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## Golden-cheeked Warbler Annual Report – 2019



### Report Overview

The status of the federally endangered Golden-cheeked Warbler is not fully understood in southeastern Hays County, Texas. Therefore, a project was assembled in which a group of undergraduate field technicians performed transect and territory mapping surveys to determine the warbler's abundance and habitat use. Though numbers of warblers were low throughout San Marcos, Texas, we were able to positively detect nesting activity for the first time on university property. Thus, this study is important and gives insight into what remaining vegetation the warbler is utilizing in central Texas as their habitat continues to diminish under anthropogenic pressures.

### Brief Species Introduction

The Golden-cheeked Warbler (*Setophaga chrysoparia*, hereafter GCWA) is a small neotropical passerine that selectively breeds only within the Edwards Plateau Region of central Texas. It is dependent upon large stands of mature juniper-oak woodlands that are typically located near or along canyon slopes. The birds use this habitat for nesting, breeding, and carrying

out most foraging behaviors during the months of March - July (Pulich 1976). Due to habitat loss and fragmentation over the past 50 years, the GCWA was emergency listed as endangered in 1990 by the U.S. Fish and Wildlife Service (USFWS 1990). Since then, multiple conservation-based institutions, organizations, military bases and independent biologists have dedicated their time, finances, and effort into studying and preserving this species. Even though research efforts have been fruitful and current GCWA population numbers appear stable, the warbler continues to suffer from (first and foremost) habitat loss and fragmentation, followed by other factors such as brood parasitism and predation, anthropogenic activities and noise, among other things (Groce et al. 2010, Duarte et al. 2016).

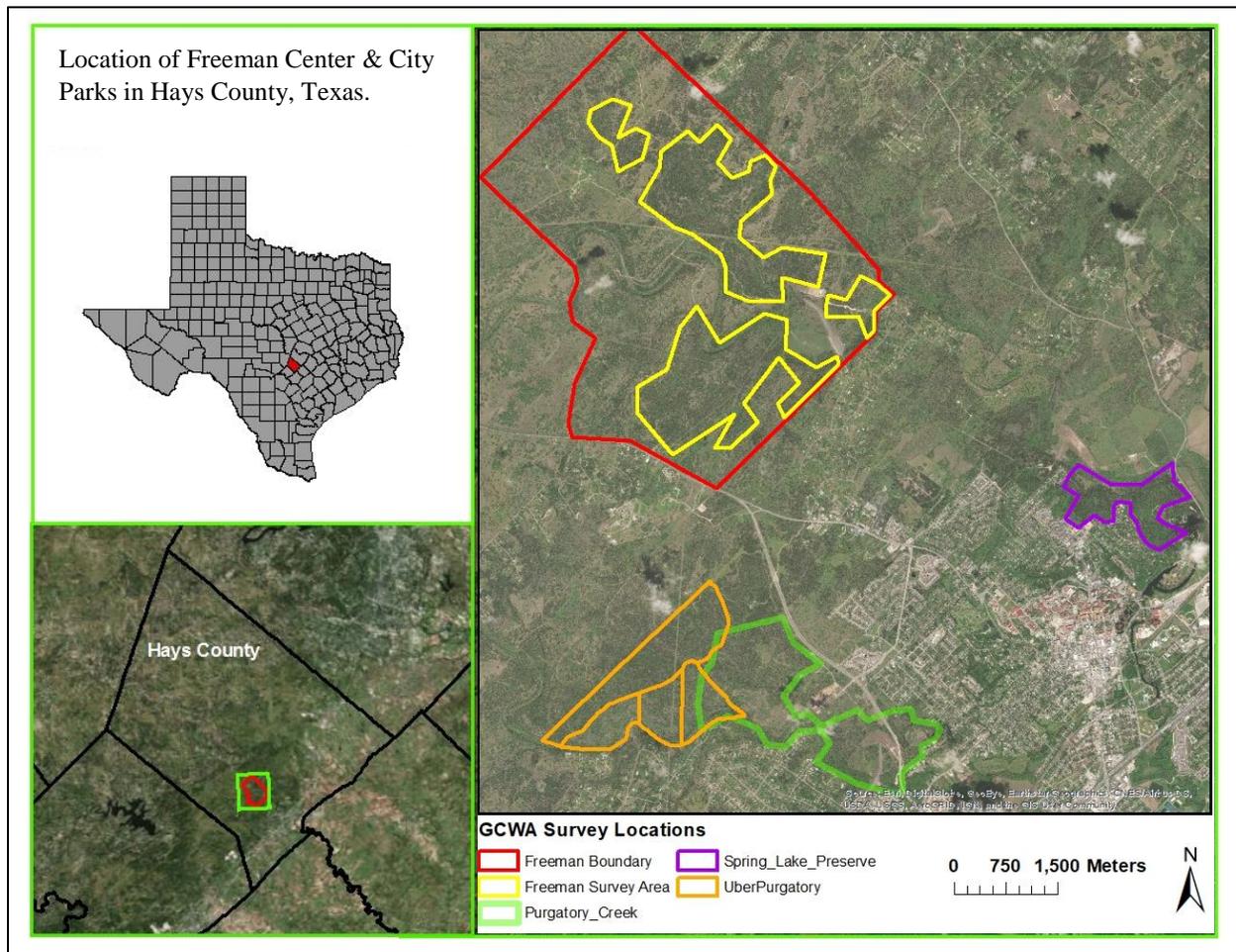
### **GCWA Survey Sites**

The City of San Marcos is located near the southeastern tip of Hays County, which is an area that has been under constant growth and construction over the past decade. According to the U.S. Census Bureau, San Marcos and the surrounding areas near the Interstate 35 (I-35) corridor are part of the fastest growing population centers, not only in the state, but in the nation. With rapid population growth comes building human infrastructures, roads, and landscape change in order to support the increasing number of people. Therefore, natural habitat such as woodlands and grasslands are fragmented and converted at an alarming rate.

Among the increasing human populations in central Texas, small areas of “suitable” GCWA habitat still exist in patches within SE Hays County. Therefore, the following survey locations were chosen mostly due to availability of access, but also because they still contained decent stands of mature juniper-oak woodlands that the GCWA needs to successfully breed.

Texas State University and the Parks and Recreation division of the City of San Marcos both gave permission to have certain properties surveyed for GCWAs during the months of March-June in 2019 (Figure 1). The Freeman Center, a Texas State University owned property, is located roughly 5 miles NW of downtown San Marcos, Texas, and contains over 4,000 acres of mixed habitat types. Large sections of oak-juniper woodlands (*Juniperus ashei*, *Quercus fusiformis*, *Quercus buckleyi*, *Ulmus crassifolia*) are scattered throughout, with the main contiguous patch of potential GCWA habitat measuring around 700 acres (as noted from arials in ArcGIS 10.2). The Freeman Center also is an operating cattle ranch and site for multiple wildlife graduate student research projects (rodents, birds, vegetation analyses, habitat management, etc.). The properties surveyed on city-owned land included areas of Spring Lake Preserve, Upper Purgatory Creek, and Uber Purgatory, all of which are selectively (or permanently) closed to the public during the nesting season of the GCWA. These city parks contain habitat made up of mature juniper-oak woodlands, but in comparison to the Freeman Center, these properties are located closer to urban centers and neighborhoods. The areas surrounding the city parks have undergone more development and fragmentation than that of the properties surrounding the Freeman Center.

Figure 1.



## Survey Methodology

We used the following methods to survey and monitor GCWAs on university property (TE168189-0). Even though there are many different ways to perform these surveys, we choose to use protocol similar to those used on Fort Hood Military Reserve, the Balcones Canyonlands Preserve (BCP), and Camp Bullis Military Base in San Antonio, Texas.

### Transects

At the beginning of the season when GCWAs first arrive (late February and early March), we conducted transects across suspected GCWA habitat at the Freeman Center and city parks. We plotted transects using the “Fishnet” tool on ArcGIS 10.2 (ESRI, Inc., Redlands, California), using aerial imagery to identify suspected warbler habitat. Each transect consisted of a series of points located every 200 m, where the observer paused for 5 minutes to listen for singing males. Observers began these transects no later than 30 minutes after daybreak, and direction in which transect plots were walked were altered on each visit. We covered each

transect point  $\geq 2$  times on visits separated by  $\geq 5$  days. If any singing males were detected at a point, we estimated and recorded a distance and bearing for each individual, as well as marked a GPS point as close to the singing individual as possible. Transects were primarily done to locate GCWAs on property so that territory mapping could be done for the remainder of the season.

### Territory mapping

If GCWAs were located via transects, we territory mapped males using similar methods to those utilized by the City of Austin, Travis County Balcones Canyonlands Preserve, and Fort Hood Military Reserve (Reidy and Thompson 2010, Peak 2011, Balcones Canyonlands Preserve Land Managers Handbook, Tier IIA, Chapter VII: Monitoring the Golden-cheeked Warbler 2007 (hereafter BCP 2007), International Bird Census Committee IBCC Guidelines 1970, Verner 1985, Bibby et al. 1992). Between March 15 and June 1, we visited each GCWA territory once a week ( $>5$  days between visits for official territory distinction), and we recorded GPS locations of the bird roughly every 5-10 minutes (or during every 'large' flight movement ( $>30$  m)) for  $\geq 45$  minutes per territory. We began surveys roughly 30 minutes before sunrise and completed surveys within 6 hours. Temperatures needed to be  $\geq 12$  degrees Celsius and consistent wind patterns  $< 25$  kph for detectability purposes. We also made observations on GCWA age (if visible through binoculars), if counter-singing males were in the vicinity, if females were present, and if we suspected nesting behavior. If males or females were suspected of nesting, then we spent extra time to locate the nest. Search time was not excessive as to keep disturbance within breeding GCWA habitat down to a minimum (BCP 2007, Reidy and Thompson 2010).

We considered GCWA territories official if a) the male was observed in the same location on at least three different visits, b) the male was seen with a female (courtship behavior, nest building, etc.), or c) was observed feeding fledglings (BCP 2007). All GPS coordinates were uploaded into ArcGIS 10.6 and plotted against an aerial imagery for that particular location. Once all points were assigned to distinctive male GCWAs, we calculated territories using minimum convex polygons (MCPs).

Nineteen separate surveyors visited the GCWA plots for both transects and territory mapping in 2019; undergraduate students Alex Klingele, Alisa Gonzalez, Amy Sherman, April Taylor, Cezanne Lossing-Cann, Charles Bintliff, Jennifer Vanhoye, Joshua Benavidez, Joshua Robledo, Katherine Underwood, Kaylee Cantu, Kaylee Read, Kevin Legrow, Laura Schweitzer, Rebecca Davis, Sarah Bullard, Thomas Thompson, and Victor Ma, all under the management of PhD Candidate Rebekah Rylander. All surveyors were trained to identify GCWAs by sight and by sound (USFWS permits TE168189-0 (Rebekah Rylander and Dr. Clay Green)), and were familiar with transect and spot mapping techniques before official data was collected. GPS points were taken using Garmin eTrex 10 or Garmin eTrex 20 units, both of which are capable of 5-meter accuracy in the field. Also, IACUC permits were obtained for this research on university property.

### Capture and banding

In addition to transect and territory mapping, we subjected male GCWAs to mist-netting for capture under federal banding permit #24108 (Rebekah Rylander). In order to capture

warblers, we used playback of aggressive male GCWA calls in early daylight hours, not to exceed 20 minutes of playback, following the protocol suggested by USFWS and Fort Hood Military Reserve. Once warblers were caught, we ceased playback, extracted birds from the net quickly, and banded each with a unique color-combination. We were given unique color combinations through Fort Hood Military Base in order to prevent repeated combinations across the state. Once age and sex of the individual was determined, we released it immediately back into its territory. By color banding male GCWAs, it provided an opportunity for surveyors to accurately identify the individual they were following, leading to territory mapping with less error. This equated to clearer results as to where specific GCWAs were located and what habitat they were utilizing.

### Survey Results

With over 900 hours of volunteer survey efforts in 2019, we detected a total of eight unique GCWA males during our Freeman Center and City of San Marcos Parks surveys – 6 at Freeman, 1 at Uber Purgatory, and 1 incidental at Upper Purgatory Creek Preserve (Figures 2 & 3). We did not detect any GCWAs at Spring Lake Preserve for a third year in a row, though information from eBird states that warblers have been spotted in the vicinity – these could have been post-breeding individuals that tend to wander as the season comes to an end, and therefore their detections do not equate to warblers breeding in the neighboring preserve. We assigned all detected male GCWAs a unique number, and those numbers are used in preceding paragraphs and tables in reference to the individual warblers (Table 1).

| <b>Male GCWA #</b> | <b># of Detection Days</b> | <b>Territory Size (ha)</b> | <b>Female Present?</b> | <b>Fledglings?</b> |
|--------------------|----------------------------|----------------------------|------------------------|--------------------|
| 1                  | 8                          | 33.5                       | Yes                    | Yes (2+)           |
| 2                  | 6                          | 13.3                       | No                     | No                 |
| 3                  | 8                          | 23                         | No                     | No                 |
| 4                  | 6                          | 10.7                       | No                     | No                 |
| 5                  | 5                          | 6.7                        | No                     | No                 |
| 6                  | 1                          | NA                         | No                     | No                 |
| 7                  | 4                          | 9.4                        | No                     | No                 |
| 8                  | 1                          | NA                         | No                     | No                 |

Our first detection in 2019 for GCWAs was March 15<sup>th</sup> (male #2), and our last detection (not including incidentals) was June 12<sup>th</sup> (male #1). Though we cannot be certain that there were no GCWAs present on property into the month of July, we can report that no individuals were singing during the morning hours on surveys after June 12th. See Table 2 for details on detection dates, as well as on behavioral and banding information. Maps at the end of this report show warbler territories in greater detail (Figures 7-9).

Figure 2. Mapped territories for GCWAs at the Freeman Center. The following numbers have been assigned to each territorial GCWA male. These will be referred to in the rest of the report:

Green = male #1, red = male #2, orange = male #3, blue = male #4, pink = male #5, purple = male #6

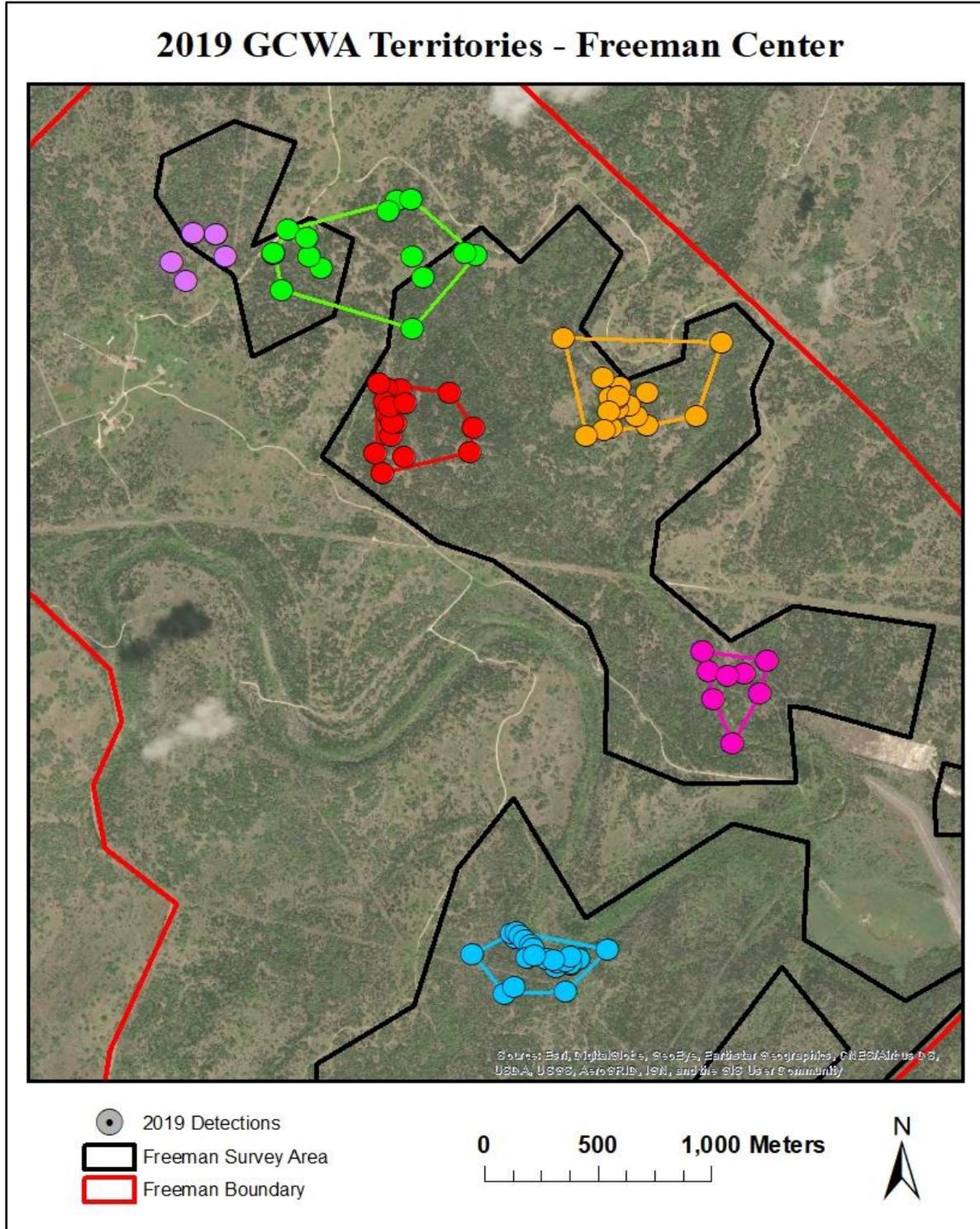
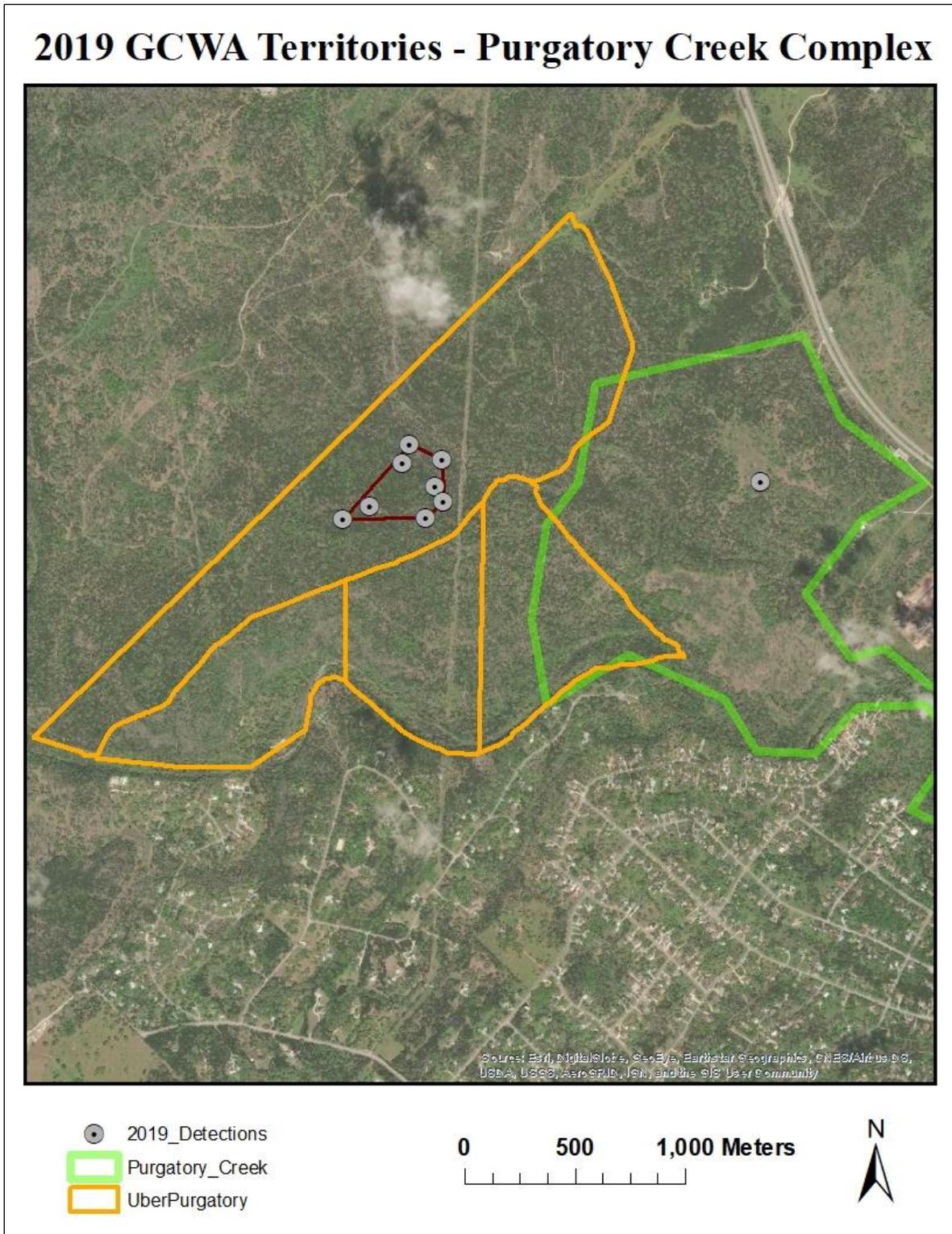


Figure 3. Uber Purgatory and Upper Purgatory Creek GCWA detections.

male #7 = maroon, male #8 = single gray dot



**Table 2. GCWA Detection Dates**

| <b>Male #</b> | <b>Date</b> | <b>Comments</b>   |
|---------------|-------------|---|
| 1             | 3/19/2019   |   |
|               | 3/26/2019   |   |
|               | 4/5/2019    | Banding attempt, but male not responsive to playback                    |
|               | 4/23/2019   |   |
|               | 4/27/2019   |   |
|               | 5/25/2019   | Two nestlings located in juniper/oak scrub. Detected from begging calls |
|               | 6/3/2019    |   |
| 2             | 6/12/2019   | Last GCWA detection of the season – male chipping and moving rapidly    |
|               | 3/15/2019   | First GCWA detection of the season – male singing quietly               |
|               | 3/17/2019   | Failed banding attempt – could not relocate the warbler; too quiet      |
|               | 3/20/2019   |   |
|               | 4/20/2019   |   |
|               | 4/23/2019   |   |
| 3             | 4/27/2019   |   |
|               | 3/25/2019   |   |
|               | 3/29/2019   |   |
|               | 3/30/2019   |   |
|               | 4/2/2019    |   |
|               | 4/3/2019    | Successful banding attempt – male sang minutes after release            |
|               | 4/8/2019    |   |
|               | 4/12/2019   |   |
| 4             | 4/22/2019   |   |
|               | 3/27/2019   | Successful banding attempt – Texas State Media accompaniment            |
|               | 4/6/2019    |   |
|               | 4/8/2019    |   |
|               | 4/16/2019   |   |
|               | 4/22/2019   |   |
| 5             | 4/30/2019   |   |
|               | 3/21/2019   | Male successfully banded and released – report cover photo one page 1   |
|               | 3/29/2019   |   |
|               | 3/30/2019   |   |
|               | 4/3/2019    |   |
| 6             | 4/9/2019    |   |
|               | 3/24/2019   | Was only detected on this date and never again                          |
| 7             | 4/1/2019    |   |
|               | 4/12/2019   |   |
|               | 4/19/2019   | First male banded on City property                                      |
|               | 4/27/2019   |   |
| 8             | 6/26/2019   | Incidental auditory detection at Upper Purgatory Creek                  |

At the Freeman Center, five official territories were delineated. Male #1 had a very large territory (33.3 hectares), and this was likely due to this male being the only one to have successfully nested as noted by his behavior feeding fledglings on May 25<sup>th</sup> (Figure 6 at the end of the report). Based on the size and behavior of the fledglings, they were still dependent on adults to feed them, meaning this male GCWA at some point did have a female mate and a successful nest somewhere in the vicinity. It is common for territories to expand significantly after successful nesting attempts, mostly because fledglings busily fly about, following their parents that still feed them, as well as males behaving less aggressively toward neighboring warblers. Though only two fledglings were detected, it is likely that there were more.

The other four delineated territories (# 2-5) on Freeman were fairly large (Table 1) as compared to other warbler surveys nearby in San Antonio. This could be due to unpaired males searching for mates, resulting in wandering behavior that results in larger detection areas. Even though these males were not observed with females or with fledglings, they were still present on three consecutive surveys, each  $\geq 5$  days apart, classifying them as official territories. Male #6 was only detected on March 24<sup>th</sup> and was never relocated on successive transects.

The GCWA territory mapped on Uber Purgatory (male #7) was initially detected on April 1<sup>st</sup>, and last detected on April 27<sup>th</sup>. However, it is likely that this warbler was present after that survey date, but due to many of the undergraduate technicians finishing their season as the spring semester finished, we were short of help. Regardless, this warbler remained for almost a month in the same area that contained suitable nesting habitat.

On June 26<sup>th</sup>, a GCWA (male #8) was incidentally detected on Upper Purgatory by undergraduate biology major Matthew Johnson. Though this warbler was not relocated on further surveys, it is likely that this GCWA nested (or fledged) somewhere nearby and wandered on to Upper Purgatory (similar to the GCWA detected at Spring Lake via eBird). The habitat in which this warbler was detected was not particularly suitable nesting habitat (sparse oak-juniper canopy, large patches of mixed savannah), thus leading to believe that it moved through the park post breeding-season, which is common for GCWAs.

## Banding Results

Four males were successfully captured and banded during the 2019 season (Table 3).

| <b>Table 3. Banding Data</b> |                  |   |                      |            |
|------------------------------|------------------|---|----------------------|------------|
| <b>Male GCWA #</b>           | <b>USGS Band</b> | <b>Color-bands (left leg : right leg)</b> | <b>Date Captured</b> | <b>Age</b> |
| 5                            | 2830-66004       | white/orange : yellow/silver              | 3/21/2019            | ASY        |
| 4                            | 2830-66005       | light blue/silver : yellow/white          | 3/27/2019            | SY         |
| 3                            | 2830-66006       | red/white : yellow/silver                 | 4/3/2019             | ASY        |
| 7                            | 2830-66007       | black/black : yellow/silver               | 4/19/2019            | SY         |

We aged two of the captured warblers as second year (SY) birds, meaning they hatched during 2018, returning to central Texas for their first breeding season. We aged the other two

adults as after second year birds (ASY), meaning that they were at least two years old and had likely attempted to nest in previous seasons. Once males had been banded and aged, we immediately released them, and all four individuals safely flew to a nearby perch and eventually returning to singing and scouting their territories. Several photos at the end of this report are included, demonstrating mist-netting techniques and warbler banding/aging.

We attempted capturing and banding males #1 & 2, but neither individual responded aggressively to playback. Instead of singing back to the playback warbler calls, these males became quiet and retreated, which is not the usual response. After two separate attempts to band each of these males, both with the same results, we ceased banding attempts for these individuals as to not harass them.

## **Discussion**

The surveys at the Freeman Center and on City of San Marcos properties are continuing to provide insight into the GCWAs behavior and habitat utilization in southeastern Hays County. Though we were only able to detect 8 unique male GCWAs during 2019, we were able to confidently confirm GCWA reproductive success for the first time on the Freeman Center. We have suspected that the warblers have successfully nested on both the Freeman Center and city properties in the past, but we have had no luck locating females or fledglings during the 2017 and 2018 seasons. Therefore, witnessing a fledgling GCWA being fed by an adult male is a noteworthy observation. It could signify that females are recognizing that the habitat is suitable for reproductive purposes in these locations, or it could mean that the habitat in surrounding areas is diminishing, pushing females and males alike into sub-par vegetation. Either way, it is a positive and hopeful detection that sheds light on perhaps the future importance of the Freeman Center and City of San Marcos properties toward the persistence of the species as a whole.

Based on the discovery of the GCWA fledglings outside of our designated survey plots, we will reevaluate our transect points on Freeman for the 2020 season. An expansion of both zones 1 and 3 should be done in order to properly cover this area, as warblers often return to the same territories in sequential years, especially if they were successful nesting. Another new zone will be proposed in North Crawford pasture along the bluff, as it has been documented as having suitable habitat that could provide territories for GCWAs. As for city properties, more surveys need to be conducted during the month of April to insure we are adequately covering ground before undergraduate technicians leave for the summer. Due to the difficult accessibility of Uber Purgatory (long hikes from just one parking area), we will need to seek volunteers willing to put in more hours because of the large amount of time it takes to walk from one side of the property to the other. It is a suspicion that we are missing warblers because we are not able to adequately cover ground throughout the season.

When comparing the three years of data from the GCWA surveys, it can be observed that warblers are mostly utilizing the same locations each year. Figure 4 demonstrates the overlap in territories at the Freeman Center, highlighting the most suitable patches of habitat that the university property provides for these birds.

Figure 4. Overlap of GCWA territories on the Freeman Center

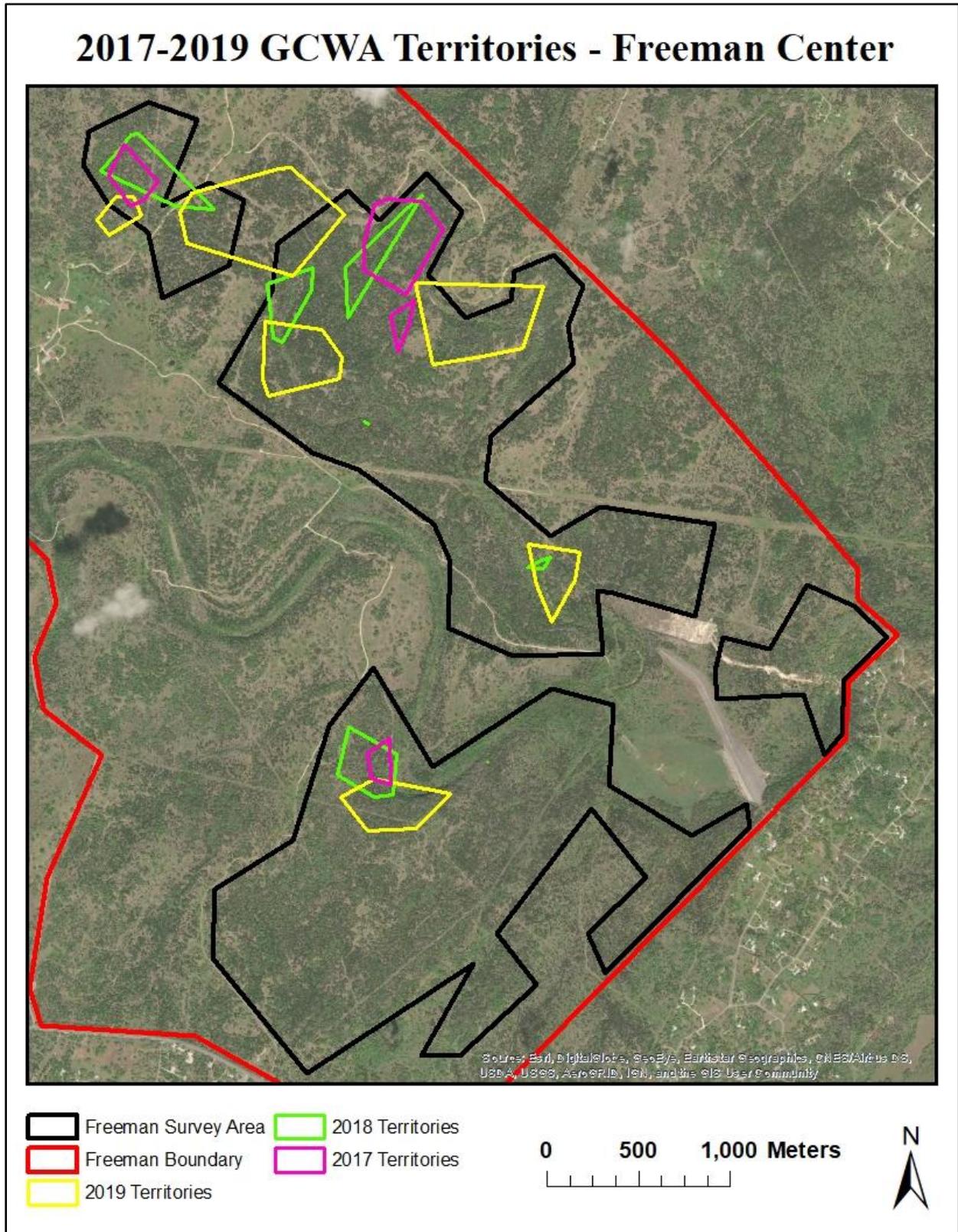
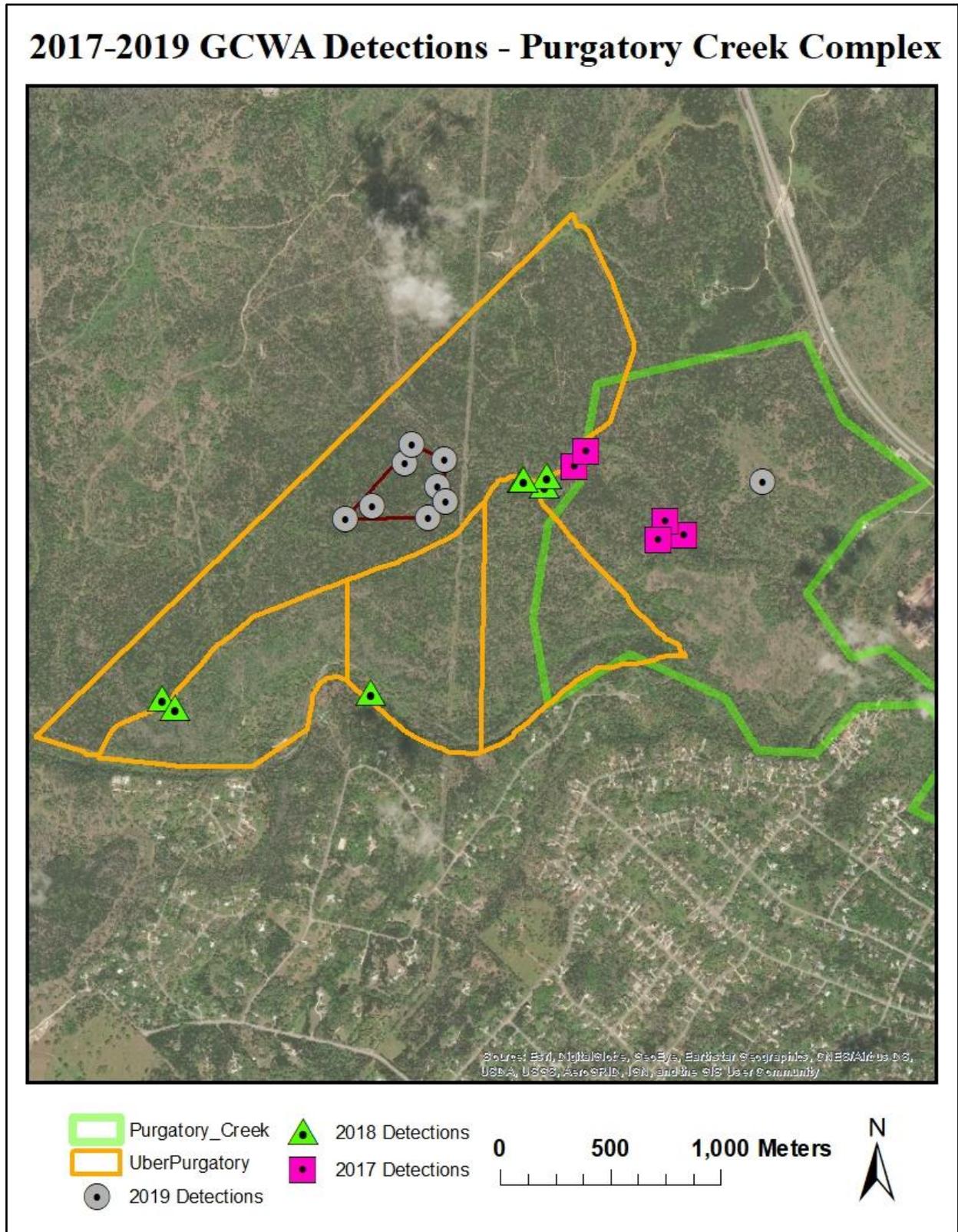


Figure 5. Disjointed pattern of GCWA distribution on Upper and Uber Purgatory Creek



However, in Figure 5, it is apparent that we are still trying to observe consistent patterns in habitat use of GCWAs at Upper and Uber Purgatory Creek. Both properties provide large contiguous patches of suitable oak-juniper woodland, and therefore it could be more difficult locating “hotspots” for GCWAs due to this. With several additional years of survey efforts, it may become apparent which patches the warblers are preferring consistently. This could then aid biologists in making educated decisions on conservation and management plans of these properties in the future.

For a third year in a row, we did not observe any GCWAs on Spring Lake Preserve. Even though we had no positive detections, we cannot say for certain that warblers were never on property. However, we can feel more certain claiming that warblers are not using Spring Lake for reproductive purposes. Because of this, we recommend that trails that have been previously closed for GCWA nesting season should be re-opened to the public for recreational use during the months of March-June. The eBird accounts of GCWAs on Spring Lake are from May and June (2018 and 2019), which is usually associated with post-breeding movements.

We did not resight any of the same banded warblers from the 2018 season during 2019. Though this is not entirely surprising, it is interesting that male warblers continue to use the same territories each year, though they are not the same individuals. We are interested to see if any of the banded males from this season return in 2020.

On March 27<sup>th</sup>, Isabel Ray and Stephanie Schulz from the Texas State University Marketing Department assisted graduate student Rebekah Rylander on a GCWA capture and banding attempt at the Freeman Center. After struggling to locate male #2 in zone 1, they were successful in capturing male # 4 in zone 2. The story, written by Isabel Ray, was posted as the top story on the university web page for several weeks, and can still be accessed through the following link: <https://stories.txstate.edu/research/a-bird-in-the-hand.html>. It was an honor that the GCWA project received this kind of attention, and it has provided motivation and encouragement to continue the project in the future. Several photos at the end of this report were taken by Stephanie Schultz during this event.

Although survey efforts for the GCWA in southeastern Hays County are still not up to par with large institutions like Fort Hood Military Base or the Balcones Canyonlands Preserve, the consistency of these surveys across multiple years are invaluable in understanding the local use and success of the warbler in the greater San Marcos area. We hope that with 1+ more years of survey efforts, we can unravel even more patterns that will help with the management of university and city properties in which the GCWA calls home.

### **Acknowledgements**

Our ongoing GCWA research has been possible because of the generous financial contributions from the Freeman Center at Texas State University and the San Marcos Greenbelt Alliance. We also appreciate their support of undergraduate participation in this project, as it allows students to experience and directly engage in endangered species conservation efforts.

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Figure 6. Notice the open corridors and savannah patches within this territory. Highly unusual.

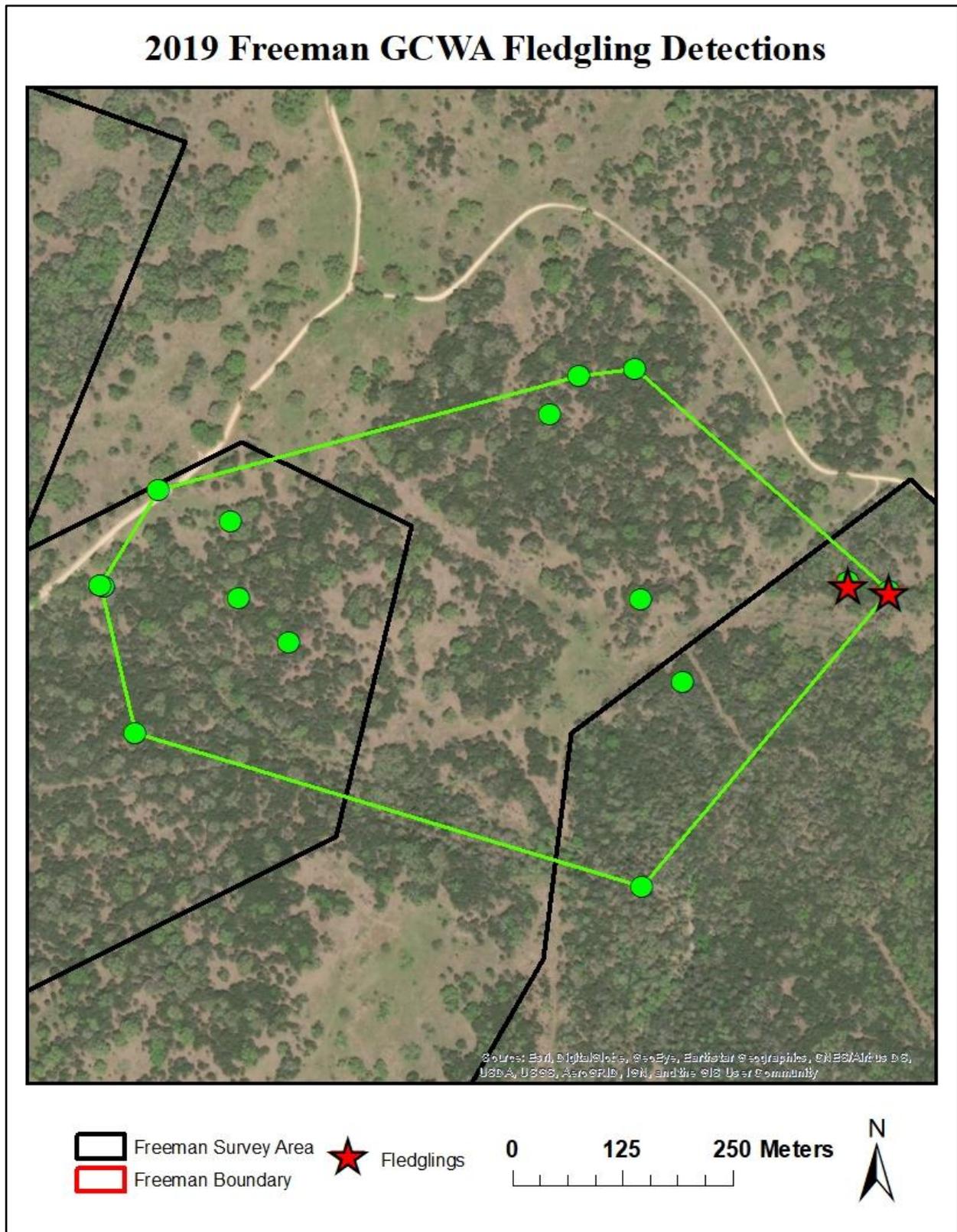


Figure 7. 2019 territories in Zone 1

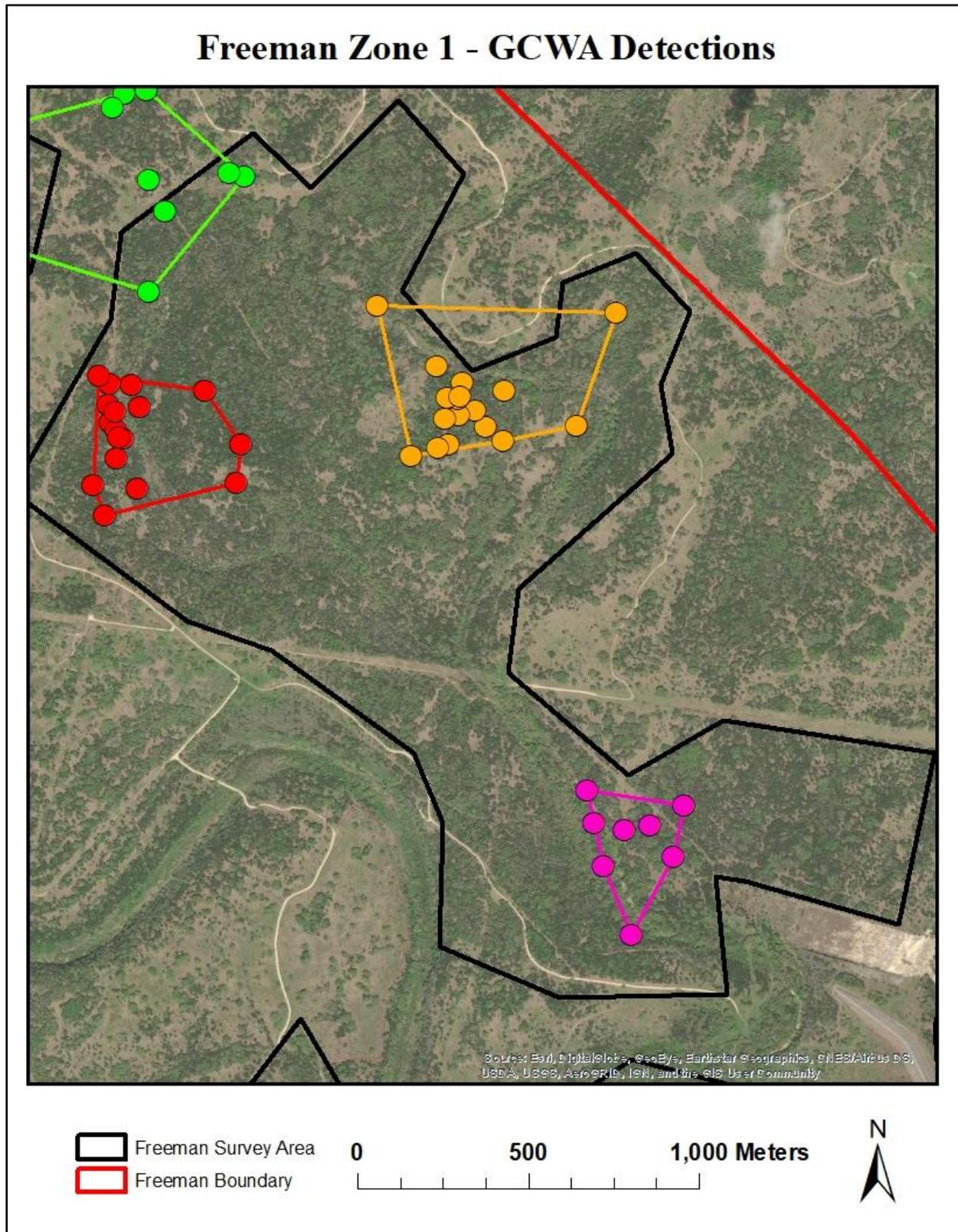


Figure 8. 2019 territories in Zone 2

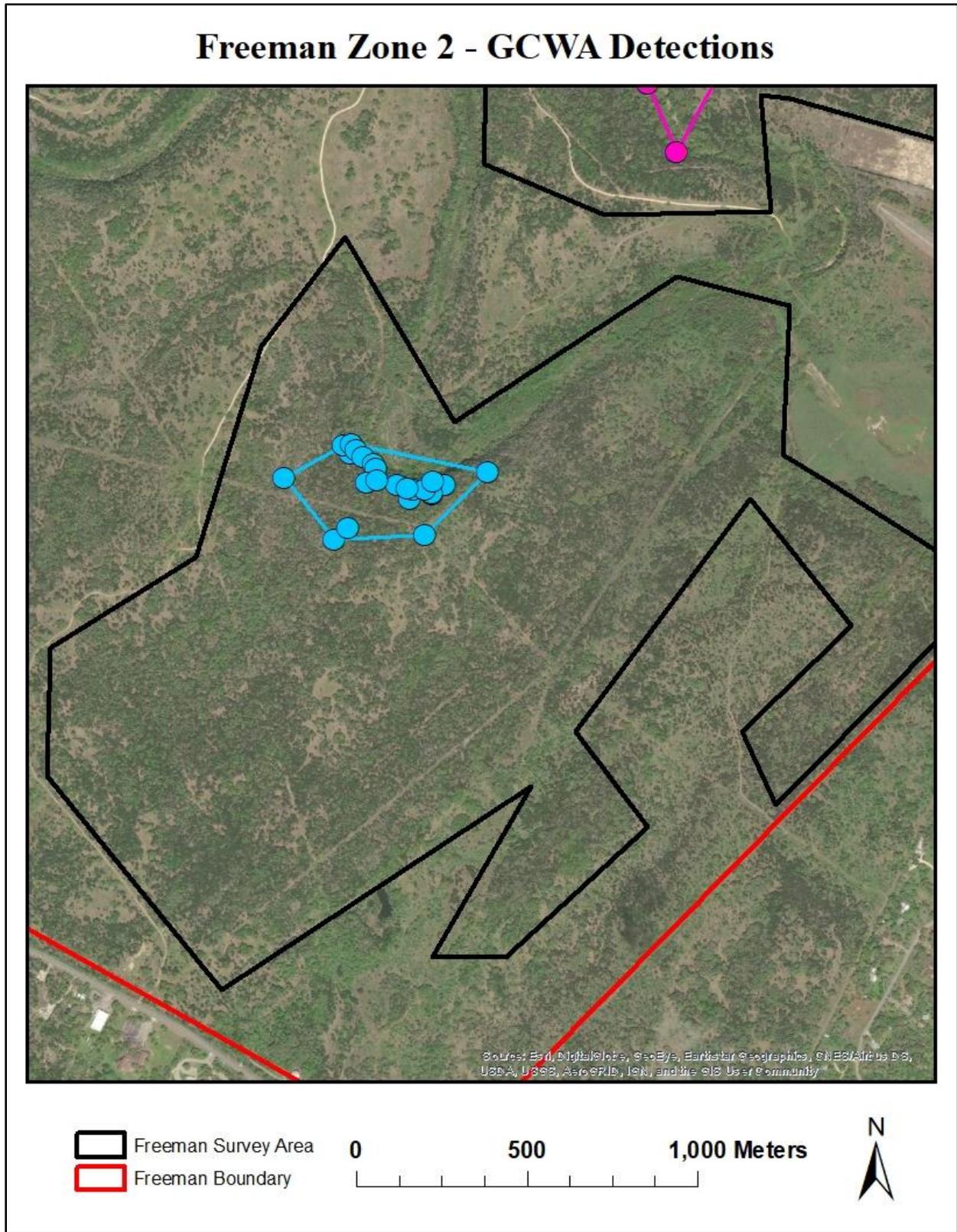
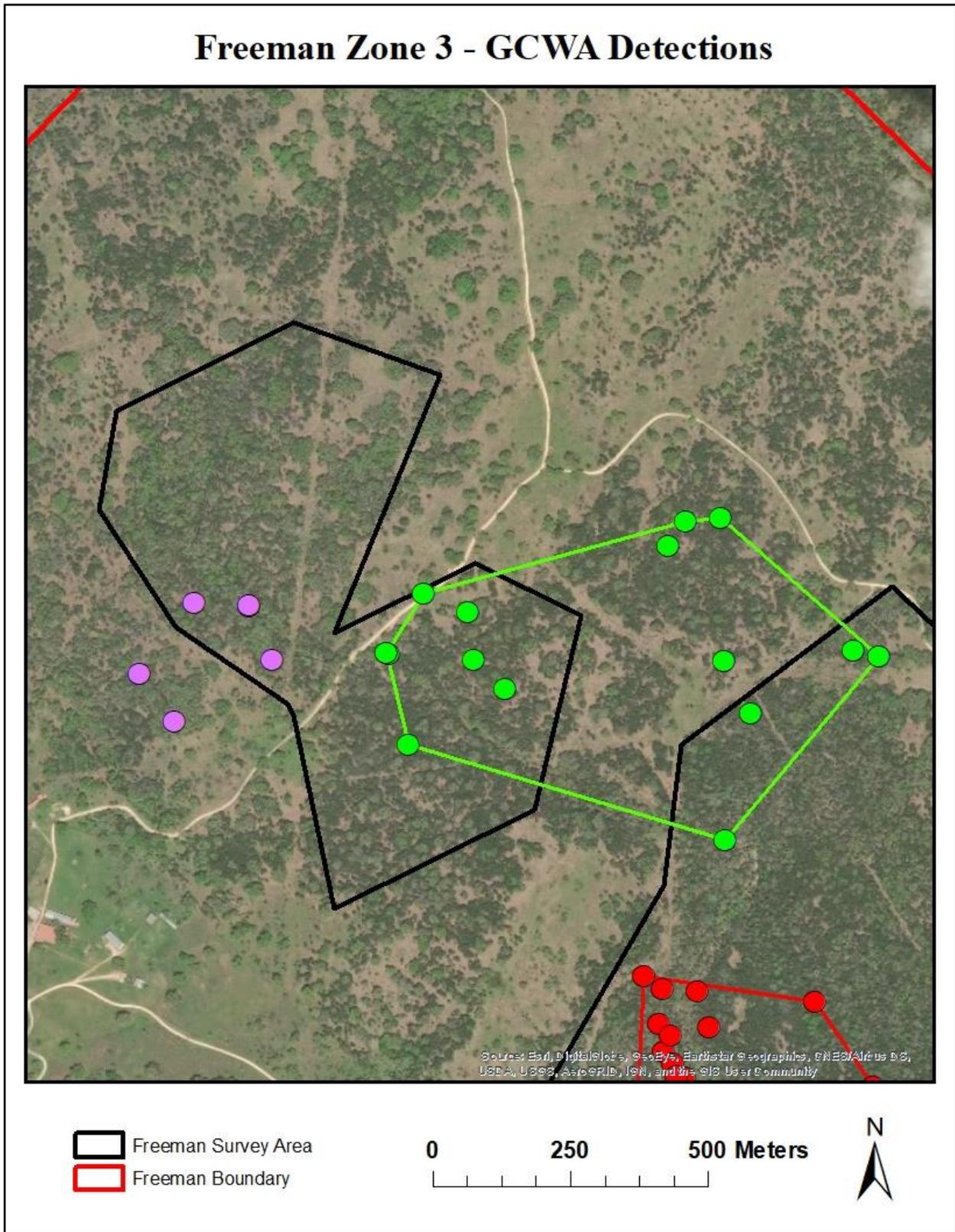


Figure 9. 2019 territories in Zone 3



Photos of GCWAs that were successfully captured at Freeman and Uber Purgatory in 2019.



Top left: Male #6, seen singing above the tree tops. (R. Rylander)

Top right: Captured male from territory #3. (C. Lossing-Cann)

Bottom left: Male #7 is a second year (SY) as seen by the black feather shafts in the median coverts and brown alula. (A. Taylor)

Bottom right: One of the fledglings in territory #1. It was still being fed by the adult male. (R. Rylander)



Top: PhD Candidate Rebekah Rylander safely extracts a male GCWA from a mist net.

Bottom: Proper installment of a mist net in GCWA habitat takes patience and knowledge of the bird's behaviors. If the net is haphazardly placed, it could result in not catching the warbler or tangling the net in dense vegetation.

These photos were taken by photographer Stephanie Schulz from the University Marketing Department and may not be reproduced without permission.

