVChkJx/arcgis/rest/services/USA_Census_Counties/FeatureServer
- Indiana Geographic Information Office (IGIO) 2024 parcel dataset download
  https://www.indianamap.org/datasets/INMap::parcel-boundaries-of-indiana-2024/explore?location=39.715446%2C-86.425060%2C7.05
  Modified Cultivated Layer (Downloaded 01/27/2025)
  https://cdn.arcgis.com/home/item.html?id=159e70ce4c284f5b972c687037f8a668
- BLM National SMA Surface Management Agency Area Polygons
  https://gbp-blm-egis.hub.arcgis.com/datasets/6bf2e737c59d4111be92420ee5ab0b46/about
- Results of Surveys for Mitchell's Satyr (Neonympha mitchellii) in Virginia, 2017. Natural Heritage Technical Report 18-07.
  neonmitc_2025 shapefile
- Software used: ArcGIS Pro version 3.2

2. Datasets and Procedures Used in Core Map Development

2.1. Create copy of template EPA polygon

1. In ArcPro, create a copy of the template EPA polygon shapefile for Mitchell's satyr butterfly, named "Mitchells_satyr_butterfly_poly"

2.2. Create polygon of Mill Creek East Fen by Geo-referencing and Digitizing

1. After internet research, a GIS data source of the Mill Creek-East Fen in Washtenaw County, Michigan was not found. What was found is a MS PowerPoint from "Defenders of Wildlife" at:
   https://defenders.org/sites/default/files/publications/pilot_projects_for_biodiversity_conservation.pdf where on page 77 there is a map of the Mill Creek East Fen Complexes' primary, secondary and tertiary conservations zones. This page was exported as a .tiff file and geo-referenced to an area south of Interstate Highway 94 and west of S. Michigan State Road 52. **(Figure A2-1)**

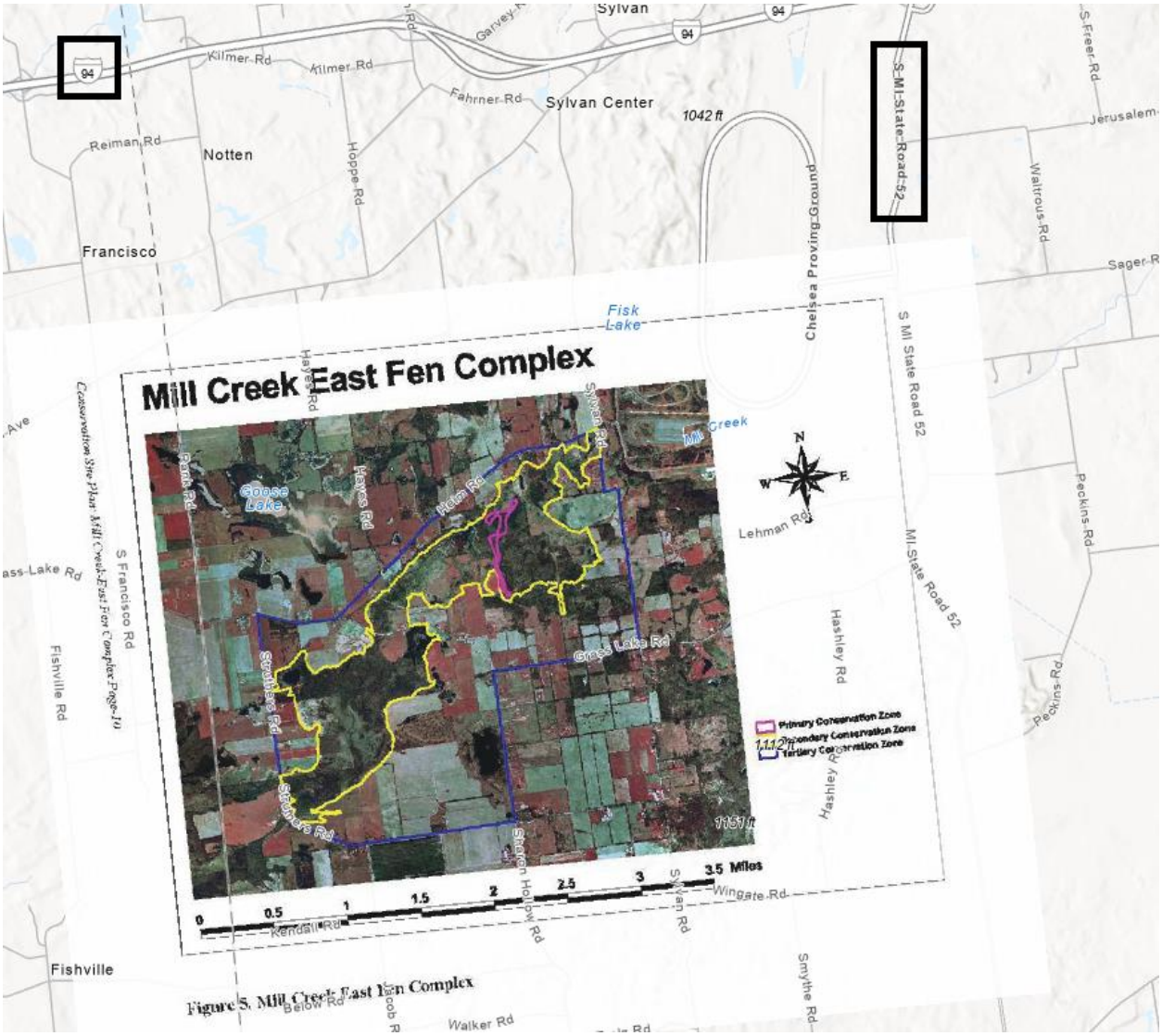

Figure A2-1. Screenshot of "Geo-referenced" Image

2. Click on "Edit"à "Create" and àUse the "yellow" Secondary Conservation Zone boundary as the basis to digitize a new polygon. **(Figure A2-2)** Update "Descriptio" field to: "Mill Creek East Fen, Washtenaw County Michigan (https://defenders.org/sites/default/files/publications/pilot_projects_for_biodiversity_conservation.pdf) page 77 (Secondary conservation Zone)"

Figure A2-2. Completed Polygon for Mill Creek East Fen

2.3. Create Polygon for Shavehead Lake Fen

1. Michigan Department of Transportation "MDOT RH 2025" file geodatabase was downloaded from: https://gis-michigan.opendata.arcgis.com/datasets/mdot::mdot-rh-2025/explore and the "MDOT_RD_2025 feature class was added to the ArcPro project.
2. The result of an internet search for Shavehead Lake Fen and Mitchell's satyr butterfly found this URL: https://mnfi.anr.msu.edu/reports/MNFI-Report-2017-06.pdf. Shavehead Lake and Camp Friedenswald are mentioned together as a site for Mitchell's satyr butterfly. The parcels owned by "CAMP FRIEDENSWALD INC" were selected in Washtenaw County's parcel web page, and a printed .png was created. This .png was added to ArcPro and geo-referenced. **(Figure A2-3)**

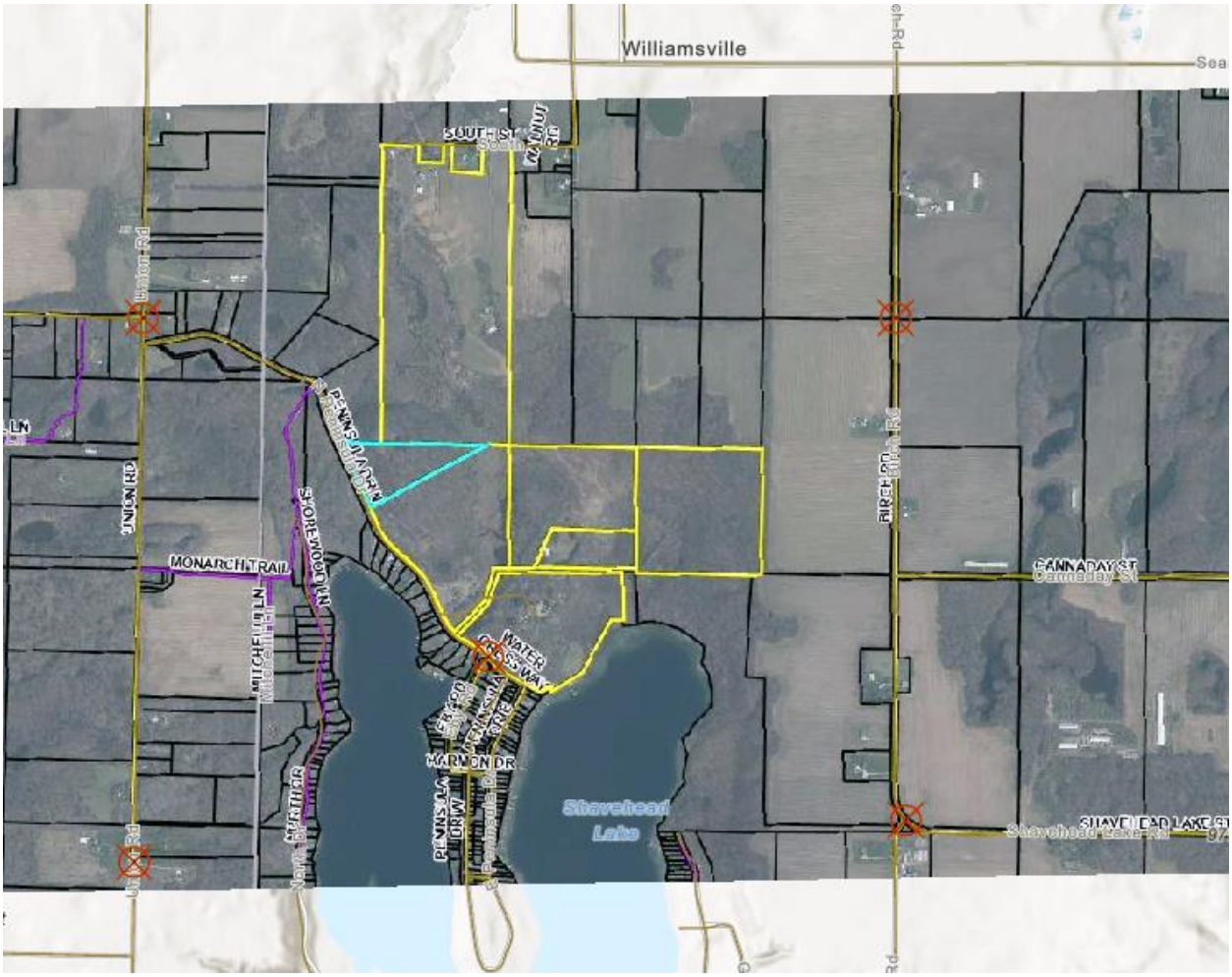

Figure A2-3. Screenshot of "Geo-referenced" Image

3. Click on "Edit"à "Create"à Use the "yellow and light blue" lines on the .png and the road centerlines as the basis of parcels owned by "CAMP FRIEDENSWALD INC". Update "Descriptio" field to: "Cass County, Michigan parcels owned by CAMP FRIEDENSWALD INC north of Shavehead Lake."
4. Additional information on the location of the Shavehead Lake fen is hinted by the name of the USGS water quality site named: "Shavehead Lake Fen met station - Cass County, MI – 415122085515603" (https://waterdata.usgs.gov/monitoring-location/415122085515603/). This URL provides a latitude and longitude, that when used by the location tool, creates a point inside the Camp Friedenswald Inc parcels.

2.4. Create Polygon for Land Purchased near Cedar Lake, Indiana

1. Download the file geodatabase of Indiana State parcels (https://www.indianamap.org/datasets/parcel-boundaries-of-indiana-current-1/explore).

Add the “parcel_boundaries_of_indiana_curre_parcel_boundaries_1” feature class to the ArcPro project.

2. In the FWS 2021 Mitchell’s Satyr Butterfly 5YR Review on page 11 under the “Land Acquisition” heading is this text:
   “The landowners of the only known Mitchell’s satyr site in Indiana parceled their property for sale in 2018 and it included the occupied fens (T. Swinford, IDNR, pers. comm. 2018). The Service contacted the landowners about acquiring the site for conservation and collaborated with LaGrange County Parks to obtain the occupied fen in 2020 (S. Fetters, FWS, pers comm. 2020).”
   At this URL: https://www.indystar.com/story/news/environment/2024/12/31/indiana-group-saves-remaining-habitat-for-endangered-butterfly/77104572007/ is an IndyStar article that mentions that “Central Indiana Land Trust (CILTI)” purchased land that is home to the endangered Mitchell’s satyr butterfly. There are three parcels owned by Central Indiana Land Trust and LaGrange County Board of Parks & Recreation in the northeast area of Cedar Lake that were copied and pasted into “Mitchells_satyr_butterfly_poly”. Update the “Descriptio” field with “La Grange County, IN parcels owned by Central Indiana Land Trust and LaGrange County Board of Parks & Recreation (https://www.indystar.com/story/news/environment/2024/12/31/indiana-group-saves-remaining-habitat-for-endangered-butterfly/77104572007/)”.

2.5. Use USGS PAD-US Feature Class to create polygons for known locations

1. The following known locations were found in the USGS PAD-US feature class with these “Unit Names”:
   a) Natchez Trace Parkway
   b) Talladega National Forest
   c) Cook Lake
   d) Portman
   e) Tamarack Swamp
   f) Coldwater Fen
   g) Held For Transfer- Blue Creek Fen
   h) Paw Paw Prairie Fen
   i) John Bell Williams WMA
   j) Sarett Nature Center
   k) Grand River Fen
2. Use Definition query in the USGSD PAD-US feature class where “OBJECTID IN (**6413**, **166765**, **167970**, **167971**, **167972**, **78889**, **77724**, **77741**, **77745**, **214585**, **1646**, **73069**, **166540**, **166541**, **166542**, **166543**, **166544**, **166545**, **166546**) **(Figure A2-4)**

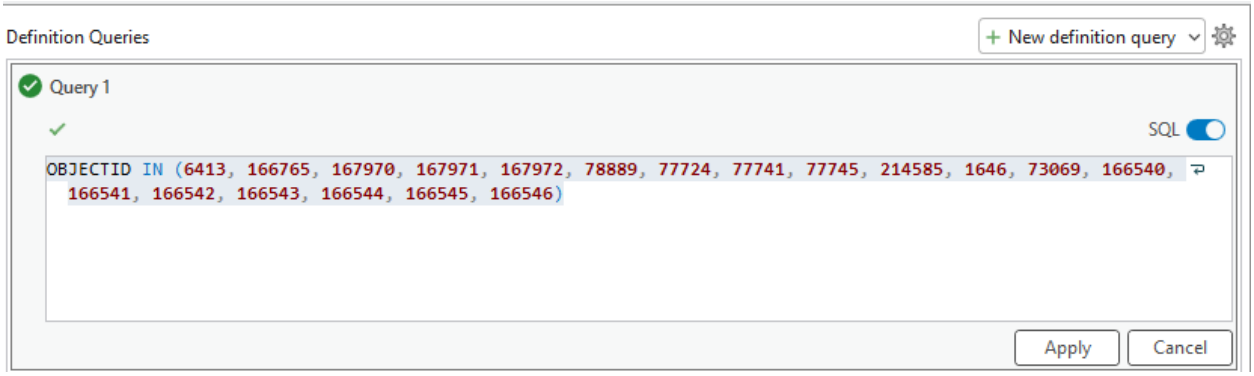

Figure A2-4. Screenshot of "Definition Query"

3. Select all records in the USGS PAD-US feature class. Copy and paste them from the feature class to "Mitchells_satyr_butterfly_poly". There are three USGS PAD-US records where the "Unit Name" is "Paw Paw Prairie Fen". Highlight them and merge them into one multi-part polygon. Update the "Descriptio" field with the beginning text of "USGS PAD-US V 4.0" plus the name from the "Unit Name". Select seven records where the "Unit Name" is "Grand River Fen". Highlight them and merge them into one multi-part polygon. Update the "Description" field with the beginning text of "USGS PAD-US V 4.0" plus the name from the "Unit Name".
4. In the County feature class, use a definition query to select the five Mississippi Counties in Table A1-1, Alcorn, Itawamba, Monroe, Prentiss, and Tishomingo. **(Figure A2-5)**

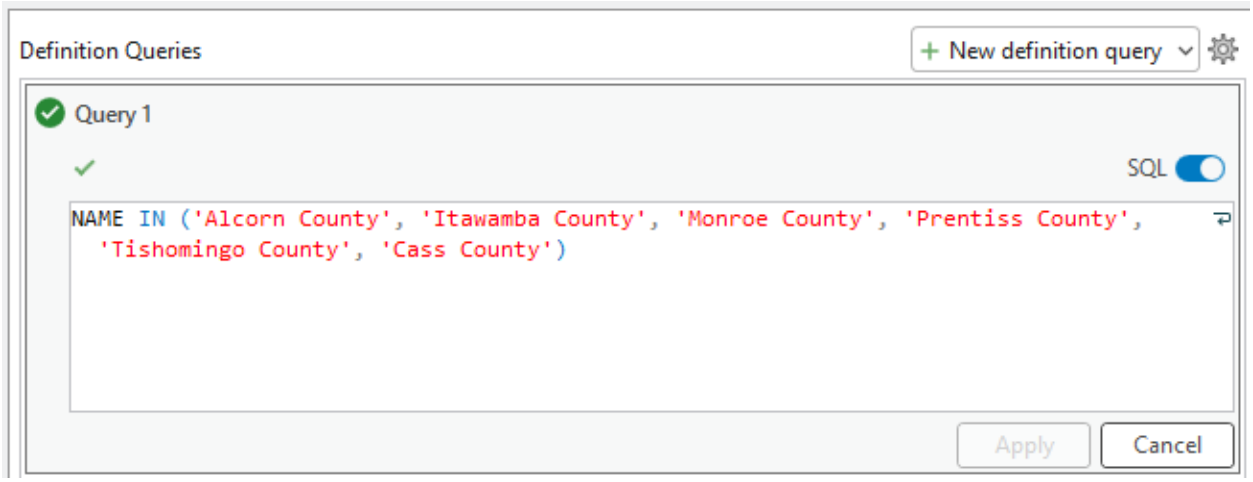

Figure A2-5. Screenshot of "Definition Query"

5. Click “Edit”à Click “Modify”àClick “Clip”à Use the “Select by Rectangle” tool to select features from the “dtl_cnty” and “Mitchells_satyr_butterfly_poly” feature classes. à Move “Mitchells_satyr_butterfly_poly” to be the “target” feature. àSelect the “Preserve” option under “When clipping features”à Click “Clip”. **(Figure A2-6)** Update the “description” field to describe the clip method and counties involved.

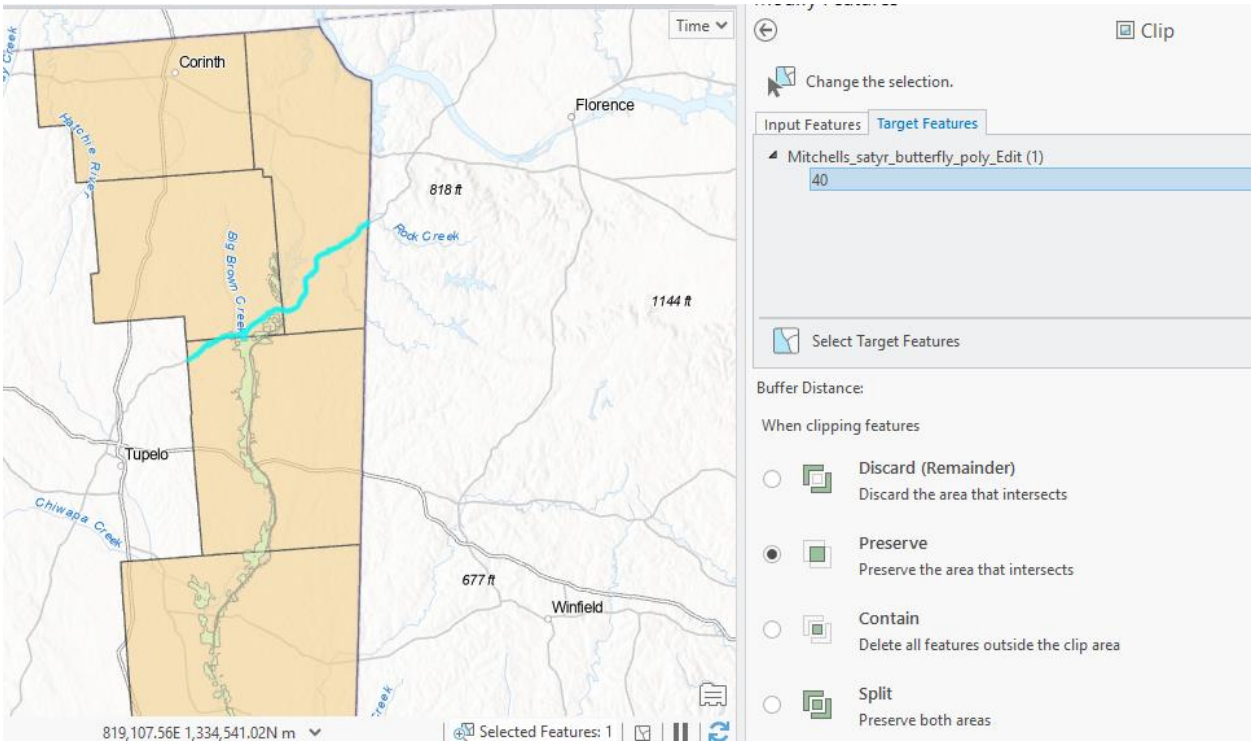

Figure A2-6. Screenshot of “Clip” tool from “Modify Features”

6. Click “Edit”à Click “Modify”àClick “Clip”à Use the “Select by Rectangle” tool to select features from the “usfws_I00K_I01_Neonympha_mitchellii_mitchellii_current_range” and “Mitchells_satyr_butterfly_poly” feature classes. à Move “Mitchells_satyr_butterfly_poly” to be the “target” feature. àSelect the “Preserve” option under “When clipping features”à Click “Clip”. **(Figure A2-7)** Update the “description” field to describe the clip method and FWS range involved.

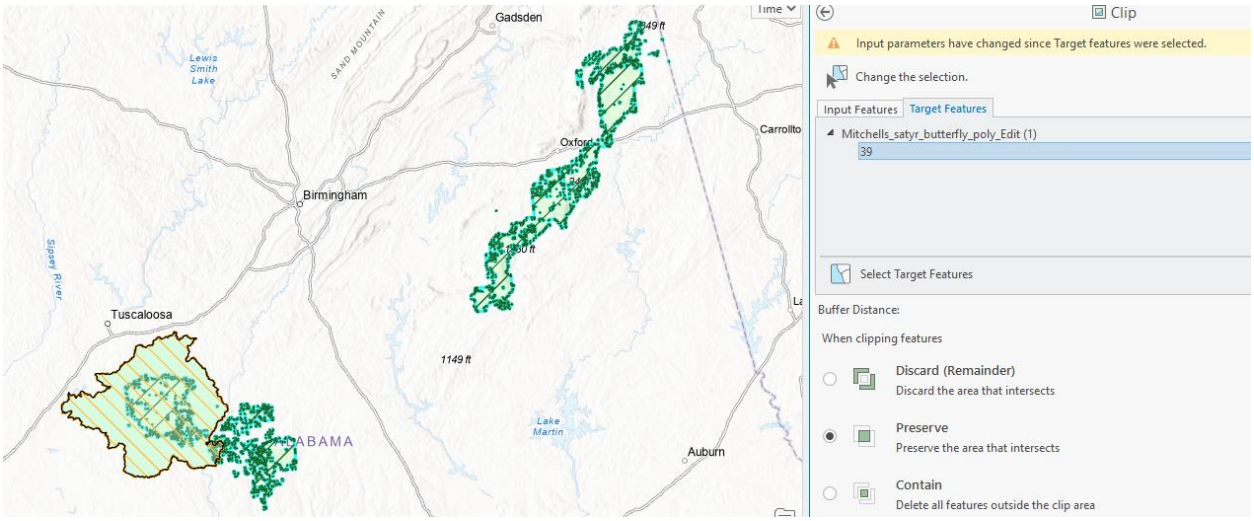

Figure A2-7. Screenshot of "Clip" tool from "Modify Features"

2.6. Create BLM State and Federal Lands that reside in these 5 Mississippi counties: Alcorn, Itawamba, Monroe, Prentiss, and Tishomingo

1. Use URL https://gbp-blm-egis.hub.arcgis.com/datasets/6bf2e737c59d4111be92420ee5ab0b46/about to download the file geodatabase. This file geodatabase is named "BLM National SMA Surface Management agency Area Polgyons".
2. Add the following feature classes from the downloaded file geodatabase to the ArcPro project: "SurfaceMgtAgy_USFS", "SurfaceMgtAgy_OTHFED", "SurfaceMgtAgy_NPS", "SurfaceMgtAgy_FWS", "SurfaceMgtAgy_DOD", "SurfaceMgtAgy_BOR", "SurfaceMgtAgy_BLM"and "group them.
3. Use "Select by Location" to find any records from the imported BLM surface management agency feature classes that intersect the five Mississippi counties. **(Figure A2-8)**

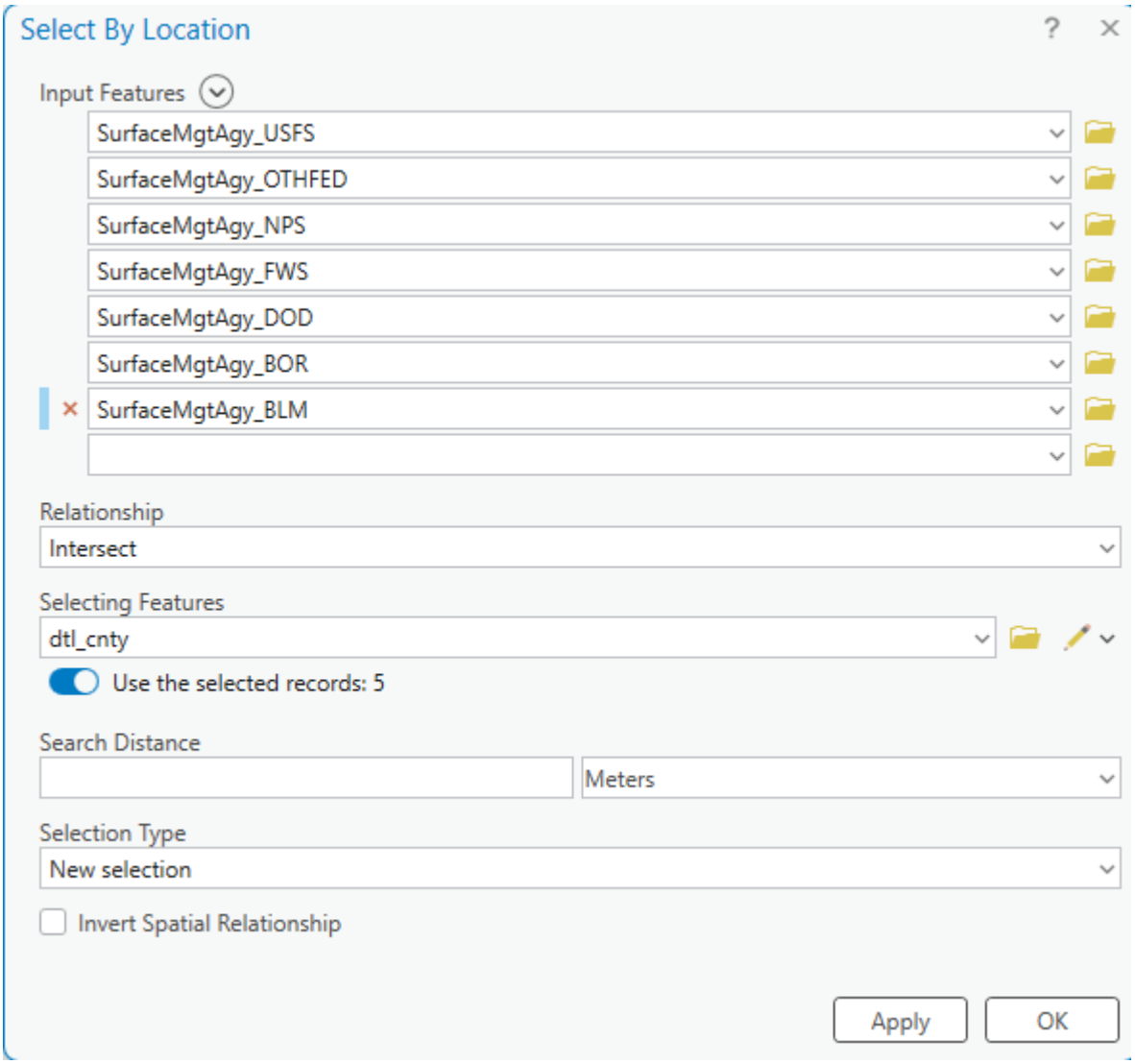

Figure A2-8. Screenshot of "Select by Location" tool

4. One record each from the "SurfaceMgtAgy_DOD" and "SurfaceMgtAgy_NPS are selected by the "Select by Location" tool. They are "Natchez Trace Parkway and National Scenic Trail" and "Corps of Engineers". **(Figure A2-9)** Since the core map area of the "Natchez Trace Parkway and National Scenic Trail" is already completed, unselect this record.

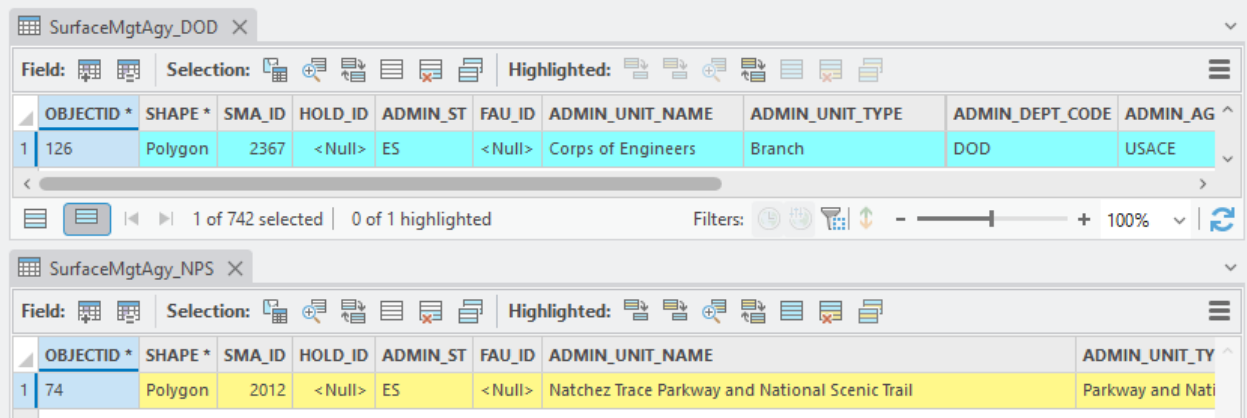

Figure A2-9. Screenshot of "Select by Location" tool results

5. Use the "Pairwise Clip" to create a record of the SurfaceMgtAgy_DOD's feature class record that is clipped by the five Mississippi Counties. Name it, "BLM_SMADOD_Clip5MSCounties", **(Figure A2-10)** Copy and paste this into "Mitchells_satyr_butterfly_poly"

Figure A2-10. Screenshot of "Pairwise Clip" tool

2.7. Use "neonmitc_2025.shp" shapefile to create habitat area of Mitchell's satyr butterfly areas

1. Add the "neonmitc_2025" shapefile to the ArcPro project. Select all the records and merge them. Copy and paste the record to "Mitchells_satyr_butterfly_poly" feature class. Update the "Descriptio" to "Orcutt, E. C. 2018. Results of Surveys for Mitchell's satyr (Neonympha mitchellii) in VA, 2017. Natural Heritage Technical Report 18-07. Virginia Dept of

Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 9 pp. plus appendix."

2.8. Create Clipped Michigan State National Wetland Inventory within 1 mile of Skiff Lake, Michigan.

1. Select Skiff Lake waterbodies from NHD Hydrology Plus 2.1 and buffer it by one mile. **(Figure A2-11)**

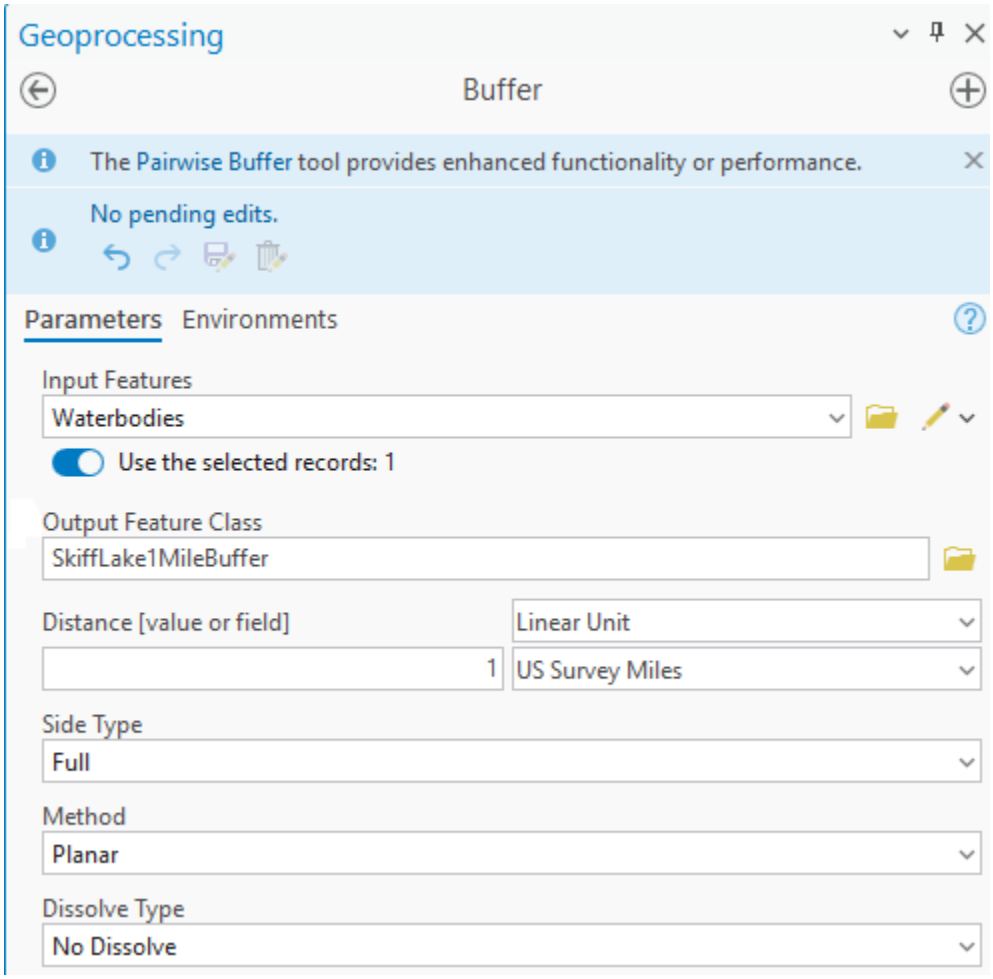

Figure A2-11. Screenshot of "Buffer" tool

2. Create a definition query in the Michigan National Wetland Inventory feature class. **(Figure A2-12)**

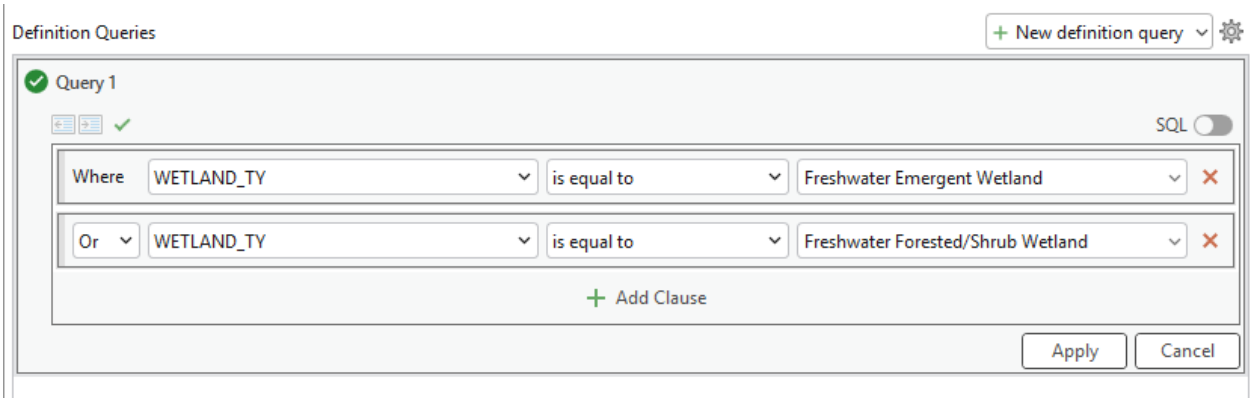

Figure A2-12. Screenshot of "Definition Query"

3. Use "Pairwise Clip" tool to clip Michigan National Wetland Inventory by the one-mile buffer of Skiff Lake. Name the resulting output as "SkiffLake_NWI_Clip". **(Figure A2-13)**

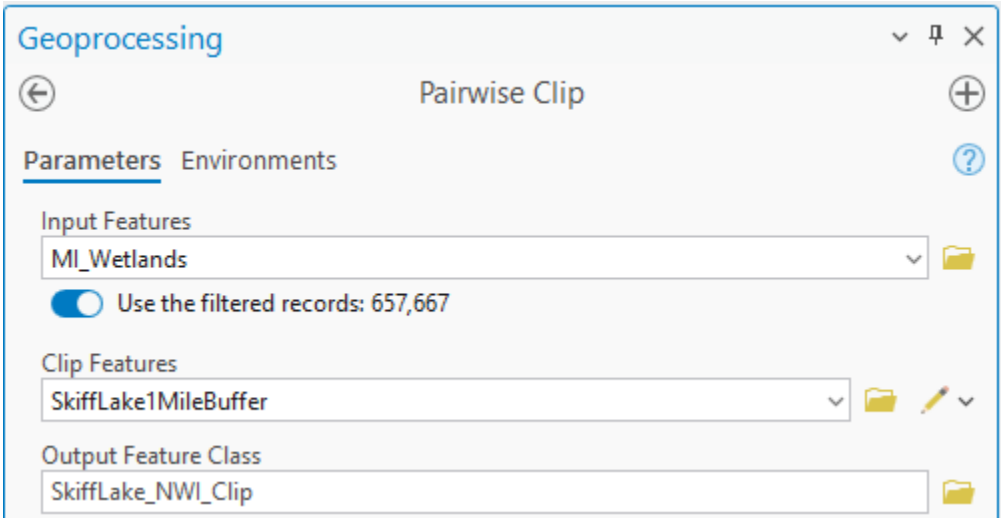

Figure A2-13. Screenshot of "Pairwise Clip" tool

4. Use the "Pairwise Erase" tool to remove the Skiff Lake waterbody polygon area from the Michigan National Wetland Inventory clipped data from the previous step. The resulting output is named, "SkiffLake_NWI_Clip_Erase ". Copy and paste this into "Mitchells_satyr_butterfly_poly" feature class. Merge the copied polygons and update the "Descriptio" field to "Michigan State National Wetland Inventory filtered by Freshwater Emergent Wetland & Freshwater Forested/Shrub Wetland types within 1 mile buffer of Skiff Lake, MI. Excludes Lake Skiff waterbody. "**(Figure A2-14)**

Figure A2-14. Screenshot of "Pairwise Erase" tool

2.9. Use EPA's "CultivatedAreas_Over25acres" to "Pairwise Erase" on "Mitchells_satyr_butterfly_poly"

1. As an effort to refine the core map boundaries, use "Pairwise Erase" to erase the core map "Mitchells_satyr_butterfly_poly" by "CultivatedAreas_Over25acres". The resulting layer is named, "Mitchells_satyr_butterfly_poly_NoCultLand". **(Figure A2-15)**

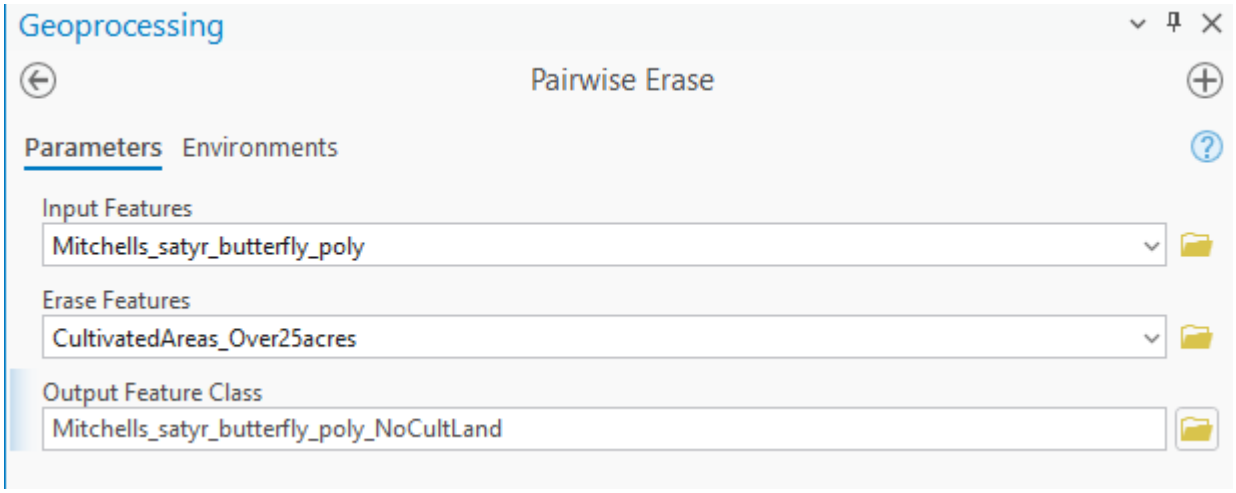

Figure A2-15. Screenshot of "Pairwise Erase" tool

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

1. Buffer "Mitchells_satyr_butterfly_poly_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, "Mitchells_satyr_butterfly_poly_NoCultLand_Buffer". **(Figure A2-16)**

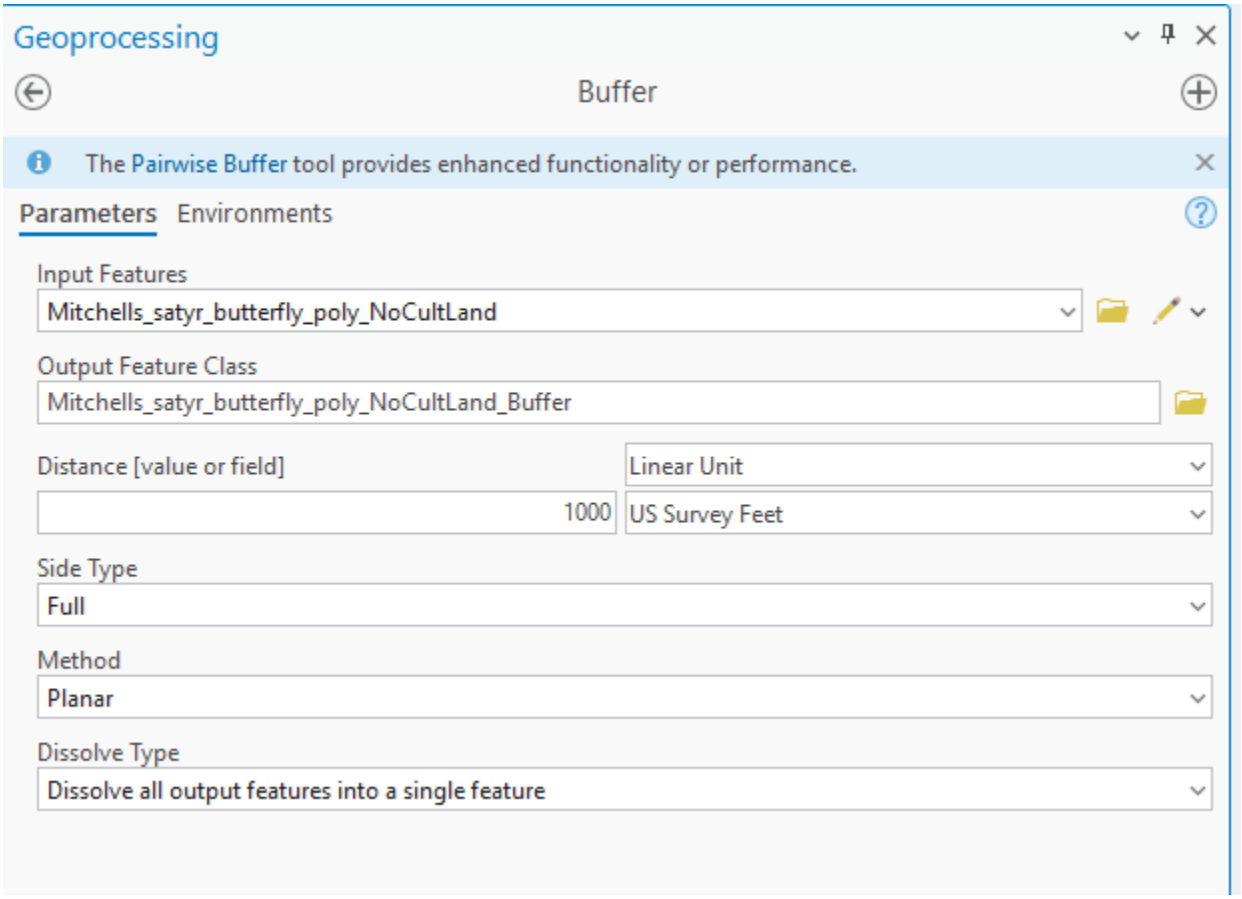

Figure A2-16. Screenshot of "Buffer" tool

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, "Mitchells_satyr_butterfly_poly_No2Acre". **(Figure A2-17)**

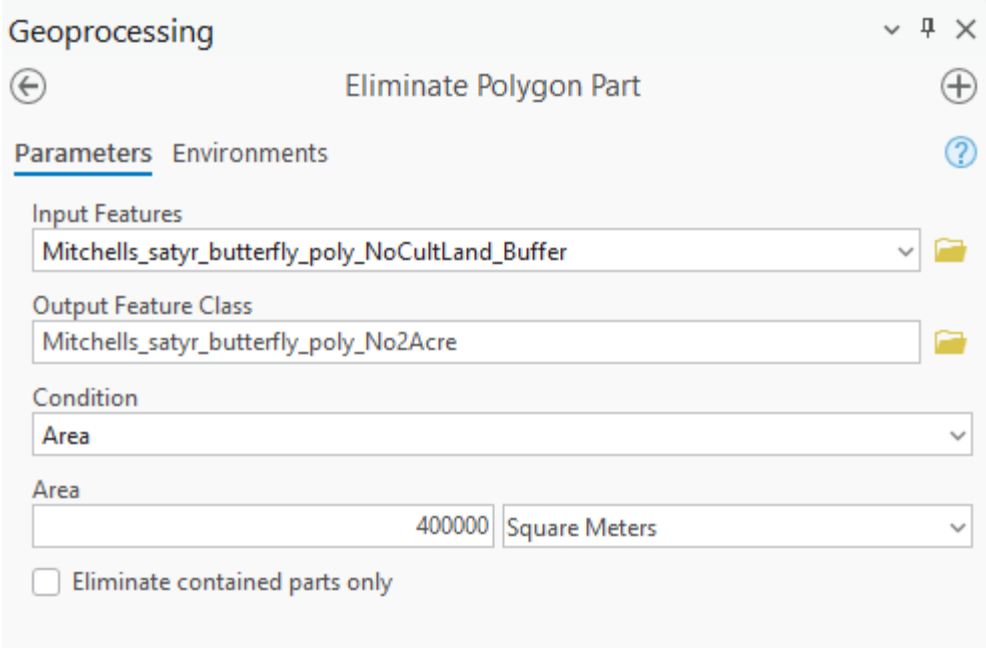

Figure A2-17. Screenshot of "Eliminate Polygon Part" tool

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, "Mitchells_satyr_butterfly_poly_Clip". **(Figure A2-18)**

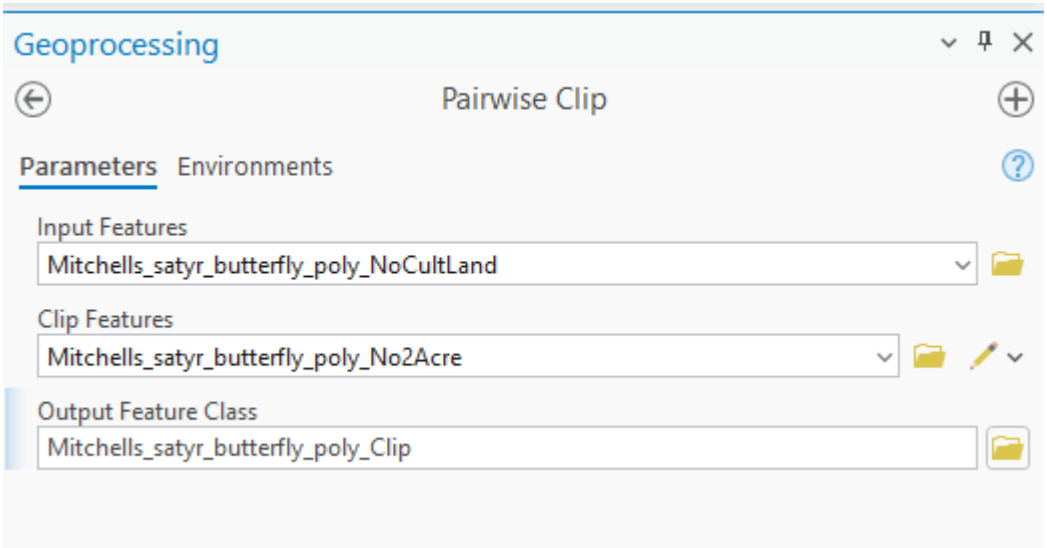

Figure A2-18. Screenshot of "Pairwise Clip" tool

2.11. 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 "Mitchells_satyr_butterfly_poly_Clip" into one polygon. The resulting output is named, "Mitchells_satyr_butterfly_poly_Dissolve" **(Figure A2-19)**

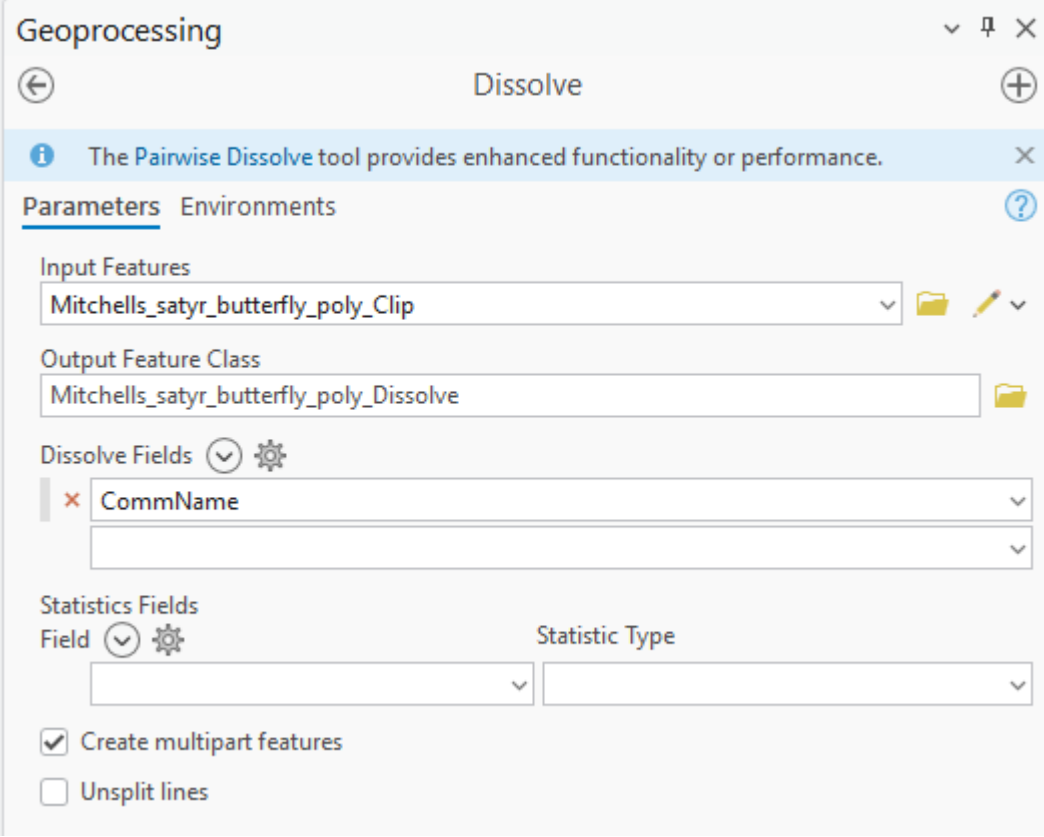

Figure A2-19. Screenshot of "Dissolve" tool

2. Use "Eliminate Polygon Part" tool to fill in gaps and holes less than 25 acres. Resulting output is named, "Mitchells_satyr_butterfly_poly_Smooth". **(Figure A2-20)**

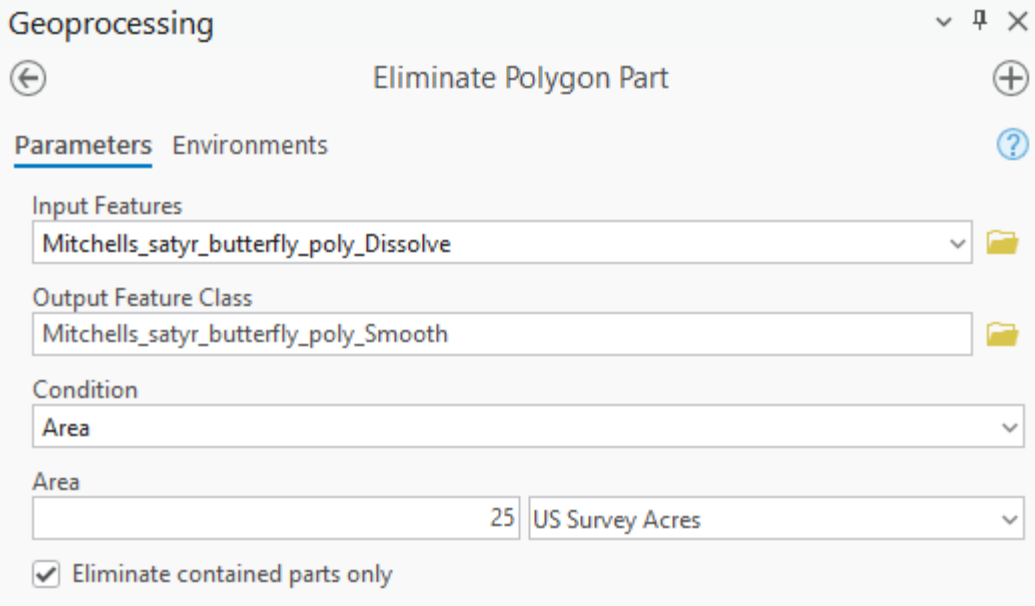

Figure A2-20. Screenshot of "Eliminate Polygon Part" tool

2.12. Update Attributes and "Calculate Geometry"

1. Create a copy of the template EPA polygon feature class for Mitchell's satyr Butterfly named "Mitchells_satyr_butterfly_Poly_Final" (core map shapefile). Copy and paste record from "Mitchells_satyr_butterfly_Poly_Smooth" to "Mitchells_satyr_butterfly_Poly_Final".
2. Since there is only one record in "Mitchell's satyr Butterfly", update each field manually with:
   a) CommName = " Mitchell's satyr Butterfly"
   b) SciName = "Neonympha mitchellii mitchellii"
   c) Description = "Known USFWS Mitchel's Satyr butterfly (MSB) locations & Orcutt, E. C. 2018. Results of Surveys for MSB in VA 2017. Natural Heritage Technical Report 18-07. VA Dept of Conservation & Recreation, Div. of Natural Heritage, Richmond, VA. 9 pp. plus app."
   d) Category = "Area of occupancy"
   e) EPA_Code = "424"
   f) FWS_Code = " I00K"
   g) CBD_Code = " 13068"
   h) Heritage = "0"
   i) ECOS_WebPg = https://ecos.fws.gov/ecp/species/8062

3. Turn on the "World UTM Grid" layer and identify the UTM zone as "16". Right-click on the "Acres" fieldàleft-click on "CalculateGeometry". "Calculate Geometry" dialog box appears. Select "Area" under "Property", "US Survey Acres" in "Area Unit" and "NAD_1983_UTM_Zone_16N" in the Coordinate System" boxes. Click Apply. Click OK. **(Figure A2-21)**

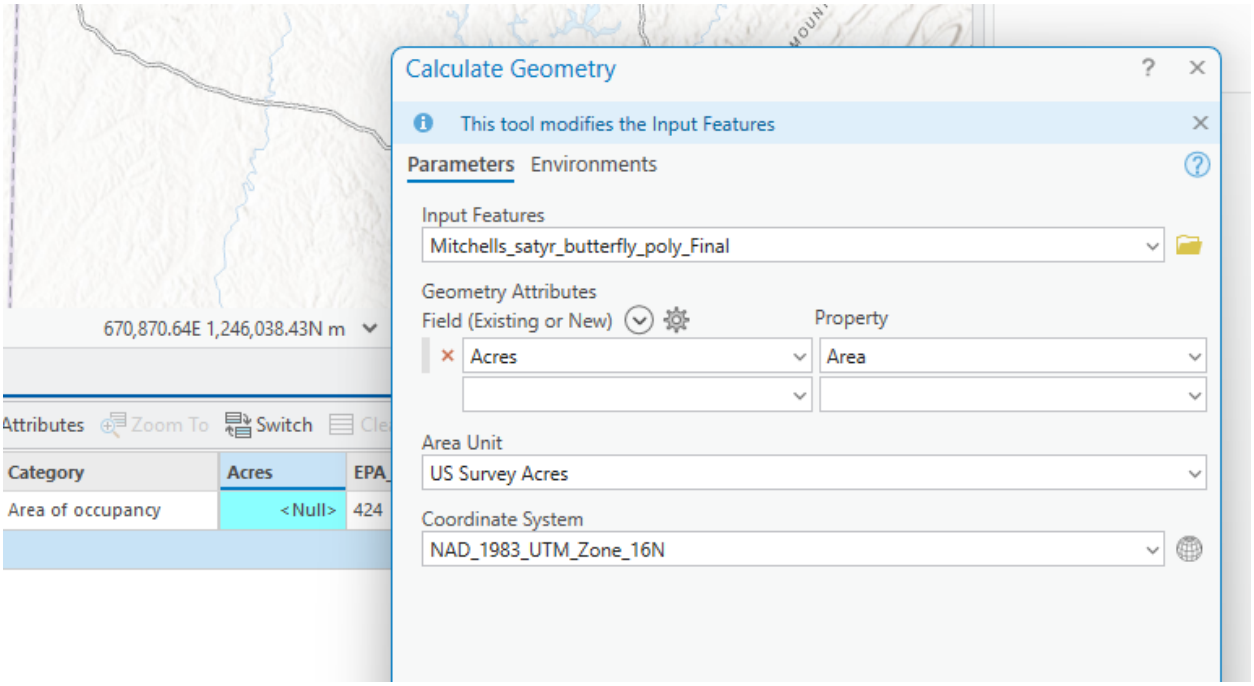

Figure A2-21. Screenshot of "Calculate Geometry" tool

2.13. 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/), uploaded four shapefile areas to use as an extent to download the NLCD that covers all the "Mitchells_satyr_butterfly_Poly_Final" records. **(Figure A2-22)** The file is downloaded and added to ArcPro and renamed; "NLCD_MSB_Area1.tiff", "NLCD_MSB_Area2.tiff". "NLCD_MSB_Area3.tiff", and "NLCD_MSB_Area4.tiff".

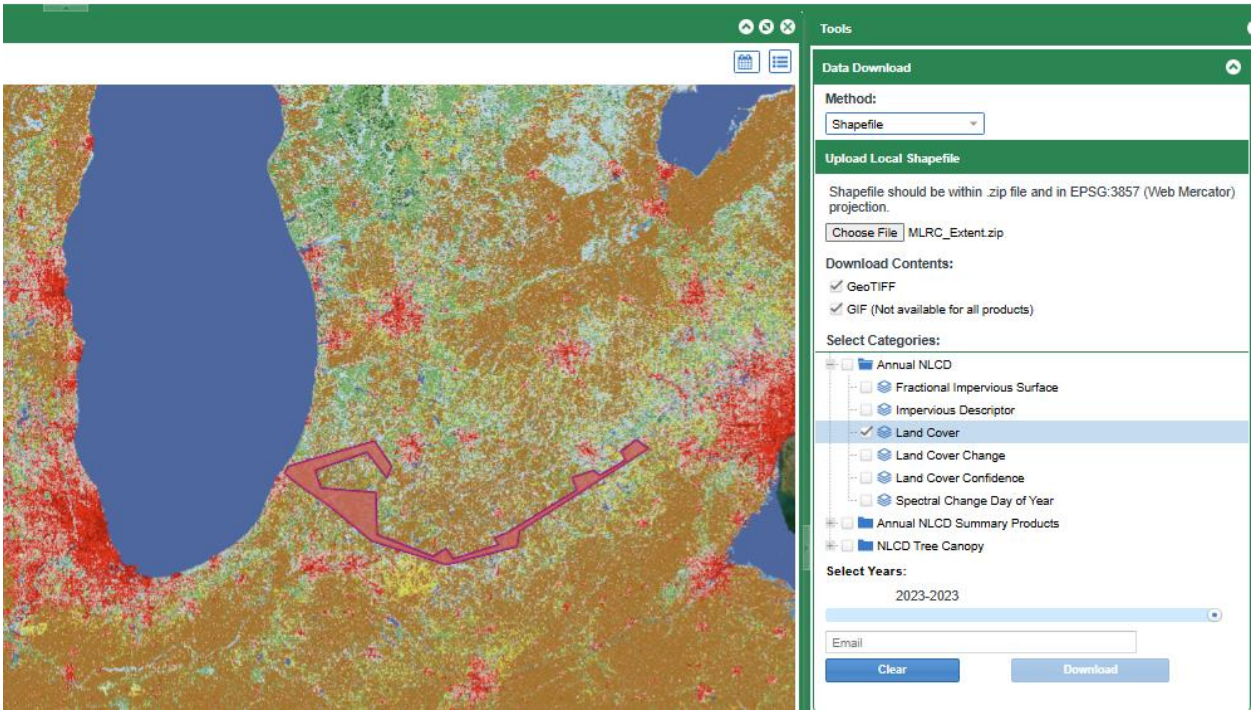

Figure A2-22. Screenshot of MRLC Viewer with Shapefile Extent

2. Use the extract by Mask" tool with each of the four MRLC downloads filtered by "Mitchells_satyr_butterfly _Poly_Final" as the extent. (Figure A2-61) In the "Environments" tab, change the output coordinate system to match "Mitchells_satyr_butterfly_Final", which in this case is "USA_Contiguous_Albers_Equals_Area_Conic_USGS_version". The output is named, "NLCD_MaskArea1", "NLCD_MaskArea2", "NLCD_MaskArea3", "NLCD_MaskArea4". **(Figure A2-23) (Figure A2-24)**

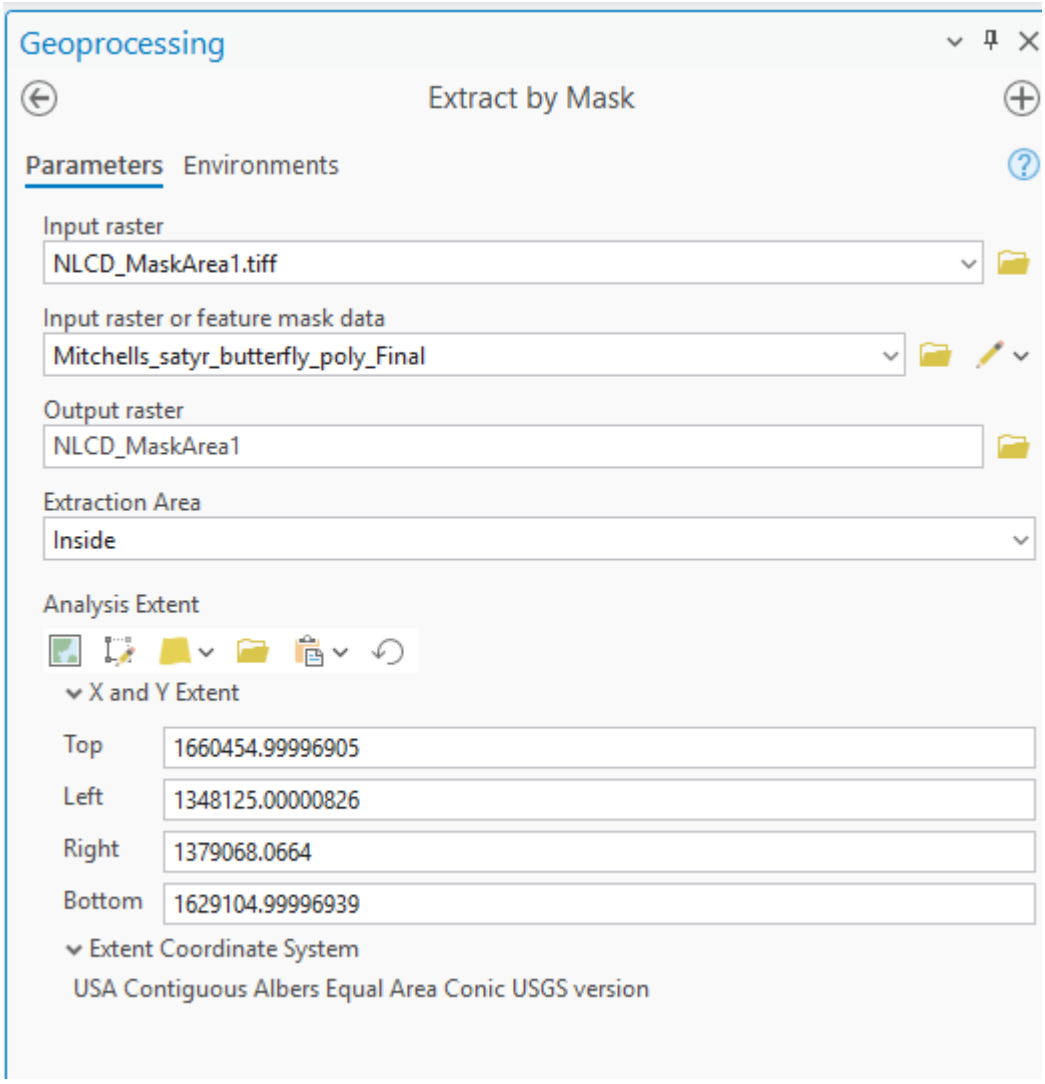

Figure A2-23. Screenshot of "Extract by Mask" tool Parameters

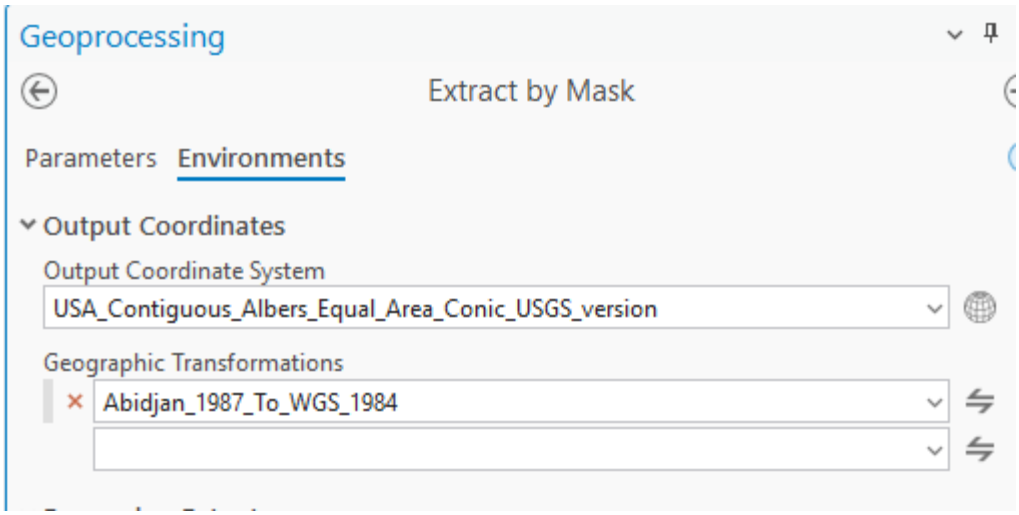

Figure A2-24. Screenshot of "Extract by Mask" tool Environments

3. Use the "Mosaic To New Raster" tool to gather all four into one output. **(Figure A2-25)**

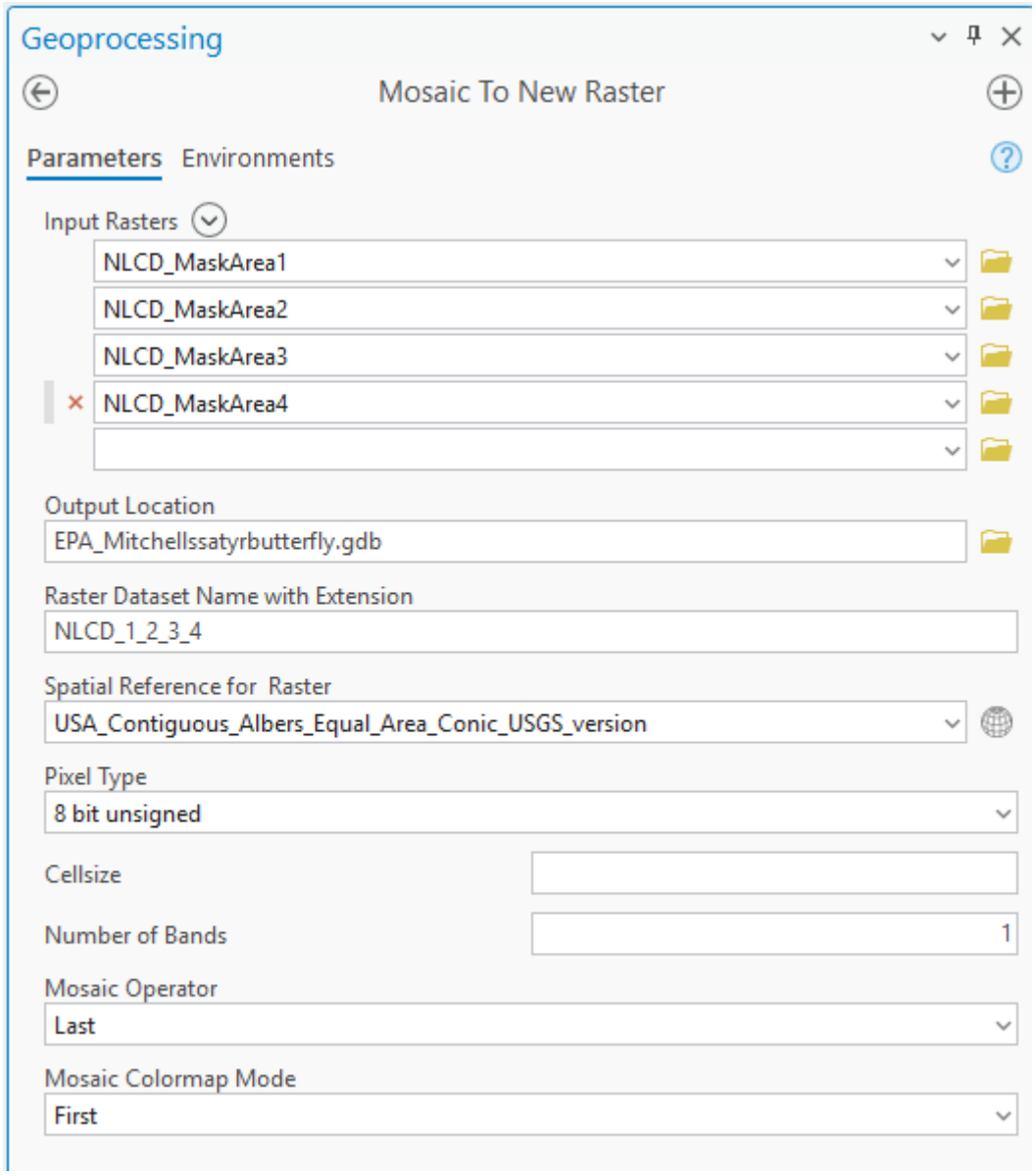

Figure A2-25. Screenshot of "Mosaic To New Raster" Tool

4. Use the "Tabulate Area" tool to determine the count of area for each NLCD code. **(Figure A2-26)**

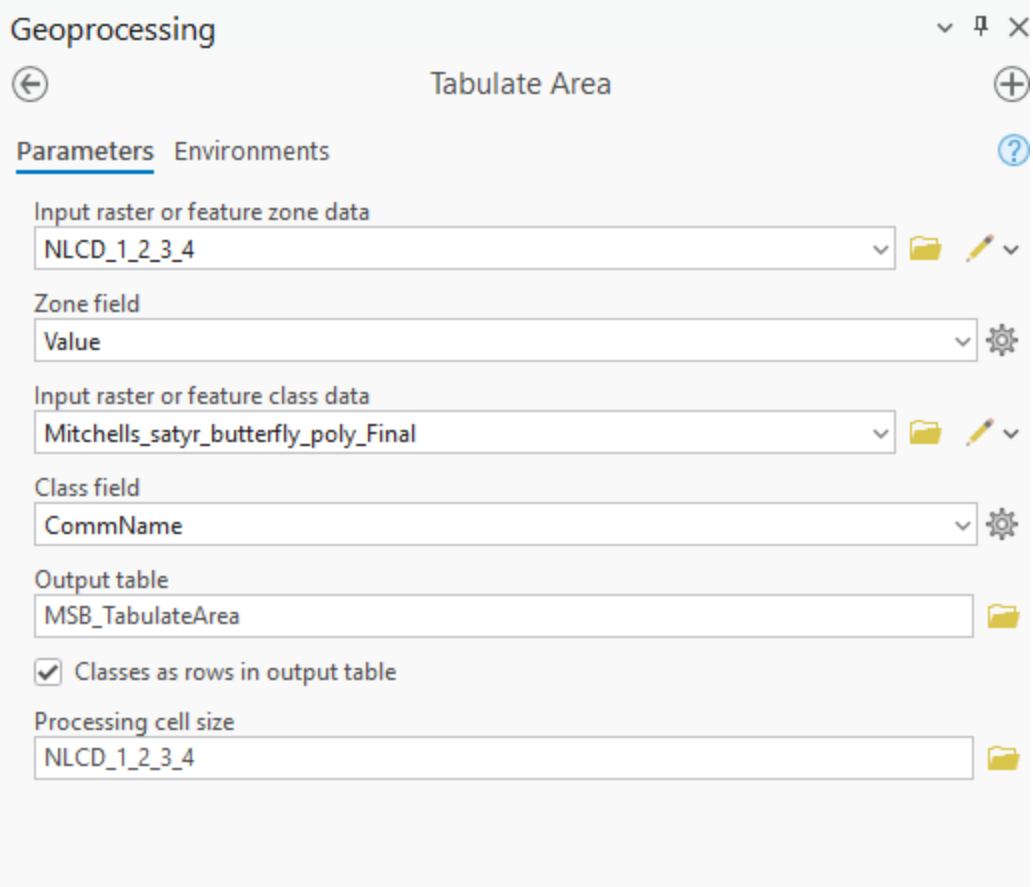

Figure A2-26. Screenshot of "Tabulate Area" Tool

5. Add a double field named, "Per" to the "MSB_TabulateArea1" table. Right clicked on field and select "Calculate Field". Entered the formula "(!Count!/ 891310)100". This calculates the percentage of NLCD within the core map area. **(Figure A2-27)** Review results and input into (Table 1. Percentage of Interim Core Map Represented by NLCD Land Covers and Associated Example Pesticide Use Sites/Types.)

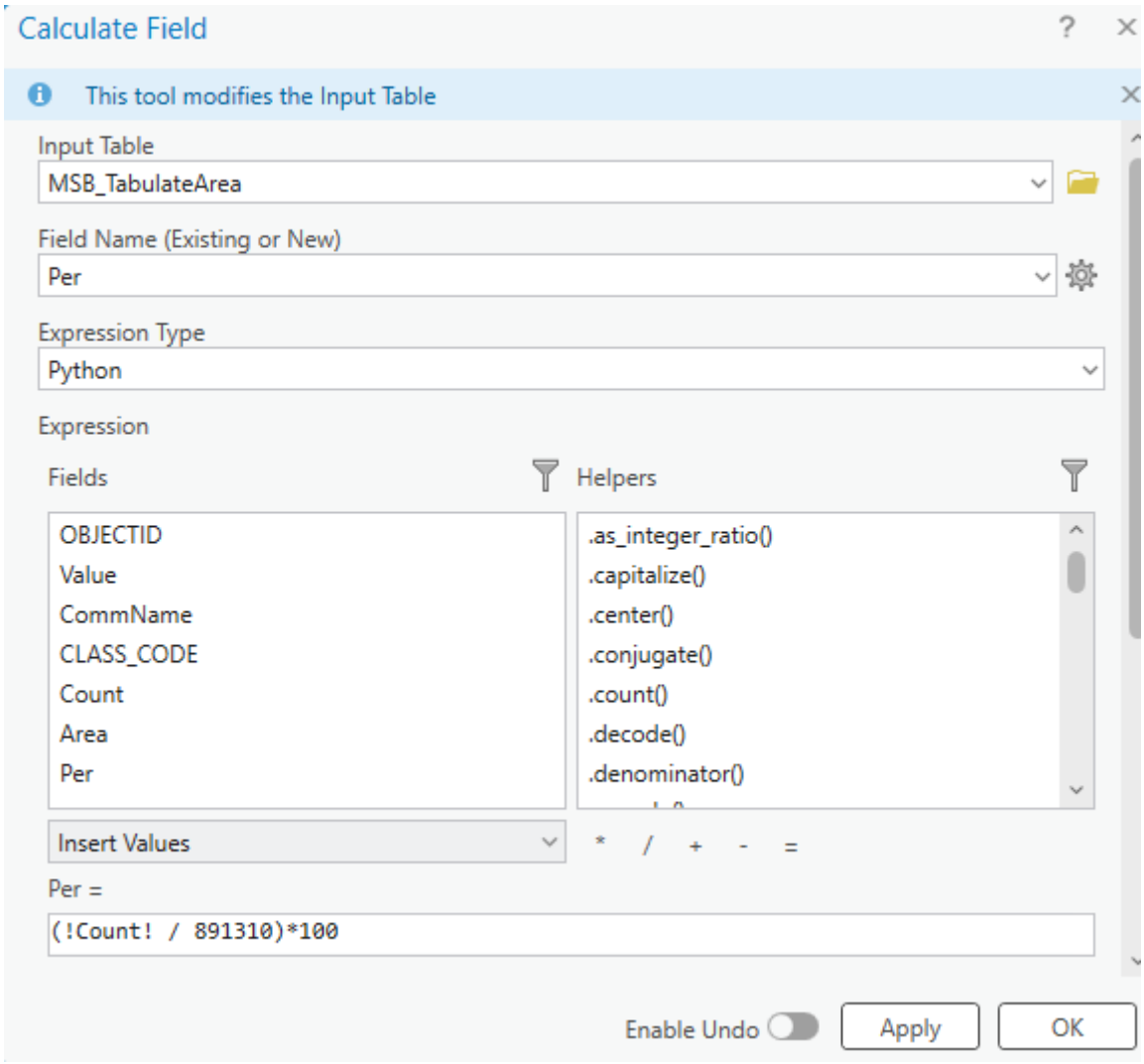

Figure A2-27. Screenshot of "Calculate Field" Tool

Appendix 3 License for Use of Virginia Natural Heritage Program Suitable Habitat Model for Floyd County, Virginia

The core map for Mitchell's satyr in Floyd County, Virginia, relies on a suitable habitat model created by the Virginia Department of Conservation and Recreation Natural Heritage Program. The Center's license to use this mode is attached below. EPA's use of core maps derived using this data must acknowledge and abide by the terms of this use license including references to the data source where appropriate. The model is current as of 5/2025.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

License for Use of Digital Data

provided by the
Virginia Department of Conservation and Recreation
Natural Heritage Program

The Virginia Department of Conservation and Recreation's Natural Heritage Program (DCR) hereby grants a revocable license to *Center for Biological Diversity* (Licensee) to use the following data: Mitchell's Satyr (*Neonympha mitchellii)* suitable habitat model in Floyd County for the development of pesticide use limitation areas. As the subscriber of this data, the Center for Biological Diversity will refer any Freedom of Information requests for this data to the data owner, the Virginia Natural Heritage Program.

Use of these data is subject to the following conditions:

1. The license is nonexclusive and revocable.
2. The license is nontransferable, and any attempted transfer is void.
3. Licensee will identify "Virginia Department of Conservation and Recreation, Natural Heritage Program" as data source on any map or publication using DCR data. If format permits, Licensee will also include the date provided.
4. Licensee will provide DCR with a list of any reports or printed materials prepared using Natural Heritage Program data and will provide a sample copy of such material if requested by DCR.
5. Although DCR maintains high standards of data quality control, DCR makes no warranty as to the fitness of the data for any purpose, nor that the data are necessarily accurate or complete.
6. Licensee understands and acknowledges that these data are provided for planning and assessment purposes only. Specific projects or activities should be reviewed for potential environmental impacts with appropriate regulatory agencies. If ground-disturbing activities are proposed in the vicinity of indicated natural heritage resources, DCR will be contacted for a site-specific review of the project area.
7. Licensee understands and acknowledges that release of natural heritage data may threaten natural heritage resources. Licensee shall take reasonable precautions to ensure the security of these data.
8. This License is the entire agreement between the parties with respect to the subject matter hereof. It shall be construed in accordance with the law of the Commonwealth of Virginia and may be amended only in writing signed by both parties.

By accepting the DCR data, Licensee agrees to abide by all of the above conditions. Licensee shall sign this license and return it to DCR to indicate receipt and acknowledgment of the terms of this license.

Signature

5/14/2025
date

Jess Tyler, Staff Scientist
Print Name and Title

for Center for Biological Diversity
agency/company

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Approved:

Jason F. Bulluck, Director
DCR Division of Natural Heritage

date