

FINAL PERFORMANCE REPORT



Federal Aid Grant No. F21AP00052 (E-94-R-1)

**Surveys within Oklahoma's historical range of the Frosted Elfin
(*Callophrys irus*) to determine current distribution and status**

Oklahoma Department of Wildlife Conservation

January 1, 2021 - December 31, 2021

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State: Oklahoma

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Grant Program: Cooperative Endangered Species Conservation Fund, Traditional Conservation Grants Program

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Grant Period: January 1, 2021 – December 31, 2021

Project Leader: Brenda D. Smith, Oklahoma Natural Heritage Inventory, Oklahoma Biological Survey, University of Oklahoma, Norman, Oklahoma

Executive Summary

Surveys for the Frosted Elfin (*Callophrys irus hadros*) in 2021 were successful. We greatly increased the number of known locations for the species in Oklahoma by adding 34 new localities within eight counties. Five of those counties were new for the species. Previously (1991–2020), we knew of only nine locations in three counties (Garvin, Murray, and McCurtain). Historical data suggested that there were but two populations in the state, separated by >140 mi (230 km). We now have bridged much of that gap by increasing the number of records of Frosted Elfins from 14 to almost 60. We recorded 404 individuals (adults and larvae) in 2021, which has helped to assess relative abundance of the regionally endemic subspecies of Frosted Elfins. We were also able to confirm the species' use of another host plant, *Baptisia nuttalliana*, and we may have evidence of its use of *B. bracteata*. Previously, *B. sphaerocarpa* was the only known host plant in Oklahoma. We obtained additional records of myrmecophily (ant associations), and we were able to rear larvae in the lab to pupation. We are awaiting emergence of those pupae. We, too, are expecting results from our DNA samples (n = 53; taken in five counties: Atoka, Garvin, McCurtain, Murray, and Pushmataha), which we hope will resolve whether *C. irus hadros* is a subspecies or deserving of specific status. Finally, we grew our network of private landowners, volunteers, and citizens interested in the project and conservation, in general.

Objectives:

- 1) Assess the continued presence of the Frosted Elfin in the projected historical range.
- 2) Assess relative abundance at known and new colonies.
- 3) Sample known and new colonies for genetic studies to determine the specific/subspecific status in Oklahoma and regionally.
- 4) Continue to build a network of private landowners, agencies, and volunteers willing to look for and monitor populations of the Frosted Elfin in successive years.

Summary of Progress:

Project Background

The Frosted Elfin, *Callophrys irus*, is a butterfly in the family Lycaenidae (gossamer-wing butterflies) and is a species of conservation concern in North America due to recent precipitous population decline (Shepherd 2005, USFWS-NY 2018). Its geographic range includes the eastern half of the United States, but it has been considered rare or at best locally uncommon where found (Brock and Kauffman 2003). It is a small butterfly with a wingspan of 25 to 32 mm (1 to 1¼ inches). Larval host plants are various species in the pea family (Fabaceae), including wild indigo, *Baptisia* sp., and wild lupine, *Lupinus* sp. Major threats to this species are loss of habitat due to urban development or agriculture, poor vegetation management that results in declines in host plant populations, and pesticide use.

The Frosted Elfin was first documented in Oklahoma in the early 1990s when Chuck Harp encountered the species in Garvin and Murray County in 1991/1992. In 2011, Bryan E. Reynolds searched in Murray County at locations Harp had encountered the species in the 1990s. Many of these locations appeared to have been developed but Reynolds was able to find the species elsewhere, a location now dubbed the “Sulphur Colony,” given its proximity to the town of Sulphur. The Garvin County location had not been re-surveyed prior to this project.

Frosted Elfin was reported for the first time away from the Garvin and Murray County area in 2008, when Berlin A. Heck discovered the species on his property southeast of Idabel, McCurtain County, a location >140 mi (230 km) to the southeast. Heck saw the species again the following year and in 2012, but it has not been reported from that locality since. In 2018, although unsuccessful at finding the species at Heck’s property, Reynolds found an adult Frosted Elfin about 5 mi (8 km) to the east near the town of Haworth, dubbed the “Haworth Colony.”

The Frosted Elfin is single brooded (one generation annually) and in Oklahoma, adults emerge early in the year, typically starting in late March, and fly through late April. Early instar larvae (caterpillars) can then be observed the first week of April. Larvae will be present through mid-May. In Oklahoma, prior to this project, the only documented larval food source was yellow wild indigo, *Baptisia sphaerocarpa*. In nearby Arkansas, it had been found primarily on Nuttall’s wild indigo, *B. nuttalliana*, which is quite common in the Ouachita Mountains. In Texas, the elfin is associated with these *Baptisia* as well as blue false indigo, *B. australis*. The butterflies occur in small colonies and stay in very close association to their host plant. The adult flight is well before the emergence of flowers of their host plants and has even been reported before host plants have begun to grow (Laurie Sheppard, *pers. comm.*, Hagerman National Wildlife Refuge Frosted Elfin population, Texas). Prior to this project, the Frosted Elfin locations known in Oklahoma were found on or near pastures, fence lines, roadside ditches, and other disturbed areas that contained *B. sphaerocarpa*.

Oklahoma is at the western periphery of the species’ range in North America, where a disjunct population exists. This population is comprised of the subspecies *Callophrys irus hadros*, found only in Arkansas, Louisiana, Texas, and Oklahoma (Fig. 1). *Callophrys irus hadros* has been assigned a NatureServe national subspecies rank of T2 (“Imperiled Subspecies”) and a subnational rank (SRank) for Oklahoma and Arkansas of S1 (critically imperiled; S2S3 in Texas, not ranked in Louisiana;

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.113674/Callophrys_irus_hadros). The species itself is currently being considered by the US Fish and Wildlife Service (USFWS) for

listing under the Endangered Species Act (ESA). The species' historical range in Oklahoma was thought to include the southcentral and southeastern portions of the state, encompassing an area approximately 19,500 km². It is reasonable to believe that the species occurs in suitable habitat throughout that area, but prior to this project it was only documented from three counties at nine localities, only two of which were known to have extant colonies. Because of the paucity of Frosted Elfin data for the state, I led a project for the Oklahoma Natural Heritage Inventory (ONHI) to survey for the species throughout its range in 2018. We attempted to do so in 2019 and 2020, but weather and health issues, especially the COVID-19 pandemic, hindered our research. The 2018 surveys produced positive results (Reynolds 2018) and given the recent positive results in both Arkansas and Texas, 2021 was an opportune time to not only continue research for this species within Oklahoma but across the region as well. This research will also be opportune for the consideration of federal listing of the species by September 30, 2023 (USFWS-NY 2018).

Prior to 2021, little was known of the Frosted Elfin's life history and phenology in the state. As will be shown, our knowledge of the species grew in leaps and bounds in the spring of 2021.

Methods

Field Surveys and monitoring

Surveys were conducted for the Frosted Elfin (*Callophrys irus hadros*) in the southeastern quadrant of Oklahoma at sites with potential suitable habitat. Previously known locations for the elfin were also monitored to determine if populations were still extant. Historical sites of the host plants, which were identified via the Oklahoma Vascular Plants Database, <https://www.oklahomaplantdatabase.org/>, and supplemented by others from the online museum specimen portal, iDigBio, <https://www.idigbio.org/portal/search>, were visited to determine if patches persisted and if elfins were present.

Timing of surveys for elfins was between mid-March and mid-May 2021 and included daytime and nighttime surveys. Daytime surveys were standard area searches of suitable habitat in which adults, larvae, and eggs were sought out by examining host plants. Nighttime surveys were conducted using handheld UV flashlights (uvBeast ultraviolet LED light 385-395 nm wavelength) that proved productive elsewhere for finding Frosted Elfin larvae (Moskowitz 2019). The amount of time spent surveying at each site depended upon habitat patch size. Searches for host plant patches continued into the summer until the *Baptisia* had died back.

Data collected included but was not limited to: presence or absence of the Frosted Elfin on a given survey; presence of other lepidoptera species and other associated organisms, when personnel were able to confidently identify them; individual counts by species and life stage; habitat associations, including notation of host plants of the Frosted Elfin; weather conditions; and geographical location data for each survey site.

Particular attention was paid to three other lepidoptera species of conservation concern, Mottled Duskywing, (*Erynnis martialis*), Cobweb Skipper (*Hesperia metea*), and the imperiled Linda's Roadside-Skipper (*Amblyscirtes linda*), to document if they were encountered. Photographs were taken to document the composition, size, and condition of the survey site. Photographs were also taken to identify and document species of plants and animals found on the site when specimens/vouchers were not taken. Photographs were archived by ONHI. Data were

archived with the ONHI's Oklahoma Biodiversity Information System, the official repository of biological data for Oklahoma.

Surveys were conducted by four teams lead by: 1) the Principal Investigator, Brenda D. Smith, 2) the on-the-ground project manager, Bryan E. Reynolds, 3) Dr. Leah Dudley of East Central University, and 4) Dr. Matt Moran of Hendrix College. Surveys were conducted within the projected historical range of this species, which includes all or portions of Atoka, Bryan, Carter, Choctaw, Cleveland, Coal, Garvin, Grady, Haskell, Hughes, Jefferson, Johnston, Latimer, Le Flore, Love, Marshall, McClain, McCurtain, McIntosh, Murray, Pittsburg, Pontotoc, Pottawatomie, Pushmataha, Seminole, Sequoyah, and Stephens Counties. Teams sought out suitable habitat in Oklahoma for the Frosted Elfin within the survey zones assigned to them at the discretion of Smith and Reynolds. Team leaders secured legal permission to survey sites and they ensured that they had expressed permission to enter properties during each visit. Each team leader also ensured that she/he and their team members were allowed to collect specimens/vouchers/genetic samples on those properties by obtaining and having in their possession all necessary federal, state, tribal, and local permits. The Oklahoma Biological Survey/Oklahoma Natural Heritage Inventory (OBS/ONHI) helped to identify survey sites and facilitate access.

DNA sampling and analyses

The Moran team collected directly or acquired through donations, several hundred specimens of *Callophrys irus* representing 15 states and 41 counties within the U.S. Samples ($n = 53$) from Oklahoma were taken by Dudley and Moran (Table 1) within five counties: Atoka, Garvin, McCurtain, Murray, and Pushmataha. They used noninvasive and nonlethal techniques of genetic sampling (e.g., removal of one adult leg or collection of larval frass). Moran's team has begun sequencing the Cytochrome c oxidase subunit I gene, a commonly used sequence to detect different species, to determine if *C. irus hadros* is a separate species from *C. irus irus*, as they suspect it to be.

Larval rearing

During the project, the opportunity for rearing larvae arose when Dr. Leah Dudley and Jose Montalva were willing to volunteer their time to rear larvae to learn more about the Frosted Elfin's life cycle. For populations in which larvae were seen, individual live larvae were collected haphazardly across the population into small brown pill bottles, collecting ~5 larvae per site. Larvae collected from field sites were taken with the intention of rearing to adulthood. Larvae were reared in a netted cage at first. Plants were dug up from the "Sulphur Colony" population with permission from the owner, potted, and placed into the netted cage. Plants were quickly defoliated by larvae. Subsequent collection and rearing maintained larvae in separate brown pill bottles and with larvae being regularly fed leaves that were collected in the field while searching for larvae at other sites. Thirty-four larvae were kept until reaching pupation (Fig. 2). At that time, all frass and leaf material were removed, and each pupa was left within its brown pill bottle at room temperature in a cardboard box. Twenty-five pupae were kept at this point (some had been attacked by fungus). Remaining pupae were moved to a cold room in late December. The intention is to take pupae out of the cold room in early Spring and to warm them

to room temperature under a 12-hour day light cycle to see if adults will emerge.

Network building

Outreach activities included working with private landowners and community members to establish and foster good relations to facilitate the understanding of the importance of researching and protecting species of conservation concern such as the Frosted Elfin. Teams also enlisted volunteers, e.g., Vonceil Harmon, Chris Rocha, Dr. Claire Curry, and Jona Tucker, who helped find host plant patches and Frosted Elfin populations. Social media posts and printed flyers were utilized to draw attention to the importance of conserving the elfin and its host plants as well as seeking the public's help in finding populations of both.

Results

Field Surveys and monitoring

Teams surveyed for 40 days between March and May. A minimum of 228 sites in 20 counties (Fig. 3; Appendix A) were investigated and many thousands of miles were driven searching for suitable habitat. We surveyed at or near 27 Oklahoma state and Federal properties (Table 2) and within numerous right-of-ways of the Oklahoma Department of Transportation.

We added 34 new positive locations for the Frosted Elfin in Oklahoma (Fig. 4). These were found in eight counties, five of which were new county records. A total of 45 occurrence records were added. Adults were recorded between 20 March and 29 April and larvae were observed between 1 April and 8 May. A minimum total of 404 individuals were reported, consisting of 229 adults and 175 larvae, with at least one individual recorded at each positive location. Highest counts were 30 for adults and 25 for larvae (mean = 7.1 and 7.8 individuals, respectively).

Surveys provided more documentation in support of the Frosted Elfin's use of *Baptisia sphaerocarpa* in Oklahoma. Surveys also documented, for the first time, the species utilizing *Baptisia nuttalliana* in Oklahoma, as they were known to do in Arkansas and Texas. The Moran team reported adult Frosted Elfins in association with *B. bracteata* and the Dudley team found two larvae on *B. bracteata* that appeared to be Frosted Elfins. We are hesitant about the larval record because the larvae were green instead of the yellow previously documented with the *hadros* subspecies of Frosted Elfins. Unfortunately, the larvae did not pupate, so documentation of Frosted Elfins at that site is still lacking. One possibility still exists for confirmation. Frass was taken for DNA sampling, so it could indicate *C. irus hadros*, but there is a possibility that the larvae were instead *Strymon melinus*, the Gray Hairstreak, which are green and can be confused with *C. irus*.

The Dudley team visited 67 historical *Baptisia sphaerocarpa* sites in hopes of finding accessible suitable habitat for the Frosted Elfin (attempts to visit four additional sites were made, but those properties could not be accessed). The team confirmed that *B. sphaerocarpa* was no longer present at 54 of those sites, an 81% loss in plant populations. Not surprisingly, no Frosted Elfins were seen at those sites. Of the nine sites where *B. sphaerocarpa* remained, Frosted Elfins were found at one.

We documented multiple occurrences of myrmecophily, apparent mutualistic or

facultative associations with ants, including both with larvae and pupae (Fig. 2). We were not able to document fluorescence with larvae (Moskowitz 2019).

Twenty additional lepidopteran species, including the SGCN species *Amblyscirtes linda*, Linda's Roadside-Skipper, were recorded at sites that Reynolds visited (Table 3).

Larval rearing

Twenty-five pupae are currently “overwintering” in cold storage. Dr. Dudley will bring them out in about a month to warm them up in hopes of them emerging as adults. Measurements of pupae, as provided by Jose Montalva, are shown below (Table 4).

DNA sampling and analyses

As of the writing of this report, the Moran team have successfully amplified DNA from multiple specimens and have a procedure that appears to be working well. They have also sequenced a small number of specimens. They are currently in the process of amplifying and sequencing the remaining specimens, which they anticipate completing by May 2022.

Network building

Numerous private landowners allowed access to their properties and we received numerous calls and emails from the public in Oklahoma and Texas reporting possible host plant patches and showing support for the Frosted Elfin project. We continued to work with state and federal agencies, conservation organizations, and other institutions to further research of the Frosted Elfin. Some of the groups, or personnel of, that have cooperated with, facilitated, and/or promoted the project include the Oklahoma Department of Wildlife Conservation, the Oklahoma Department of Transportation, Oklahoma Gas & Electric, Okies for Monarchs, The Nature Conservancy, Bebb Herbarium, US Fish and Wildlife Service, US Forest Service, and the Kerr Center.

Some unexpected and welcomed opportunities arose during the project. For example, the species was highlighted in an exhibit at the Chickasaw Cultural Center in Sulphur due to the work of the Dudley team. One of our team members, Jose Montalva, was also asked to write an article about the project for the Entomological Society of America’s magazine. Such fortuitous highlights not only bring attention to the hard work of all our team members but more importantly brings needed attention to conservation of this and other insect species.

Discussion

Our goals for the project were met and exceeded. We sought to:

- 1) Assess the continued presence of the Frosted Elfin in the projected historical range.
- 2) Assess relative abundance at known and new colonies.
- 3) Sample known and new colonies for genetic studies to determine the specific/subspecific

status in Oklahoma and regionally.

4) Continue to build a network of private landowners, agencies, and volunteers willing to look for and monitor populations of the Frosted Elfin in successive years.

Frosted Elfin are indeed still present and seemingly doing well within the projected historical range. Prior to our surveys, we knew of only 14 records for the species in Oklahoma. These records came from nine locations within only three counties (Garvin, Murray, and McCurtain). Historical data suggested that there were but two populations in the state, separated by >140 mi (230 km).

Our 2021 surveys added an additional 45 records at 34 new localities within eight counties. Five of those counties were previously unknown for the species. These data suggest there are 8-10 populations. Further, they greatly added to the known distribution of the Frosted Elfin in the state and the region (Fig. 4, 5).

Counts of both adults and larvae indicate that the species appears to have healthy populations in the state. Preliminary comparisons to regional data indicate that abundance is higher in Oklahoma. Elsewhere, high counts for specific localities top out around 15 individuals, whereas in Oklahoma adult counts have met or exceeded that number five times (high count = 30) and larvae have done so four times (high count = 25). Our knowledge of the species' phenology in Oklahoma was also enhanced. We know now that Frosted Elfin adults are active from at least 12 March until 29 April and that larvae are present from at least 1 April until 8 May. Nighttime surveys indicated that detecting larvae using UV lights may not be as productive as it has been for eastern populations of the Frosted Elfin. This may be that the UV wavelengths of the lights recommended for surveys do not work for the yellow of the *hadros* subspecies larvae or it could be that this subspecies just does not fluoresce. Pending genetic analyses may reveal that the *hadros* subspecies is actually a species unto itself, which may explain why *C. irus hadros* differs in many ways from its eastern counterpart.

We continued to build upon the regional network of private landowners, agencies, and volunteers. While in the field we met many landowners and drew support of the project and for conservation in general. Our continued work to create a network of landowners, agencies, and volunteers for this project will have much broader implications by continuing to foster good community relations for the Oklahoma Natural Heritage Inventory and the Oklahoma Department of Wildlife Conservation. These positive relations will further ford the unnecessary division between the lay public's understanding of science, the importance of protecting plant and animal species, and the role individuals can play in caring for our nationally shared natural resources. We also hope that such relationship building will allow for the project to continue into subsequent years and be a useful tool to assist in the conservation of other species and habitat.

Conclusions/Management Recommendations

A few key recommendations for the *Callophrys irus hadros* subspecies of the Frosted Elfin are:

- to continue surveying for new populations, especially within areas where there are gaps in our knowledge, for example along the border of Oklahoma and Texas and even into northern Texas where a relatively large area lacks records but likely harbors the species
- to determine the full geographical range extent of the species within Oklahoma
- to continue monitoring known populations of the Frosted Elfin in Oklahoma

- because so many Frosted Elfin localities are found within roadway right-of-ways, we strongly recommend that the Oklahoma Department of Transportation maintain their policy of pollinator conservation mowing, i.e., not mowing during the Spring and preferably not until late May or later
- further investigations of the life history, behavior, and ecology of the Frosted Elfin are needed
- further investigate why larvae of the *hadros* subspecies of the Frosted Elfin are yellow instead of green as with the nominate subspecies and why they do not fluoresce as well
- further investigate ant associations with the Frosted Elfin. Although myrmecophily is common with Lycaenidae butterflies, we know little of this phenomenon with *Callophrys irus hadros*.

Significant Deviations:

None.

Equipment Purchased (Cumulative):

No equipment exceeding \$5,000 in cost was purchased under this grant.

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Oklahoma Department of Wildlife Conservation

Andrea K. Crews, Federal Aid Coordinator
Oklahoma Department of Wildlife Conservation

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Tables:

county	# samples	sample type	collector
Atoka	12	frass, legs	Leah Dudley/Jose Montalva
Garvin	5	frass	Leah Dudley/Jose Montalva
McCurtain	2	legs	Matt Moran
Murray	21	frass, legs	Leah Dudley/Jose Montalva
Pushmataha	13	frass	Leah Dudley/Jose Montalva

Table 1. DNA samples collected of *Callophrys irus hadros* in 2021 in Oklahoma. Matt Moran’s team is assessing whether *C. irus hadros* ought to have specific status.

- | | |
|--|---------------------------------------|
| Atoka Public Hunting Area | McGee Creek State Park |
| Arbuckle Springs Wildlife Management Area | McGee Creek Wildlife Management Area |
| Atoka Wildlife Management Area | Ouachita National Forest |
| Blue River Public Fishing and Hunting Area | Pine Creek Wildlife Management Area |
| Chickasaw National Recreation Area | Pushmataha Wildlife Management Area |
| Grassy Wildlife Management Area | Red Slough Wildlife Management Area |
| Hickory Creek Wildlife Management Area | Robbers Cave State Park |
| Homer L. Johnson Wildlife Management Area | Robbers Cave Wildlife Management Area |
| Hugo Wildlife Management Area, Hamden Unit | Three Rivers Wildlife Management Area |
| Hugo Wildlife Management Area, Sawyer Unit | Tiak Unit |
| James Collins Wildlife Management Area | Tishomingo National Wildlife Refuge |
| Lake Murray State Park | Wister State Park |
| Lexington Wildlife Management Area | Wister Wildlife Management Area |
| Little River National Wildlife Refuge | |

Table 2. Surveys for *Callophrys irus hadros* in 2021 occurred at or near many Oklahoma and Federal properties.

Scientific name	Common name
<i>Amblyscirtes alternata</i>	Dusky Roadside-Skipper
<i>Amblyscirtes linda</i>	Linda's Roadside-Skipper
<i>Anaea andria</i>	Goatweed Leafwing
<i>Anthocharis midea</i>	Falcate Orangetip
<i>Atlides halesus</i>	Great Purple Hairstreak
<i>Atrytonopsis hianna</i>	Dusted Skipper
<i>Callophrys henrici</i>	Henry's Elfin
<i>Calycopis cecrops</i>	Red-banded Hairstreak
<i>Celastrina neglecta</i>	Summer Azure
<i>Chlosyne nycteis</i>	Silvery Checkerspot
<i>Colias eurytheme</i>	Orange Sulphur
<i>Danaus plexippus</i>	Monarch
<i>Erynnis brizo</i>	Sleepy Duskywing
<i>Erynnis horatius</i>	Horace's Duskywing
<i>Erynnis juvenalis</i>	Juvenal's Duskywing
<i>Papilio polyxenes</i>	Black Swallowtail
<i>Parrhasius m-album</i>	White-M Hairstreak
<i>Phyciodes phaon</i>	Phaon Crescent
<i>Polites themistocles</i>	Tawny-edged Skipper
<i>Thorybes bathyllus</i>	Southern Cloudywing
<i>Vanessa atalanta</i>	Red Admiral

Table 3. Other lepidopteran species observed during surveys for *Callophrys irus hadros* in 2021 in Oklahoma.

Weight (g)	Length (mm)	Width (mm)	Identity
0.0867	10.2	4.73	Cage 1
0.1253	11.38	5.56	Cage 11
0.1036	10.76	6.41	Cage 12
0.0338	10.56	6.62	Cage 13
0.1214	10.59	6.08	Cage 2
0.1186	10.48	6.26	Cage 3
0.1046	10.80	6.06	Cage 4
0.1501	11.73	7.06	Cage 5
0.0339	10.84	6.10	Cage 6
0.131	11.02	6.01	Cage 7
0.0784	8.89	5.21	Cage 8
0.0277	9.46	5.97	Cage 9
0.1133	10.81	5.19	Sardis Road F10
0.0432	10.00	4.97	Sardis Road F11
0.0291	10.44	4.91	Sardis Road F12
0.0257	10.40	5.73	Sardis Road F13
0.0151	8.94	5.22	Sardis Road F2
0.0149	9.20	4.63	Sardis Road F3
0.0652	9.88	5.18	Sardis Road F5
0.0874	10.14	5.27	Sardis Road F6
0.125	11.73	6.30	Sardis Road F7
0.0292	10.03	5.17	Wynnewood F1
0.1151	10.89	6.18	Wynnewood F3
0.097	11.14	6.31	Wynnewood F4
0.0366	10.94	6.65	Wynnewood F5
0.08	10.45	5.75	mean
0.04	0.76	0.67	StDev

Table 4. Measurements of *Callophrys irus hadros* pupae. Individuals were collected by Leah Dudley and Jose Montalva as larvae during 2021 field surveys in Oklahoma and were reared to pupation.

Figures:

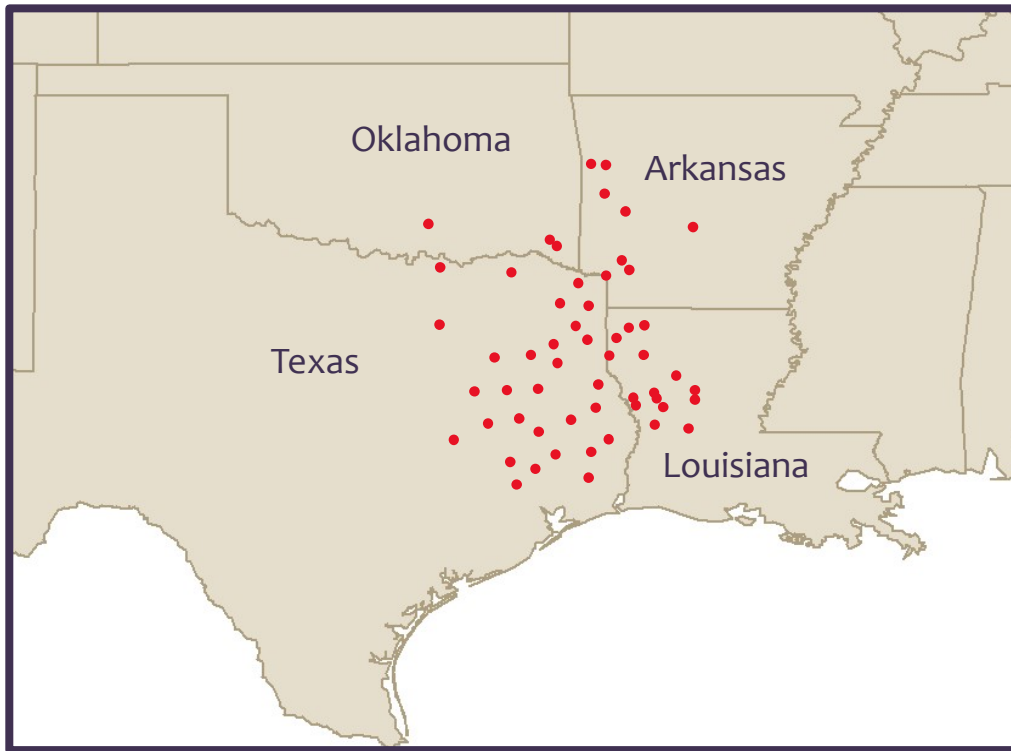


Figure 1. Historical data points of the regional subspecies of the Frosted Elfin (*Callophrys irus hadros*).



Figure 2. Ant tending to Frosted Elfin larva (left) and several tending a pupa (right).

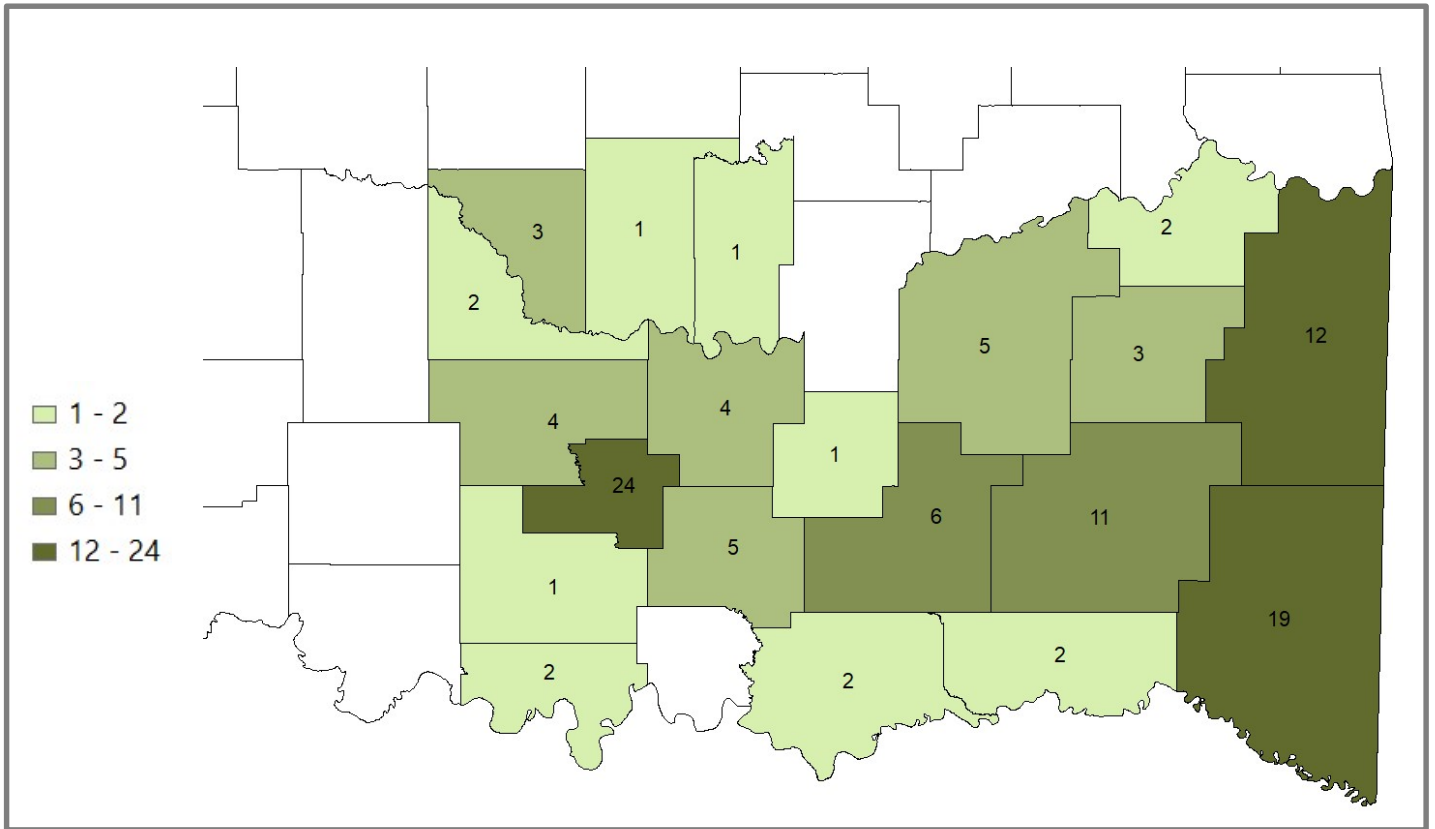


Figure 3. Survey effort by county during the 2021 fieldwork searching for the Frosted Elfin, *Callophrys irus hadros*, in Oklahoma.

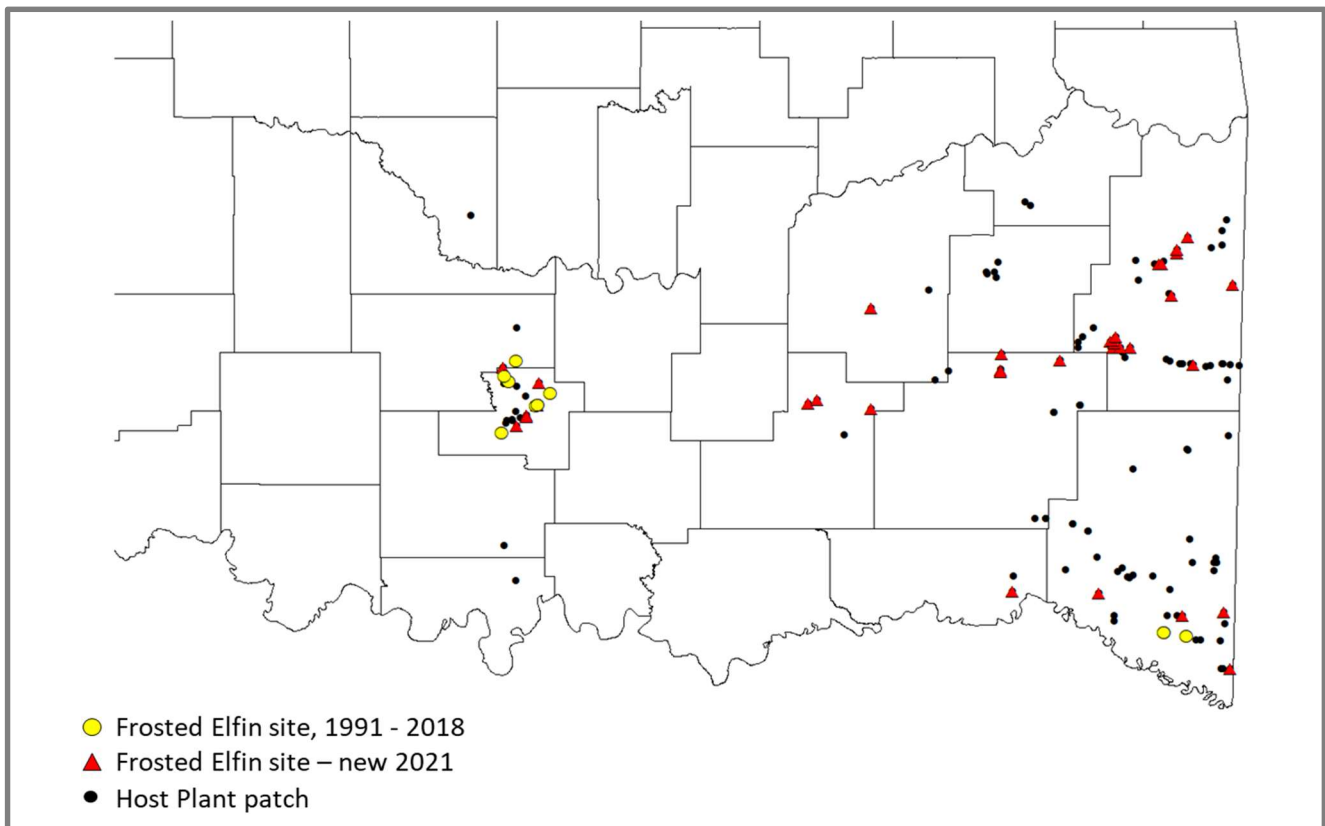


Figure 4. Known locations of the Frosted Elfin, *Callophrys irus hadros*, in Oklahoma prior to the project. Surveys in 2021 added 34 additional localities for the species as well as located numerous host plant patches that will be investigated in future research.

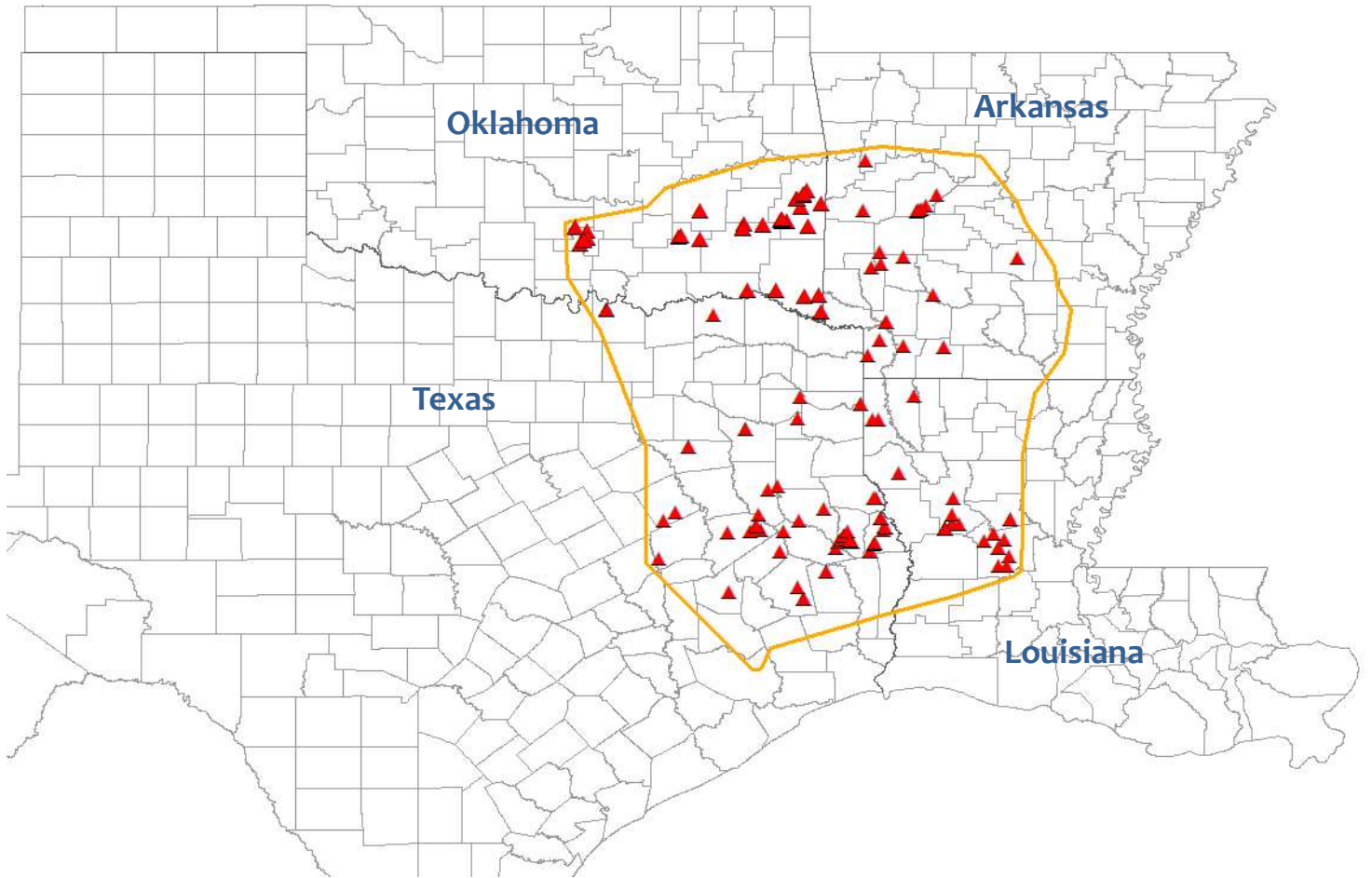


Figure 5. Known and suspected geographic range of the Frosted Elfin, *Collophrys irus hadros*.

Appendix A

Survey effort in 2021 for *Callophrys irus hadros*, the Frosted Elfin, in Oklahoma.

Route Name	Site Name	County	Surveyor	Visit Date	Locality
DUDL20210317	LOVE001	Love	Dudley, Leah S; Montalva, Jose M	3/17/2021	Lake Murray State Park
REYN20210320	MURR001	Murray	Reynolds, Bryan E	3/20/2021	3 km NW of Sulphur; "Sulphur Colony"
REYN20210320	MURR002	Murray	Reynolds, Bryan E	3/20/2021	Chickasaw National Recreation Area, Yucca Point and Bromide Hill
MORA20210321	MCCU012	McCurtain	Moran, Matthew D; Sammon, Keane; JK	3/21/2021	7.2 km E of Tom, Hwy 3
MORA20210321	MCCU013	McCurtain	Moran, Matthew D; Sammon, Keane; JK	3/21/2021	4.4 km E of Tom, Hwy 3
MORA20210321	MCCU014	McCurtain	Sammon, Keane; JK	3/21/2021	4 km W of Moon, Hwy 3
MORA20210321	MCCU015	McCurtain	Sammon, Keane; JK	3/21/2021	2 km SSW of Redland, Hwy 3
MORA20210321	MCCU016	McCurtain	Sammon, Keane; JK	3/21/2021	4.6 km SW of Redland, Hwy 3
MORA20210321	MCCU017	McCurtain	Moran, Matthew D; Sammon, Keane; JK	3/21/2021	8 km W of Idabel, Hwy 37
MORA20210321	MCCU018	McCurtain	Sammon, Keane; JK	3/21/2021	4 km E of Moon, N4790 Road
MORA20210321	MCCU019	McCurtain	Moran, Matthew D	3/21/2021	8 km WSW of Idabel, Cisco Road
MORA20210321	MCCU020	McCurtain	Moran, Matthew D	3/21/2021	2.5 km W of Tom, Hwy 3
MORA20210321	MCCU021	McCurtain	Moran, Matthew D	3/21/2021	4.8 km E of Tom, N4800 Road
REYN20210322	BRYA001	Bryan	Reynolds, Bryan E	3/22/2021	Lake Durant
REYN20210322	JOHN005	Johnston	Reynolds, Bryan E	3/22/2021	vic. Tishomingo National Wildlife Refuge, Hwy 22
REYN20210322	MCCU001	McCurtain	Reynolds, Bryan E	3/22/2021	Haworth, near jct Hwy 3 and N2190 Road, "Haworth Colony"
REYN20210322	MCCU002	McCurtain	Reynolds, Bryan E	3/22/2021	2.5 km SE of Millerton, Hwy 70 and Wheelock Road
REYN20210322	MCCU003	McCurtain	Reynolds, Bryan E	3/22/2021	Idabel and vicinity
REYN20210323	MCCU004	McCurtain	Reynolds, Bryan E	3/23/2021	Little River National Wildlife Refuge, Unit 2 [road to]
REYN20210323	MCCU005	McCurtain	Reynolds, Bryan E; Arbour, David	3/23/2021	3 km NE of Eagletown, N of Hwy 70
REYN20210323	MCCU006	McCurtain	Reynolds, Bryan E; Arbour, David	3/23/2021	vic. Mountain Fork Park
REYN20210323	MCCU007	McCurtain	Reynolds, Bryan E; Arbour, David	3/23/2021	2 km SSE of Redland, Hwy 3
REYN20210323	MCCU008	McCurtain	Reynolds, Bryan E; Arbour, David	3/23/2021	Jadie Fire Tower access (Jadie Tower Loop, W of N4800 Rd)
REYN20210323	MCCU009	McCurtain	Reynolds, Bryan E; Arbour, David	3/23/2021	1 km S of Shinewell, N4800 Road
REYN20210323	MCCU010	McCurtain	Reynolds, Bryan E; Arbour, David	3/23/2021	Little River National Wildlife Refuge, access road to Cow Crossing
REYN20210324	MCCU003	McCurtain	Reynolds, Bryan E	3/24/2021	Idabel and vicinity
DUDL20210327	COAL001	Coal	Dudley, Leah S; Montalva, Jose M	3/27/2021	1.7 km SW of Centrahoma
DUDL20210327	COAL002	Coal	Dudley, Leah S; Montalva, Jose M	3/27/2021	2.5 km SW of Centrahoma
DUDL20210327	COAL003	Coal	Dudley, Leah S; Montalva, Jose M	3/27/2021	7 km NW of Tupelo
MORA20210327	MCCU022	McCurtain	JK; KP; Moran, Matthew D	3/27/2021	3.7 km NE of Eagletown, Hwy 70
MORA20210327	MCCU023	McCurtain	JK; KP; Moran, Matthew D	3/27/2021	2 km ESE of Eagletown, S of E2057 Road
MORA20210327	MCCU030	McCurtain	JK; KP; Moran, Matthew D	3/27/2021	4.6 km NE of Eagletown

DUDL20210327	PONT001	Pontotoc	Dudley, Leah S; Montalva, Jose M	3/27/2021	3.5 km SW of Fittstown
DUDL20210327	PONT002	Pontotoc	Dudley, Leah S; Montalva, Jose M	3/27/2021	1.5 km SW of Fittstown
DUDL20210327	PUSH001	Pushmataha	Dudley, Leah S; Montalva, Jose M	3/27/2021	5 km E of Tuskahoma
MORA20210328	MCCU024	McCurtain	JK; KP; Moran, Matthew D	3/28/2021	1.3 km ENE of Golden, N of E2050 Road
MORA20210328	MCCU025	McCurtain	JK; KP; Moran, Matthew D	3/28/2021	0.8 km SSW of Golden, E2060 Road
MORA20210328	MCCU026	McCurtain	JK; KP; Moran, Matthew D	3/28/2021	3.8 km SE of Golden, E2070 Road
MORA20210328	MCCU027	McCurtain	JK; KP; Moran, Matthew D	3/28/2021	4.4 km SE of Golden
MORA20210328	MCCU028	McCurtain	JK; KP; Moran, Matthew D	3/28/2021	5 km SE of Golden, N4610 Road
MORA20210328	MCCU029	McCurtain	Moran, Matthew D	3/28/2021	3.5 km SW of Broken Bow, N4650 Road
DUDL20210328	MURR001	Murray	Dudley, Leah S; Reynolds, Bryan E; Smith, Brenda D; Harmon, Vonceil	3/28/2021	3 km NW of Sulphur; "Sulphur Colony"
DUDL20210328	MURR002	Murray	Dudley, Leah S; Reynolds, Bryan E; Harmon, Vonceil; Smith, Brenda D	3/28/2021	Chickasaw National Recreation Area, Yucca Point and Bromide Hill
ROEV20210331	CHOC001	Choctaw	Roever, Killian	3/31/2021	6 km S of Fort Towson, Hwy 109
REYN20210331	LEFL001	Le Flore	Reynolds, Bryan E	3/31/2021	Ouachita National Forest, Beech Creek Trail
REYN20210331	PUSH020	Pushmataha	Reynolds, Bryan E	3/31/2021	2 km ENE of Fewell, Hwy 44
REYN20210401	LEFL002	Le Flore	Reynolds, Bryan E	4/1/2021	Kerr Center for Sustainable Agriculture
REYN20210401	LEFL003	Le Flore	Reynolds, Bryan E	4/1/2021	Kerr Center for Sustainable Agriculture
REYN20210401	LEFL004	Le Flore	Reynolds, Bryan E	4/1/2021	Wister State Park, Wards Landing area, "Wister Colony"
REYN20210401	LEFL005	Le Flore	Reynolds, Bryan E	4/1/2021	Cedar Lake Recreation Site, Ouachita National Forest
REYN20210401	LEFL006	Le Flore	Reynolds, Bryan E	4/1/2021	Homer L. Johnson Wildlife Management Area
DUDL20210401	MURR001	Murray	Dudley, Leah S; Montalva, Jose M	4/1/2021	3 km NW of Sulphur; "Sulphur Colony"
DUDL20210410	ATOK001	Atoka	Dudley, Leah S; Montalva, Jose M	4/10/2021	3.3 km NW of Atoka
DUDL20210410	ATOK002	Atoka	Dudley, Leah S; Montalva, Jose M	4/10/2021	2.5 km SE of Stringtown
DUDL20210410	ATOK003	Atoka	Dudley, Leah S; Montalva, Jose M	4/10/2021	5 km E of Stringtown
DUDL20210410	LATI001	Latimer	Dudley, Leah S; Montalva, Jose M	4/10/2021	4 km SW of Yanush
MORA20210410	LEFL004	Le Flore	Holman, Kaylen M; Sammon, Keane	4/10/2021	Wister State Park, Wards Landing area, "Wister Colony"
MORA20210410	LEFL036	Le Flore	Holman, Kaylen M; Sammon, Keane	4/10/2021	Wister State Park, Wards Landing area
DUDL20210410	PUSH002	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	15 km NW of Clayton, Hwy 43
DUDL20210410	PUSH003	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	11 km NW of Clayton, Hwy 43
DUDL20210410	PUSH004	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	9.5 km NW of Clayton, Hwy 43
DUDL20210410	PUSH005	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	4 km N of Clayton
DUDL20210410	PUSH006	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	4 km N of Clayton
DUDL20210410	PUSH007	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	5.4 km NNE of Clayton
DUDL20210410	PUSH008	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	1 km NNE of Clayton
DUDL20210410	PUSH009	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	Clayton
DUDL20210410	PUSH010	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	8 km NNE of Clayton
DUDL20210410	PUSH011	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	10 km NNE of Clayton

DUDL20210410	PUSH012	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	10.5 km NNE of Clayton
DUDL20210410	PUSH013	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	9.7 km N of Clayton
DUDL20210410	PUSH014	Pushmataha	Dudley, Leah S; Montalva, Jose M	4/10/2021	8 km N of Clayton
MORA20210411	LEFL002	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	Kerr Center for Sustainable Agriculture
MORA20210411	LEFL003	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	Kerr Center for Sustainable Agriculture
MORA20210411	LEFL031	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	11 km E of Heavener, Hwy 128
MORA20210411	LEFL032	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	6.5 km WNW of Hodgen, Hwy 156
MORA20210411	LEFL033	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	7.7 km WNW of Hodgen, Hwy 156
MORA20210411	LEFL034	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	7 km E of Fanshawe, Hwy 271
MORA20210411	LEFL035	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	Wister State Park, Wards Landing area
MORA20210411	LEFL037	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	Wister State Park, Wards Landing area
MORA20210411	LEFL038	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	Wister State Park
MORA20210411	LEFL039	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	9.5 km E of Poteau, N4780 Road/Gilmore Road
MORA20210411	LEFL040	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	10.7 km SE of Poteau, N4780 Road/Gilmore Road
MORA20210411	LEFL041	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	8 km SE of Poteau, Hwy 83
MORA20210411	LEFL042	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	11.5 km ENE of Poteau, N4790 Road
MORA20210411	LEFL043	Le Flore	Holman, Kaylen M; Sammon, Keane	4/11/2021	4 km SSW of Poteau, Hwy 59
DUDL20210411	MURR026	Murray	Dudley, Leah S; Montalva, Jose M	4/11/2021	9.4 km NNW of Sulphur
DUDL20210411	MURR027	Murray	Dudley, Leah S; Montalva, Jose M	4/11/2021	10.6 km NNW of Sulphur
REYN20210413	GARV005	Garvin	Reynolds, Bryan E	4/13/2021	8 km E of Wynnewood, Hwy 29 near Sunshine Road
DUDL20210417	MURR028	Murray	Dudley, Leah S; Montalva, Jose M	4/17/2021	6.5 km SE of Davis, J. Lackey site
DUDL20210417	MURR035	Murray	Dudley, Leah S; Montalva, Jose M	4/17/2021	5 km S of Sulphur
DUDL20210418	HASK001	Haskell	Dudley, Leah S; Montalva, Jose M	4/18/2021	1 km N of Kinta
DUDL20210418	LATI002	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	17 km WSW of Wilburton
DUDL20210418	LATI003	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	6.2 km W of Wilburton
DUDL20210418	LATI004	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	6.5 km W of Wilburton
DUDL20210418	LATI005	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	5.6 km W of Wilburton, 3R Ranch Road
DUDL20210418	LATI006	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	5.3 km W of Wilburton, Hwy 270
DUDL20210418	LATI007	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	3.9 km W of Wilburton, Hwy 270
DUDL20210418	LATI008	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	3 km W of Wilburton
DUDL20210418	LATI009	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	3 km SW of Wilburton
DUDL20210418	LATI010	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	5 km S of Wilburton
DUDL20210418	LATI011	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	3.8 km NNW of Wilburton
DUDL20210418	LATI012	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	Robbers Cave State Park
DUDL20210418	LATI013	Latimer	Dudley, Leah S; Montalva, Jose M	4/18/2021	6 km NW of Wilburton, Degnan Road
SMIT20210418	LEFL008	Le Flore	Smith, Brenda D; Harmon, Vonceil	4/18/2021	4.4 km NE of Whitesboro, Hwy 63 and 374th Avenue
SMIT20210418	LEFL009	Le Flore	Smith, Brenda D; Harmon, Vonceil	4/18/2021	2.7 km W of Whitesboro, Bohannon Road

DUDL20210418	PITT001	Pittsburg	Dudley, Leah S; Montalva, Jose M	4/18/2021	7.5 km WNW of Arpelar
DUDL20210418	PITT002	Pittsburg	Dudley, Leah S; Montalva, Jose M	4/18/2021	1.2 km N of Haileyville
DUDL20210418	PITT003	Pittsburg	Dudley, Leah S; Montalva, Jose M	4/18/2021	3.9 km E of Crowder
DUDL20210418	PITT004	Pittsburg	Dudley, Leah S; Montalva, Jose M	4/18/2021	2.7 N of Crowder, Hwy 69
DUDL20210418	PITT005	Pittsburg	Dudley, Leah S; Montalva, Jose M	4/18/2021	11.3 km N of McAlester
DUDL20210418	PITT006	Pittsburg	Dudley, Leah S; Montalva, Jose M	4/18/2021	10 km NW of McAlester, Indian Nations Turnpike
SMIT20210418	PITT009	Pittsburg	Smith, Brenda D; Harmon, Vonceil	4/18/2021	7 km N of Blanco, east side of Indian Nations Turnpike
DUDL20210418	PONT006	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/18/2021	7 km E of Ada, Hwy 1
SMIT20210418	PUSH020	Pushmataha	Smith, Brenda D; Harmon, Vonceil	4/18/2021	2 km ENE of Fewell, Hwy 44
SMIT20210418	PUSH023	Pushmataha	Smith, Brenda D; Harmon, Vonceil	4/18/2021	8 km ENE of Nashoba, Hwy 44
REYN20210402	LEFL007	Le Flore	Reynolds, Bryan E	4/2/2021	3 km E of Whitesboro, Hwy 63, Ouachita National Forest, "Whitesboro Colony"
REYN20210402	MCCU011	McCurtain	Reynolds, Bryan E	4/2/2021	5.3 km E of Watson, Hwy 4
DUDL20210424	MURR029	Murray	Dudley, Leah S; Montalva, Jose M	4/24/2021	Chickasaw National Recreation Area, Bluestem Prairie, small reservoir and vicinity
DUDL20210425	ATOK004	Atoka	Dudley, Leah S; Montalva, Jose M	4/25/2021	Atoka Wildlife Management Area
DUDL20210425	ATOK005	Atoka	Dudley, Leah S; Montalva, Jose M	4/25/2021	Atoka Wildlife Management Area, near Breadtown Road
DUDL20210425	JOHN001	Johnston	Dudley, Leah S; Montalva, Jose M	4/25/2021	12 km NE of Tishomingo
REYN20210425	MURR029	Murray	Reynolds, Bryan E	4/25/2021	Chickasaw National Recreation Area, Bluestem Prairie
REYN20210425	MURR030	Murray	Reynolds, Bryan E	4/25/2021	Chickasaw National Recreation Area
SMIT20210426	ATOK008	Atoka	Smith, Brenda D	4/26/2021	McGee Creek State Park
SMIT20210426	ATOK009	Atoka	Smith, Brenda D	4/26/2021	McGee Creek State Park
SMIT20210426	MCCU031	McCurtain	Smith, Brenda D	4/26/2021	10 km N of Wright City, Hwy 3
SMIT20210426	MCCU032	McCurtain	Smith, Brenda D	4/26/2021	3 km SE of Ringold
DUDL20210426	MURR029	Murray	Montalva, Jose M; Reynolds, Bryan E; Smith, Brenda D; Harmon, Vonceil	4/26/2021	Chickasaw National Recreation Area, Bluestem Prairie
SMIT20210426	PUSH024	Pushmataha	Smith, Brenda D	4/26/2021	12 km E of Corinne, Hwy 3, W of N4430 Rd, vic. Pine Lake
REYN20210427	CLEV001	Cleveland	Reynolds, Bryan E	4/27/2021	Lexington Wildlife Management Area
CURR20210428	MCCU047	McCurtain	Curry, Claire	4/28/2021	Beavers Bend State Park
CURR20210429	MCCU047	McCurtain	Curry, Claire	4/29/2021	Beavers Bend State Park
CURR20210430	MCCU047	McCurtain	Curry, Claire	4/30/2021	Beavers Bend State Park
DUDL20210429	MURR001	Murray	Dudley, Leah S; Montalva, Jose M	4/29/2021	3 km NW of Sulphur; "Sulphur Colony"
MORA20210403	LEFL010	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	17.3 km E of Big Cedar, Hwy 63
MORA20210403	LEFL011	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	14 km E of Big Cedar, Hwy 63
MORA20210403	LEFL012	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	11.8 km E of Big Cedar, Hwy 63
MORA20210403	LEFL015	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	2.6 km W of Big Cedar, Hwy 63

MORA20210403	LEFL016	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	1.5 km W of Big Cedar, Hwy 63
MORA20210403	LEFL019	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	3.7 km E of Summerfield
MORA20210403	LEFL020	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	0.7 km NW of Whitesboro, Hwy 63
MORA20210403	LEFL021	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	0.5 km WNW of Whitesboro, E1595 Road
MORA20210403	LEFL022	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	3 km NW of Whitesboro, Hwy 63 at Pete Kennedy Lane
MORA20210403	LEFL023	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	5.5 km E of Talihina, Hwy 271
MORA20210403	LEFL024	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	4.6 km S of Talihina, Hwy 271
MORA20210403	LEFL025	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/3/2021	6.2 km S of Talihina, Hwy 271, tributary to Prairie Creek
DUDL20210403	MURR003	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	3 km W of Sulphur, 0.5 km N of Hwy 7, Nelson/N3370 Rd
DUDL20210403	MURR004	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	3 km W of Sulphur, 0.4 km N of Hwy 7, Nelson/N3370 Rd
DUDL20210403	MURR005	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	3.2 km W of Sulphur, N of Hwy 7
DUDL20210403	MURR006	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	3.4 km W of Sulphur, Hwy 7
DUDL20210403	MURR007	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	Chickasaw National Recreation Area, 5.5 km W of Sulphur, Hwy 7
DUDL20210403	MURR008	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4.4 km E of Davis, Hwy 7
DUDL20210403	MURR009	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	5.4 km ESE of Davis
DUDL20210403	MURR010	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4 km SE of Davis
DUDL20210403	MURR011	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4.3 km SE of Davis, Primrose Lane
DUDL20210403	MURR012	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	3.4 km SE of Davis, Primrose Lane (Oklahoma Gas & Electric solar panel site)
DUDL20210403	MURR013	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	3 km SE of Davis
DUDL20210403	MURR014	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4 km SSE of Davis, Hanover Road
DUDL20210403	MURR015	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4 km S of Davis
DUDL20210403	MURR016	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4 km S of Davis
DUDL20210403	MURR017	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4.5 km S of Davis, Knappe Road
DUDL20210403	MURR018	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	4.7 km S of Davis, S of Knappe Road
DUDL20210403	MURR019	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	Davis
DUDL20210403	MURR020	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	Sulphur, W Oklahoma Ave between W 15th St and W 14th St
DUDL20210403	MURR021	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	Sulphur, E Oklahoma Ave between 1st/Hwy177 and Division St
DUDL20210403	MURR022	Murray	Dudley, Leah S; Montalva, Jose M	4/3/2021	5 km E of Sulphur, Hwy 7
DUDL20210403	PONT003	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/3/2021	Ada, NW Broadway, N of Hwy 1
DUDL20210403	PONT004	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/3/2021	3 km E of Ada
DUDL20210403	PONT005	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/3/2021	4.5 km SE of Ada
DUDL20210403	PONT006	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/3/2021	7 km E of Ada, Hwy 1
DUDL20210403	PONT007	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/3/2021	9.5 km SE of Ada
DUDL20210403	PONT008	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/3/2021	Roff, W Main Street near S 10th Street

REYN20210430	ATOK007	Atoka	Reynolds, Bryan E	4/30/2021	McGee Creek Wildlife Management Area
DUDL20210404	GARV001	Garvin	Dudley, Leah S; Montalva, Jose M	4/4/2021	9 km WSW of Pauls Valley
DUDL20210404	GARV002	Garvin	Dudley, Leah S; Montalva, Jose M	4/4/2021	Wynnewood
DUDL20210404	GARV003	Garvin	Dudley, Leah S; Montalva, Jose M	4/4/2021	5 km E of Wynnewood
SMIT20210404	JOHN004	Johnston	Smith, Brenda D; Hoagland, Bruce W	4/4/2021	1.2 km W of Bromide, E 1790 Rd
SMIT20210404	JOHN006	Johnston	Smith, Brenda D; Hoagland, Bruce W	4/4/2021	Arbuckle Springs Wildlife Management Area
SMIT20210404	JOHN007	Johnston	Smith, Brenda D; Hoagland, Bruce W	4/4/2021	Blue River Public Fishing and Hunting Area, Hwy 7
SMIT20210404	JOHN008	Johnston	Smith, Brenda D; Hoagland, Bruce W	4/4/2021	Blue River Public Fishing and Hunting Area, vic. Desperado Springs
MORA20210403	LEFL013	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	6.2 km E of Big Cedar, Hwy 63
MORA20210403	LEFL014	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	1 km E of Big Cedar, Hwy 63
MORA20210404	LEFL017	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	6 km WNW of Big Cedar, Hwy 63
MORA20210404	LEFL018	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	7 km WNW of Big Cedar, Hwy 63
MORA20210404	LEFL026	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	3 km SE of Talihina, N4500 Road
MORA20210404	LEFL027	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	3.8 km NW of Whitesboro, Camp Tom Hale Road/N4560 Road
MORA20210404	LEFL028	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	4.5 km NNW of Whitesboro, Camp Tom Hale Road/N4560 Road
MORA20210404	LEFL029	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	1 km S of Whitesboro, N4580 Road, S of Kiamichi River
MORA20210404	LEFL030	Le Flore	Moran, Matthew D; Holman, Kaylen M; KP	4/4/2021	3 km SSE of Whitesboro, E1620 Road
DUDL20210404	MURR023	Murray	Dudley, Leah S; Montalva, Jose M	4/4/2021	12.5 NNW of Davis
DUDL20210404	MURR024	Murray	Dudley, Leah S; Montalva, Jose M	4/4/2021	9.3 km N of Davis
DUDL20210404	MURR025	Murray	Dudley, Leah S; Montalva, Jose M	4/4/2021	10 km NNW of Davis
DUDL20210404	PONT009	Pontotoc	Dudley, Leah S; Montalva, Jose M	4/4/2021	12.7 km NE of Stratford
DUDL20210404	POTT001	Pottawatomie	Dudley, Leah S; Montalva, Jose M	4/4/2021	3 km N of Tecumseh
DUDL20210404	SEMI001	Seminole	Dudley, Leah S; Montalva, Jose M	4/4/2021	4 km NE of Konawa
SMIT20210408	GARV003	Garvin	Smith, Brenda D	4/8/2021	5 km E of Wynnewood
SMIT20210408	GARV006	Garvin	Smith, Brenda D	4/8/2021	8 km NE of Maysville, jct N3180 Road and E1500 Road
SMIT20210408	GARV007	Garvin	Smith, Brenda D	4/8/2021	Elmore City Lake
SMIT20210408	GARV008	Garvin	Smith, Brenda D	4/8/2021	1.6 km S of Katie
SMIT20210408	GARV009	Garvin	Smith, Brenda D	4/8/2021	2.4 km S of Katie
SMIT20210408	GARV010	Garvin	Smith, Brenda D	4/8/2021	0.5 km W of Longmire Lake, E1560 Road
SMIT20210408	GARV011	Garvin	Smith, Brenda D	4/8/2021	9.5 km NW of Stratford, jct N3340 Road and E1500 Road
SMIT20210408	MCCL001	McClain	Smith, Brenda D	4/8/2021	Wiley Post Memorial Lake and vicinity
SMIT20210408	MURR032	Murray	Smith, Brenda D	4/8/2021	3 km NE of Joy
SMIT20210408	MURR033	Murray	Smith, Brenda D	4/8/2021	2 km W of Chigley

SMIT20210408	MURR034	Murray	Smith, Brenda D	4/8/2021	1.4 km WNW of Chigley
DUDL20210501	ATOK006	Atoka	Dudley, Leah S; Montalva, Jose M	5/1/2021	5 km SW of Daisy, Hwy 43
DUDL20210501	PUSH011	Pushmataha	Dudley, Leah S; Montalva, Jose M	5/1/2021	10 km NNE of Clayton
DUDL20210501	PUSH015	Pushmataha	Dudley, Leah S; Montalva, Jose M	5/1/2021	14.6 km NW of Clayton, Hwy 43
DUDL20210501	PUSH016	Pushmataha	Dudley, Leah S; Montalva, Jose M	5/1/2021	5.3 km NNE of Clayton, jct Hwy 2 and 271
DUDL20210501	PUSH017	Pushmataha	Dudley, Leah S; Montalva, Jose M	5/1/2021	4.8 km NNE of Clayton, jct Hwy 2 and 271
DUDL20210501	PUSH018	Pushmataha	Dudley, Leah S; Montalva, Jose M	5/1/2021	Pushmataha Wildlife Management Area, 10 km S of Clayton
DUDL20210501	PUSH019	Pushmataha	Dudley, Leah S; Montalva, Jose M	5/1/2021	Pushmataha Wildlife Management Area, 7 km S of Clayton
REYN20210512	CLEV001	Cleveland	Reynolds, Bryan E	5/12/2021	Lexington Wildlife Management Area
REYN20210513	HASK002	Haskell	Reynolds, Bryan E	5/13/2021	2 km E of Kinta, Hwy 31
SMIT20210513	MCCU037	McCurtain	Smith, Brenda D	5/13/2021	11 km ESE of Hochatown, Carnasaw Creek area
REYN20210513	PITT008	Pittsburg	Reynolds, Bryan E	5/13/2021	James Collins Wildlife Management Area
SMIT20210514	LEFL044	Le Flore	Smith, Brenda D	5/14/2021	11 km E of Big Cedar, Hwy 63
SMIT20210514	LEFL045	Le Flore	Smith, Brenda D	5/14/2021	7.7 km E of Big Cedar, Hwy 63
SMIT20210514	LEFL046	Le Flore	Smith, Brenda D	5/14/2021	2 km E of Big Cedar, Hwy 63
SMIT20210514	MCCU038	McCurtain	Smith, Brenda D	5/14/2021	8.6 km S of Smithville, 28000 Rd
SMIT20210514	MCCU039	McCurtain	Smith, Brenda D	5/14/2021	8.5 km S of Smithville, 28000 Rd
DUDL20210514	MURR001	Murray	Dudley, Leah S; Montalva, Jose M	5/14/2021	3 km NW of Sulphur; "Sulphur Colony"
SMIT20210515	MCCU040	McCurtain	Smith, Brenda D	5/15/2021	3 km SSW of Bethel, 56000 Rd
SMIT20210515	PITT010	Pittsburg	Smith, Brenda D	5/15/2021	1 km NE of the Pushmataha-Pittsburg County line, Hwy 43
SMIT20210515	PUSH020	Pushmataha	Smith, Brenda D	5/15/2021	2 km ENE of Fewell, Hwy 44
SMIT20210515	PUSH023	Pushmataha	Smith, Brenda D	5/15/2021	8 km ENE of Nashoba, Hwy 44
DUDL20210502	JOHN002	Johnston	Dudley, Leah S; Montalva, Jose M	5/2/2021	Blue River Public Fishing and Hunting Area, 10 km SSE of Connerville
DUDL20210502	JOHN003	Johnston	Dudley, Leah S; Montalva, Jose M	5/2/2021	7 km E of Connerville, Harris Ranch Road, Delaware Creek
DUDL20210502	JOHN004	Johnston	Dudley, Leah S; Montalva, Jose M	5/2/2021	1.2 km W of Bromide, E 1790 Rd
SMIT20210526	PUSH021	Pushmataha	Smith, Brenda D	5/26/2021	1 km SW of Albion, Hwy 271 and 4454 Road
REYN20210503	CART001	Carter	Reynolds, Bryan E	5/3/2021	Lake Murray State Park
REYN20210503	LOVE002	Love	Reynolds, Bryan E	5/3/2021	Hickory Creek Wildlife Management Area
REYN20210503	MURR029	Murray	Reynolds, Bryan E	5/3/2021	Chickasaw National Recreation Area, Bluestem Prairie
REYN20210503	MURR031	Murray	Reynolds, Bryan E	5/3/2021	6 km ESE of Davis, Private property on Chickasaw Trail Road
REYN20210504	LEFL007	Le Flore	Reynolds, Bryan E	5/4/2021	3 km E of Whitesboro, Hwy 63, Ouachita National Forest, "Whitesboro Colony"
REYN20210504	PUSH021	Pushmataha	Reynolds, Bryan E	5/4/2021	1 km SW of Albion, Hwy 271 and 4454 Road
REYN20210504	PUSH022	Pushmataha	Reynolds, Bryan E	5/4/2021	Hugo Wildlife Management Area

REYN20210506	BRYA001	Bryan	Reynolds, Bryan E	5/6/2021	Lake Durant
REYN20210506	JOHN005	Johnston	Reynolds, Bryan E	5/6/2021	vic. Tishomingo National Wildlife Refuge, Hwy 22
DUDL20210506	MURR001	Murray	Dudley, Leah S; Montalva, Jose M	5/6/2021	3 km NW of Sulphur; "Sulphur Colony"
SMIT20210508	CHOC001	Choctaw	Smith, Brenda D	5/8/2021	6 km S of Fort Towson, Hwy 109
SMIT20210508	CHOC002	Choctaw	Smith, Brenda D	5/8/2021	Raymond Gary State Park
SMIT20210508	CHOC003	Choctaw	Smith, Brenda D	5/8/2021	1 km SW of Fort Towson, Hwy 109
DUDL20210508	GARV003	Garvin	Dudley, Leah S; Montalva, Jose M	5/8/2021	5 km E of Wynnewood
DUDL20210508	GARV004	Garvin	Dudley, Leah S; Montalva, Jose M	5/8/2021	9 km SW of Stratford, Longmire Lake
SMIT20210508	MCCU031	McCurtain	Smith, Brenda D	5/8/2021	10 km N of Wright City, Hwy 3
SMIT20210508	MCCU032	McCurtain	Smith, Brenda D	5/8/2021	3 km SE of Ringold
SMIT20210508	MCCU033	McCurtain	Smith, Brenda D	5/8/2021	2.5 km E of Wright City, Hwy 98
SMIT20210508	MCCU034	McCurtain	Smith, Brenda D	5/8/2021	3.5 km N of Valliant, Pine Creek Road between Birdhouse Lane and N2050 Rd
SMIT20210508	MCCU035	McCurtain	Smith, Brenda D	5/8/2021	2.6 km WNW of Garvin, Hwy 70
SMIT20210508	MCCU036	McCurtain	Smith, Brenda D	5/8/2021	2.5 km WNW of Garvin, Hwy 70
DUDL20210508	MURR024	Murray	Dudley, Leah S; Montalva, Jose M	5/8/2021	9.3 km N of Davis
SMIT20210508	PUSH024	Pushmataha	Smith, Brenda D	5/8/2021	12 km E of Corinne, Hwy 3, W of N4430 Rd, vic. Pine Lake
SMIT20210508	PUSH025	Pushmataha	Smith, Brenda D	5/8/2021	8 km E of Corinne, Hwy 3
DUDL20210509	LATI014	Latimer	Dudley, Leah S; Montalva, Jose M	5/9/2021	James Collins Wildlife Management Area
DUDL20210509	LATI015	Latimer	Dudley, Leah S; Montalva, Jose M	5/9/2021	James Collins Wildlife Management Area
DUDL20210509	LATI016	Latimer	Dudley, Leah S; Montalva, Jose M	5/9/2021	James Collins Wildlife Management Area
HARM20210509	MURR036	Murray	Harmon, Vonceil	5/9/2021	7.7 km NW of Sulphur
HARM20210509	MURR037	Murray	Harmon, Vonceil	5/9/2021	9.6 km NE of Davis, Triple L Road
DUDL20210509	PITT007	Pittsburg	Dudley, Leah S; Montalva, Jose M	5/9/2021	James Collins Wildlife Management Area, vic. headquarters