City of Austin
2006 Golden-cheeked Warbler
Dendroica chrysoparia and Black-capped Vireo
Vireo atricapilla Monitoring Program

Balcones Canyonlands Preserve Annual Report
Fiscal Year 2005-06



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City of Austin

2006 Golden-cheeked Warbler and Black-capped Vireo Monitoring Program

Balcones Canyonlands Preserve Annual Report

FY 2005-06

This report summarizes the results of the City of Austin's 2006 golden-cheeked warbler (*Dendroica chrysoparia*) and black-capped vireo (*Vireo atricapilla*) endangered species monitoring program. The 2006 field season was the ninth year of endangered species monitoring on the City of Austin's Balcones Canyonlands Preserve tracts.

I. GOLDEN-CHEEKED WARBLER MONITORING

INTRODUCTION

Background

The golden-cheeked warbler (hereafter, warbler) is a neotropical migrant passerine that breeds only in central Texas where suitable oak-juniper (*Quercus spp.-Juniperus Ashei*) habitat occurs (Ladd and Gass 1999). Due to accelerating loss of breeding habitat over the past several decades, this species was listed as federally endangered by the U.S. Fish and Wildlife Service in 1990 (USFWS 1990). The Balcones Canyonlands Preserve (BCP) was established in 1996 in part to mitigate for continuing loss of warbler breeding habitat in western Travis County and to aid in the species' local recovery (BCP 1998). The Balcones Canyonlands Preserve is managed by a number of private and public entities, including the City of Austin. The City of Austin manages 13,035 acres of the BCP.

Objectives

Stated management goal of the Balcones Canyonlands Preserve for the golden-cheeked warbler is

> . . . to maintain and, if possible, increase the population of golden-cheeked warblers in the BCP. The focus of management should be to produce rates of occupancy, fecundity, and survivorship … that equal or exceed those recommended in the [USFWS 1996] *Golden-cheeked Warbler Population and Habitat Viability Assessment Report* (BCP 1998).

To facilitate species' survival and recovery, the golden-cheeked warbler population on the BCP and on the Balcones Canyonlands National Wildlife Refuge is monitored using a standardized, region-wide program. Population and productivity trends are tracked on a series of 100-acre plots located on the BCP and BCNWR. The City of Austin collects data on territory density, territory location, pairing success, breeding success, and productivity. The City of Austin also conducts territory enumerations over a large area of the BCP to ascertain warbler distribution and to estimate overall territory numbers.

METHODS

Study Sites

In field season 2006, golden-cheeked warbler territories were mapped on six 100-acre "prime" study plots on the BCP. Prime plots are defined as those with >75% excellent warbler habitat, i.e. habitat with >70% canopy cover (BCP 1998). Prime plots are located on six different BCP tracts: Emma Long Metropolitan Park, Barton Creek Wilderness Preserve, Ivanhoe, Forest Ridge, 3M/St. Edwards, and Bohls. Staff biologists monitor these plots annually.

At least one study plot is located in each Macrosite where the City of Austin owns significant BCP acreage: South Lake Austin (3,127ac), North Lake Austin (4,047ac), Bull Creek (3,123ac) and Barton Creek (1,907ac). Limited prime habitat in the South Lake Austin Macrosite required establishing the Bohls study plot in an area that does not fully meet the definition of prime plot, but rather contains <75% excellent habitat. The plot shape also differs from all other prime plots.

Enumeration surveys were conducted on 16 BCP tracts comprising 9,174 acres. A complete list of properties on which enumerations were conducted is included in Appendix A. Acres surveyed, surveyors, and survey effort for each tract are given.

Site Description

The topography and vegetation of the surveyed tracts are typical of the eastern edge of the Edwards Plateau. Steep, wooded canyons and riparian corridors dissect drier upland savannahs. Most streams are intermittent, though a few have a permanent water source, such as a perennial spring. The predominant vegetation association is oak-juniper.

It is thought that woodlands in western Travis County were logged in the late 1800s and early 1900s and are currently in various stages of recovery (Keddy-Hector 1996). After clearing, much of the topsoil was lost due to chaining and subsequent goat and cattle overgrazing. On some steep slopes, this soil loss has greatly reduced the revegetation potential. Current and

past overbrowsing by white-tailed deer (*Odocoileus virginianus*) has reduced understory floral diversity and species abundance. A distinct browse line is visible on the majority of Preserve tracts. A paucity of certain deciduous woody species is evident throughout the Preserve.

In woodlands and forests, the canopy is dominated by Texas oak (*Quercus texana*), Ashe juniper (*Juniperus Ashei*), plateau live oak (*Q. fusiformis*), shin oak (*Q. sinuata var. breviloba*), escarpment black cherry (*Prunus serotina var.exsimia*), Texas ash (*Fraxinus texensis*), and cedar elm (*Ulmus crassifolia*). Common understory species include young Ashe juniper, Carolina buckthorn (*Rhamnus caroliniana*), yaupon holly (*Ilex vomitoria*), red buckeye (*Aesculus pavia* var. *pavia*), Mexican buckeye (*Ungnadia speciosa*), Lindheimer silk-tassel (*Garrya Lindheimeri*) and elbow bush (*Forestiera pubescens*). Descriptions of individual prime plots can be found in Abbruzzese and Koehler (2003), as well as in Tier III Land Management Plans for each property (BCP 1998).

Region-wide Monitoring Program: 100-acre Study Plots

Territory mapping of breeding warblers was conducted on six 100-acre prime study plots. Each plot was monitored a minimum of 60 hours. Surveys were spread out over the breeding season. The monitoring program and data collection protocol are described in detail in the Balcones Canyonlands Preserve Land Managers Handbook, Chapter VIII: Monitoring of the Golden-cheeked Warbler (BCP 1998); the City of Austin Golden-cheeked Warbler and Black-capped Vireo Monitoring Program (Abbruzzese and Koehler 2003); and Appendix B of this document.

Analysis of Territory Density on Prime Plots. Number of territories on 100-acre plots were calculated in three ways: 1) as a low estimate (=only full territories were counted); 2) as a high estimate (=both full and edge territories were counted as 1.0); and 3) applying Verner's (1995) method (=each territory that straddles the boundary of the plot is counted as 0.5 territories). Verner's counting method avoids the upward bias inherent in the IBCC's (1970) methodology. Finally, territory density is given as number of territories (using Verner's counting method) per 100 hectares. These calculations were also applied during the previous eight survey years for the 100-acre plots.

Analysis of Pairing and Productivity on Prime Plots. In previous years, pairing and productivity data were collected for full territories only. However, on low-density plots, this protocol was problematic in that data gathering opportunities were limited. To remedy this in 2006, territories surveyed for pairing and productivity data were no longer restricted to full territories only. Instead, a set of territories was chosen that optimized data collection

opportunities. Specific territories were chosen randomly in order to avoid biasing data. These are referred to as "monitored territories".

A male was determined to be paired if he was observed associating with a female, observed tending young, or a nest was located for that male. The pairing success rate is the number of males determined to have paired with a female divided by the number of monitored territories.

A territory was considered to have bred successfully if the male or female was observed tending one or more nestlings or fledglings. The breeding success rate is the number of territories determined to have produced at least one nestling or fledgling divided by the number of monitored territories.

Productivity is the sum of all fledglings observed for all monitored territories. Average productivity is presented in two ways: 1) as the sum of all fledglings divided by the number of pairs that successfully bred (as defined above), and 2) as the sum of all fledglings divided by the total number of monitored territories.

Fecundity was derived by multiplying the total number of offspring (nestlings or fledglings) produced for all monitored territories by 0.5 (based on studies indicating a 1:1 ratio of male and female offspring for this species (Anders 2000)) and then dividing by the number of monitored territories. This gives an estimate of the number of male offspring per territorial male.

Enumerations

An enumeration is a survey of all male warblers in a given area. This data provides information on distribution of the species over a large area. Surveyors attempt to determine the breeding status of males and estimate territory numbers. Enumerations require three to four visits per survey area during good weather conditions (USFWS 1994). Incidental sightings of females and fledglings are also recorded, as are observations of parasitism and potential predators. Surveys were carried out by staff biologists and trained volunteers.

Because enumeration survey effort varies between tracts and between years, results are not comparable. Surveyors attempted to sort out individual warblers to increase the accuracy of the count. However, significantly less time was spent on enumeration surveys per acre than on 100-acre prime plots. Therefore, all enumeration results are rough estimates only.

RESULTS AND DISCUSSION

100-acre Study Plots

Territory Densities and Locations. In field season 2006, average golden-cheeked warbler territory density for six prime plots was 39.7 territories per 100 hectares (range 16.1–60.5), a large increase over 2005 average territory density (33.6 territories/100ha) (see Table 1). The largest increases in territory densities occurred at Emma Long and Forest Ridge, gaining 6.5 and 6.0 territories, respectively. Territory density increased slightly over 2005 at Barton Creek and Ivanhoe, gaining 2.0 and 3.5 territories, respectively. Territory densities fell slightly from 2005 at the Bohls and 3M/St. Edwards plots. Both plots had 1.5 fewer territories in 2006.

Consistent with 2005 surveys, Emma Long and Ivanhoe had the highest territory densities of all six plots (60.5 and 59.3 territories/100ha, respectively). Barton Creek and Bohls had the lowest densities (22.2 and 16.1 territories/100ha, respectively). Variability in plot parameters may explain in part the low territory density on the Bohls plot. The configuration of the Bohls plot results in a higher edge to area ratio than all other plots. Less than 75% of habitat on Bohls is prime warbler habitat, whereas on the remaining five plots, prime habitat is >75%.

Average increase in territory density on prime plots in 2006 may reflect the continuing rapid loss of warbler breeding habitat in western Travis County. As habitat becomes developed, warblers crowd into remaining habitat patches. It is unlikely that increases in occupancy on the BCP reflect an increase in the regional warbler population.

Figures 1-6 depict warbler territory locations for six prime plots in field season 2006. Plot maps depict territory locations relative to topographic features and to other warbler territories. Locations do not represent actual territory sizes or boundaries.

Table 1. Golden-cheeked warbler territory number and territory density (per 100ha) for six 100-acre prime study plots on the City of Austin Balcones Canyonlands Preserve, Travis County, Texas, field season 2006. See Methods section for calculations.

Prime Plot Name	No. of Full Territories	No. of Full and Edge Territories	No. of Full Territories + (0.5 x Edge Territories)	Territory Density (100ha)[1]
Barton Creek	6	12	9.0	22.2
Emma Long	19	30	24.5	60.5
Ivanhoe	20	28	24.0	59.3
3M/St Edwards	8	15	11.5	28.4
Forest Ridge	16	26	21.0	51.9
Bohls Hollow	3	10	6.5	16.1
Average			16.1	39.7

Pairing Success, Breeding Success, and Productivity. In 2006, a total of 83 breeding territories were monitored for pairing and productivity data. Number of territories monitored for each plot is given in Table 2. Average pairing rate for monitored territories on six prime plots was 0.80, a slight increase over 2005 (0.74) (see Table 2). One hundred percent pairing occurred on Forest Ridge and 3M/St. Edwards. Pairing rates on Emma Long, Ivanhoe and Barton Creek ranged from 0.70 to 0.90 males paired per monitored territory. Out of all six plots, Bohls had the lowest pairing rate of 0.20 males paired per monitored territory.

Average breeding success for six plots was 60%, up from 47% in 2005. 3M/St. Edwards had 100% breeding success, followed by Forest Ridge (78%), Emma Long (71%) and Barton Creek (67%). Both Ivanhoe and Bohls had very low breeding success rates (0.30 and 0.20 males successfully bred per monitored territory, respectively) compared with all other prime plots. However, breeding success on both Ivanhoe and Bohls was slightly higher than in 2005 (Ivanhoe, 27%; Bohls, 0%).

In 2006, a total of 113 fledglings were observed in 49 broods. For those territories that did produce offspring, the average productivity for all six plots was 2.31 fledglings. For five of

[1] Calculation based on Verner's counting method.

six plots, productivity for successfully breeding territories ranged from 2.17 to 2.50 fledglings. Productivity was much lower at Bohls, with each successfully breeding pair producing only 1.5 fledglings. Average productivity for all monitored territories on all six prime plots was 1.36 fledglings, an increase from an average of 1.00 fledglings in 2005. No second broods were reported.

In 2006, the fecundity rate was 0.68 male offspring per territorial male. Because nests and fledglings are difficult to locate, breeding success rates, productivity and fecundity rates represent minimum estimates only. Reported fecundity rates from studies conducted at Ft. Hood in 2000 and 2001 were 1.44 female young per SY female in 2000 and 2001, and 1.56 female young per ASY female in 2000 and 1.74 female young per ASY female in 2001 (Anders 2000, 2001). Fecundity rates at Ft. Hood are the highest rates documented for golden-cheeked warblers (Alldredge et al. 2002). Note that these fecundity rates are assumed to be the same for male young per SY and ASY males.

In 2005, a two-year warbler nest camera monitoring study was initiated on several tracts on the BCP (Reidy and Thompson, *in progress*). The study was designed, in part, to determine golden-cheeked warbler productivity at sites with differing characteristics. The study was continued in field season 2006 and, as in the previous year, territories included in this study overlapped with territories monitored in the 100-acre prime plot surveys on Forest Ridge and Emma Long. A comparison of data from both studies will allow biologists to ascertain the difference between actual productivity, as derived from the camera study, and surveyed productivity, as derived from post-fledgling counts. A probability of detection may then be calculated and applied to future post-fledgling counts for a more accurate estimate of warbler productivity.

Table 2. Number of monitored golden-cheeked warbler territories and warbler pairing rates on six prime study plots on the City of Austin's Balcones Canyonlands Preserve, Travis County, Texas, field season 2006. See Methods for calculations.

Prime Plot Name	No of Monitored Territories	No. of Territories w/ Females	Pairing Rate
Barton Creek	6	5	0.83
Emma Long	21	19	0.90
Ivanhoe	20	14	0.70
St. Eds/3M	8	8	1.00
Forest Ridge	18	18	1.00
Bohls Hollow	10	2	0.20
Average			0.80

Table 3. Golden-cheeked warbler breeding success and productivity on six prime study plots on the City of Austin's Balcones Canyonlands Preserve, Travis County, Texas, field season 2006. See Methods for calculations.

Prime Plot Name	No. of Terr. producing ≥1 offspring	Breeding Success Rate	Avg. Product. / Successful Territories	Avg. Product. / Monitored Territories
Barton Creek	4	0.67	2.25	1.50
Emma Long	15	0.71	2.27	1.62
Ivanhoe	6	0.30	2.17	0.65
St. Eds/3M	8	1.00	2.38	2.38
Forest Ridge	14	0.78	2.50	1.94
Bohls Hollow	2	0.20	1.50	0.30
Average		0.60	2.31	1.36

Enumerations

Total enumeration effort in 2006 equaled 477 hours, covering 16 BCP tracts and 9,174 acres (see Appendix A). A total of 304 territorial golden-cheeked warbler males and three non-breeding males (or "floaters") were recorded during enumeration surveys. Incidental observations included 37 females and 40 fledglings. Figures 7 through 19 show the distribution of territories and incidentally sighted females, floaters and fledglings.

For each hour spent conducting enumerations in 2006, 19 acres were covered. For each hour spent conducting territory mapping on 100-acre prime plots in 2006, 1.5 acres were covered. Because enumerations represent a lesser survey effort than territory mapping on 100-acre prime plots, results of enumerations should be considered rough estimates of distribution and territory numbers.

Nest Parasitism

No direct or indirect evidence of nest parasitism of golden-cheeked warblers by brown-headed cowbirds (*Molothrus ater*) was reported on any survey in field season 2006. On the southern half of Double J and T, brown-headed cowbirds (as well as Western Scrub Jays) were observed during every survey, although a cowbird trap was in operation at the north end of the tract. These two species were also seen at each visit to Cortaña. (Interestingly, at upper Cortaña, Scrub Jays were replaced by Blue Jays.) Appendix C contains a summary of brown-headed cowbird management for 2006.

II. BLACK-CAPPED VIREO MONITORING

INTRODUCTION

Background

The black-capped vireo (hereafter, vireo) is an endangered, neotropical migrant that breeds only in portions of central Texas, southern Oklahoma, and Coahuila, Mexico (Grzybowski 1995). This species was listed by the U.S. Fish and Wildlife Service in 1987. Major threats to species' survival are habitat loss, habitat fragmentation, and parasitism by brown-headed cowbirds (*Molothrus ater*).

The Balcones Canyonlands Preserve (BCP) was established in 1996 to mitigate for loss of vireo habitat in western Travis County due to exurban sprawl and to aid vireo recovery. The black-capped vireo has been documented on several City of Austin-managed BCP tracts. The best-studied vireo colony occurred at the Black-capped Vireo Research Area. The colony declined steadily from 32 pairs in 1987 to just one pair in 1997 (Steed 1988; Abbruzzese 1998). In 2004, a male vireo was observed briefly at the Vireo Research area; however, its breeding status could not be confirmed.

A small breeding colony of vireos (three to five territories) have occupied habitat on the Cortaña tract every year since 2000. A part of this colony occupies the adjacent River Place Mitigation tract to the east. Other records for vireos on the City of Austin's BCP tracts for the past decade include sightings of males on Forest Ridge, Ivanhoe and Parke West; however, breeding status of these individuals was not confirmed.

Objectives

The Balcones Canyonlands Conservation Plan requires setting aside a total of 2,000 acres of potential black-capped vireo habitat in western Travis County within the BCP (1998). The vireo management plan calls for protection and enhancement of the black-capped vireo population on the BCP. In conjunction with the Balcones Canyonlands National Wildlife Refuge, the BCP should support a viable breeding population, as outlined in the Black-capped Vireo Recovery Plan (USFWS 1991).

In order to meet the objectives outlined in the vireo recovery plan, the City of Austin BCP management program focuses on three critical tasks: monitoring vireo population trends and productivity; managing nest parasites; and creating and restoring vireo habitat. To monitor population trends, black-capped vireos are surveyed every year using territory mapping methods. Data are collected on abundance, pairing, breeding and productivity. Survey effort is roughly equivalent to golden-cheeked warbler 100-acre prime plots, totaling approximately 50 hours each field season.

Creation and restoration of vireo habitat on the BCP is critical to establishing a viable population of breeding vireos on the BCP. Restoration projects are undertaken every year on various City of Austin tracts. Descriptions of projects undertaken in FY 2005-06 can be found in Appendix D. Restoration projects prior to this are described in Becker and Koehler (2005).

The BCP has managed cowbirds at the Cortaña colony every year since vireos were first observed there in 2000 (see Appendix C). The BCP is committed to intensively managing cowbirds at all future vireo colonies. In addition, monitoring for direct and indirect signs of cowbird parasitism during field surveys is a top priority.

METHODS

Sites and Survey Effort

In field season 2006, black-capped vireos were surveyed on a 39-acre section of the Cortaña tract (total acreage: 1,750) and on an 18-acre section of the adjacent River Place Mitigation tract. Together, this 57-acre parcel makes up the original 1996 vireo habitat restoration area. Vireos detected during other endangered species surveys were also recorded and mapped (see Appendix A for tracts surveyed in 2006). An attempt was made to determine their breeding status.

On Cortaña, data were collected on territory number, territory location, pairing success, breeding success, parasitism, and productivity. Staff biologists used territory mapping (IBBC 1970; Bibbey 1995) to determine territory numbers and locations. Nest searching was initiated to monitor for cowbird parasitism, but avoided if vireos appeared agitated or changed their behavior in response to biologist's presence. Staff biologists conducted surveys from 6 April to 11 July 2006 for a total of 56 hours. Late season checks were carried out at the end of August and first week of September for a total of 9.5 hours to establish presence/absence.

Data Collection and Analysis

Locations of males, females, fledglings and nests were recorded on Digital Aerial Imagery (2003) at a scale of 1:2000 or recorded using a GPS unit with an accuracy of 20-40 feet (Garmin Summit). Pairing status, breeding success and number of fledglings produced per pair were determined for each territory. (For methodology and calculations, see Part I: Data Collection and Analysis.) If nests were located, regular checks of contents were made to monitor parasitism and nest success. Playback tapes of vireo song and shrads were used occasionally to elicit responses, especially during late season monitoring.

RESULTS AND DISCUSSION

Territory Mapping

In 2006, no black-capped vireos were located on any other tract except for Cortaña. Five male black-capped vireos defended territories on the restored portions of Cortaña and River Place, an increase of two territories from 2005. Figure 20 depicts territory locations. On 3 July 2006, a sixth male was detected on the far west side of the restoration area. This male may or may not have established a breeding territory. Subsequent searches for the sixth male yielded no additional data.

Two of the territorial males were ASY and three were SY (based on plummage characteristics described in Pyle (1997)). The sixth male that was detected in July was not aged. Three breeding territories were located in the same area as the previous year. The two other territories were in locations not occupied in 2004 or 2005. For the third straight year, all males avoided the southern half of the Cortaña restoration area and the far northeastern wedge on River Place.

All five territorial males were observed either associating with a female or tending one or more fledglings (see Table 3). Thus, pairing success was 100%. All five pairs produced at least one offspring; breeding success was 100%. Breeding success was based on observations of fledglings only, as no nests were located this year. Productivity for the five territorial males was eight fledglings, with an average of 1.6 fledglings for each brood. One brood had three fledglings, one brood had two fledglings, and the other three pairs produced one fledgling each. The earliest brood was detected on 21 May 2006. Productivity results represent minimum numbers. As with golden-cheeked warblers, vireo fledglings are very difficult to detect. Thus, it is highly likely that actual productivity is higher than was observed.

Late season observations. Late season searches were conducted on 31 August and 6, 7, and 8 September 2006 for a total of 9.5 hours. On 26 August, two male vireos were incidentally detected by a researcher on Cortaña. Both males were on territory and counter-singing (pers. comm. D. Houston 2006). On a subsequent search on 31 August by BCP biologists, one of the two males was detected vocalizing on territory again and the female and a fledgling of the second male were also observed. A third male was observed vocalizing on territory as well. On the following three presence/absence checks in early September, no vireos were detected. We could not determine with certainty if vireos were absent at this time, or present, but simply not detected. 31 August 2006 is the latest date on which vireos have been recorded on Cortaña since the City began monitoring there in 2000.

Brown-headed Cowbirds

Two female cowbirds were observed searching in the restoration area, presumably for opportunities to lay eggs. Both females made vocalizations associated with breeding areas. One of these females was observed to have entered the cowbird trap on the same day. The fate of the other female could not be confirmed. No black-capped vireos or other avian species were observed tending cowbird fledglings. A total of 20 cowbirds were trapped in the hybrid trap located in the restoration area; eight of these were females and one was a fledgling (see Appendix C).

As in 2005, no incidences of harassment of vireos by corvids or other avian species were observed in 2006. In 2004, Common Grackles, Western Scrub Jays and Northern Mockingbirds were seen on several occasions harassing vireos in the Cortaña restoration area. Although depredation of nests was not observed in 2006, potential predators include several snake species, ringtails, raccoons, foxes, squirrels, Western Scrub Jays, American Crows, various raptor species and imported red fire ants.

Future Work

Based on locations and movements of vireos on the restoration areas of Cortaña and River Place, habitat manipulation efforts in winter 06-07 and beyond will focus on areas that vireos consistently avoid. Some of this work has already begun (see Appendix D). Better methodologies need to be developed to obtain more accurate productivity results, such nest camera studies or nest searching and banding studies. Finally, the Cortaña/River Place restoration area is an ideal location for call boxes (see Ward and Schlossberg 2004) to attract additional males to nest on Cortaña.

Golden-cheeked Warblers in Black-capped Vireo Habitat

Golden-cheeked warblers were incidentally mapped during vireo surveys on the 57-acre restoration area on Cortaña and River Place. Ten singing males comprising nine breeding territories were recorded in April and May. Males were usually detected near the perimeter of the restoration area; however, as in previous years, males were also observed in vireo habitat relatively far from the closed canopy woodlands that surround the restoration area. The canyons surrounding the upland restoration site are excellent golden-cheeked warbler habitat. In past years, golden-cheeked warbler fledglings and females have also been recorded in the vireo restoration area (see Becker and Koehler 2004, 2005).

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IV. APPENDICES

APPENDIX A: 2006 SURVEY SUMMARY

Summary of BCP tracts surveyed for GCWA and BCVI by the City of Austin, field season 2006, Travis County, Texas. Tract acreage, surveyor(s) and total survey effort given in hours.

GCWA Surveys	**Acres Surveyed**	**Surveyor(s)**	**Survey Hours**
100-acre prime plots			
3M/St. Edwards	100	B. Reiner	68
Barton Creek	100	B. Reiner J. Chenoweth	73
Bohls	100	J. Chenoweth	62
Emma Long	100	H. Becker	71
Forest Ridge	100	H. Becker	72
Ivanhoe	100	M. Sanders	60
Enumeration tracts			
Barton Creek Wilderness and Greenbelt	1400	J. Chenoweth M. Cetaruk J. Brown	51
Bohls	350	B. Reiner J. Chenoweth	23
Coldwater/Cowfork	443	J. Chenoweth	22
Commons Ford	115	E. Fair	10
Cortaña (mid and lower)	1174	C. Davis	29
Double J and T	1729	C. Davis J. Chenoweth L. Moulton	36
Emma Long Park	850	J. Walther H. Becker	67
Franklin	151	M. Sanders	14
Hanks	88	M. Sanders	14
Ivanhoe (sw. corner)	200	B. Reiner	11
Lime Creek	594	M. Cetaruk	27
Long Canyon	440	J. Chenoweth	27
Park West	468	B. Reiner J. Chenoweth	30
Reicher Ranch	820	J. Chenoweth	27
Vireo Preserve	214	Stu Wilson E. Fair	17
WTP4	138	M. Sanders	16
GCWA Totals	**9,774**		**883**
BCVI Survey			
Cortaña (upper)	79	H. Becker	56

100-acre Study Plot Protocol

I. Protocol from Management Handbook, Chapter VII: Golden-cheeked Warbler Management:

Plot selection: random as possible, based on habitat rather than warbler density

Plot shape: square as possible

Plot characteristics:

Prime sites: minimum 75-80% excellent warbler habitat w/ >70% canopy cover.

Transitional sites: currently has zero to a few warbler territories and has potential to develop into excellent habitat in next 30 years

II. Standardization of methods:

Season for territory mapping: March 25-May 25 (after this, observations should not be used for territory data, only productivity); **productivity data** can still be gathered after May 25

Start time: ½ hour after sunrise

Weather: rough guidelines: temp>55°; wind<15mph; none to light precipitation

Visits during season:

Prime sites: 10x

Transitional: 3x: Transitional sites only need to be surveyed every other year. Productivity data not gathered.

Hours per visit: Six hours per visit

Mapping methods: territory mapping roughly following IBCC (1970) guidelines (except calculation of edge territories); breeding territories are differentiated using observations of bird behavior, location, counter-singing, and sequential movements rather than using "clusters" (see Bibbey et al 1992)

Playback tapes: No playback tapes

Data Analysis:

territory density: # of territories per 100 acres

calculation of edge territories*:* each territory that straddles the plot boundary counts as a half territory (0.5 territories) (see Verner 1995)

territory size: NOT doing territory size estimates based on research by Anders (2000).

productivity measures (see Anders 2000): these will only be calculated for full territories ONLY:

1) ***pairing success***: Pairing success of male warblers determined by observing one or more of the following conditions: a territorial male associating with a female; the nest of a territorial male; and/or a male tending ≥1 fledgling. Pairing success rate = number of territories determined to have pairing success / total number of full territories

2) ***breeding success***: Breeding success rate = number of territories that successfully fledged at least one young / total number of full territories

3) ***estimated brood size***: average brood size per successful pair (based on "breeding success"

4) ***productivity*** = sum of the highest number of fledglings recorded at any one time for each full territory / total number of full territories

Citations

Anders, A.D. 2000. Demography of golden-cheeked warblers on Fort Hood, Texas in 2000: productivity, age structure, territory density, and adult return rates. *In* Endangered species monitoring and management at Fort Hood, Texas: 2000 annual report. Fort Hood Project, The Nature Conservancy of Texas, Fort Hood, Texas.

Bibbey, C. J., N.D. Burges, and D.A. Hill. 1992. Bird Census Techniques. Academic Press. San Diego, California. 257pp.

IBCC. 1970. An international standard for a mapping method in bird census work. Audubon Field Notes 24(6): 722-726.

Verner, J. 1985. Assessment of counting techniques. Current Ornithology. 2:247-30.

APPENDIX C: COWBIRD MANAGEMENT

2006 Brown-headed Cowbird Management

Nest parasitism of black-capped vireos by brown-headed cowbirds (*Molothrus ater*) has been well documented and is considered a major threat to species' survival (see the Black-capped Vireo, Birds of North America, J. A. Grzybowski, 1995). Parasitism of golden-cheeked warblers on the BCP has also been documented by both City of Austin and Travis County biologists (Abbruzzese and Koehler 2000, 2001, 2002, 2003; Becker and Koehler 2004; Travis County NR 1999, 2000, 2001, 2002, 2003). In 2006, we expanded trapping efforts in golden-cheeked warbler habitat. It was anticipated that cowbird trapping would also benefit other songbird species that breed on the BCP and surrounding lands.

The cowbird management program was expanded to nine traps this year from three in 2005. Locations of new traps were based on observations of cowbird abundance on different tracts during the previous field season. Logistics was also a major consideration (e.g., ability to service traps with fresh water). One trap was operated in black-capped vireo habitat (the only currently occupied black-capped vireo habitat on City of Austin BCP). The other eight traps were situated adjacent to golden-cheeked warbler breeding habitat.

The Emma Long trap that was in operation in 2005 was found vandalized two days after opening in 2006. All decoys escaped, including five females. The trap was subsequently moved to a location near Long Canyon not open to the public. Trapping was also planned for the Bohls tract. However, construction on a new mall development adjacent to the tract rendered access impossible.

Two of the traps in operation in 2006 were wooden mega traps. These were situated on Canyon Creek and the east side of Ivanhoe. All other traps were hybrids (two metal and five wooden) and built according to specifications recommended by TPWD (http://www.tpwd.state.tx.us/conserve/pdf/cowbirds.pdf). The maintenance of additional traps this year was made possible by an expanded volunteer program. All volunteers took part in a 2-hour training program and were supervised by staff biologists throughout the field season.

Euthanization of cowbirds and care of cowbirds and non-targets followed TPWD guidelines (see previously referenced URL). Non-targets included *Elaphe obsolete lindeimeri, Cardinalis cardinalis, Thryomanes bewickii,* and *Mimus polyglottos*. Two unidentified small rodents were reported observed on two occasions at the 3M trap. Two tunnels under the trap frame and hardware cloth were subsequently located and blocked. A new tunnel was found several inches away a few days later.

Trap results for field season 2006 are given below. Results will be used to gauge the success of current trap locations. The results for the upper Cortaña trap demonstrate that cowbird abundance can vary from year to year at any one site, impacting trapping success differentially from year to year.

Trap Location	Habitat	Trap Opening and Closing Dates	Total BHCO Trapped	Females Trapped	Fledglings Trapped	Trap Rate (=females caught per trap day)
3M	GCWA	3/06/06-6/02/06	8	2	0	0.02
Canyon Ck[2]	GCWA	3/06/06-6/09/06	25	17	0	0.18
Cortaña n.	BCVI	4/05/06-7/03/06	20	8	1	0.09
Cortaña s.	GCWA	4/05/06-6/02/06	8	4	0	0.07
Ivanhoe e.[3]	GCWA	3/06/06-6/09/06	17	11	0	0.12
Ivanhoe w.	GCWA	3/21/06-6/07/06	0	0	0	0.00
Double J&T	GCWA	4/04/06-7/10/06	32[4,5]	5	10	0.05
Reicher	GCWA	3/12/06-6/12/06	7	3	0	0.03
Long Canyon	GCWA	4/10/06-6/10/06	2	2	00.18	0.03

[2] Mega-trap.
[3] Mege-trap.
[4] Including (1) *Molothru aeneus.*
[5] An additional (4) house sparrow fledglings were trapped and dispatched.

APPENDIX D: HABITAT RESTORATION

Black-capped Vireo Habitat Restoration

Background. The BCCP Land Management Plan (BCP 1998) requires maintaining or creating 2000 acres of black-capped vireo habitat within the BCP. The plan originally identified specific acreages as potential vireo habitat. Much of this acreage has, through natural succession, been replaced by oak-juniper woodland that is prime habitat for the golden-cheeked warbler. Additionally, a number of properties containing potential or occupied vireo habitat that were originally included within the proposed BCP boundaries have been lost to development since 1996.

Current occupied habitat. The Cortaña tract (1752 acres) in the North Lake Austin Macrosite is the only CoA BCP property currently occupied by black-capped vireos. In 1996, circa 57 acres of oak-juniper habitat were manipulated on upper Cortaña and the adjacent, privately managed, River Place Mitigation tract. Approximately 39 acres were manipulated on Cortaña and 18 acres on River Place. Both hand-clearing and hydro-axing methods were applied. In each year since 2000, three to five males have established territories in this area.

The Black-capped Vireo Preserve, although once home to 32 breeding pairs of vireos, is no longer occupied habitat. The last breeding pair was detected there in 1997.

Identifying sites. Identification in the field of possible sites for restoration or habitat creation is ongoing from year to year. During wildlife monitoring and land management activities, biologists search for occupied or potential vireo habitat. GIS is used to assess site characteristics and to locate additional possible sites. Specific site characteristics (e.g., soils, topography, geology), the distribution of golden-cheeked warblers, and the history of occupation by black-capped vireos are all considered in identifying restoration sites. Size of potential restoration area, proximity to nearest vireo colony, and proximity to exurban development are also critical variables.

Habitat creation and restoration FY2005-06. The following projects were completed or initiated in winter 2005-2006. (Descriptions of projects prior to this can be found in Becker and Koehler (2005)).

- Habitat manipulation was conducted on approximately 15 acres on upper Cortaña in the fall of 2006. Efforts focused on 1) control of Ashe juniper regrowth, and 2) topping woody deciduous vegetation to force lateral growth (shrubbiness). Because a small section of this area was occupied by a blck-capped vireo in 2006, we attempted to minimize changes in this area in the site physiogomy in order to avoid negatively impacting the colony (see Becker and Koehler 2005).

- Creation of 50 acres of black-capped vireo habitat continued on the Bohls tract in winter 2005-2006. Shin oaks and live oaks were topped with hand tools on two 10-acre sections that had been selectively cleared the winter before. Forty acres of this

site is expected to become excellent vireo habitat within ten years. The remaining ten acres is expected to become only marginal BCV habitat. It is not likely to be occupied by vireos for >20 years, if ever.

- Habitat creation is scheduled for winter 2006-07 on the Lime Creek tract. A total of 60 acres will be mechanically manipulated. This site is expected to yield excellent black-capped vireo habitat within the next ten years.

- Habitat creation efforts in FY2007-2008 will focus on a 30-acre parcel on Cortaña that is a short distance from the current vireo colony on upper Cortaña. Vegetative characteristics and the lack of previous vireo occupation, suggest that this parcel may yield only marginal habitat or possibly require other management tools, such as prescribed burning, to attract vireos to it.

- Other sites under consideration for FY2007-2008 include sections of Reicher Ranch, Double J and T, Park West, and Ivanhoe.

V. SURVEY MAPS

100-acre Plots

Figure 1: 3/M St. Edwards

Figure 2: Barton Creek

Figure 3: Bohls

Figure 4: Emma Long

Figure 5: Forest Ridge

Figure 6: Ivanhoe

Enumerations

Figure 7: Barton Creek Wilderness and Greenbelt

Figure 8: Bohls

Figure 9: Commons Ford

Figure 10: Cortaña

Figure 11: Cowfork/Coldwater

Figure 12: Double J and T

Figure 13: Emma Long

Figure 14: Ivanhoe

Figure 15: Lime Creek

Figure 16: Park West/Long Canyon

Figure 17: Reicher Ranch

Figure 18: Vireo Preserve

Figure 19: WTP4/ Hanks/Franklin

Black-capped Vireo Survey

Figure 20: Cortaña

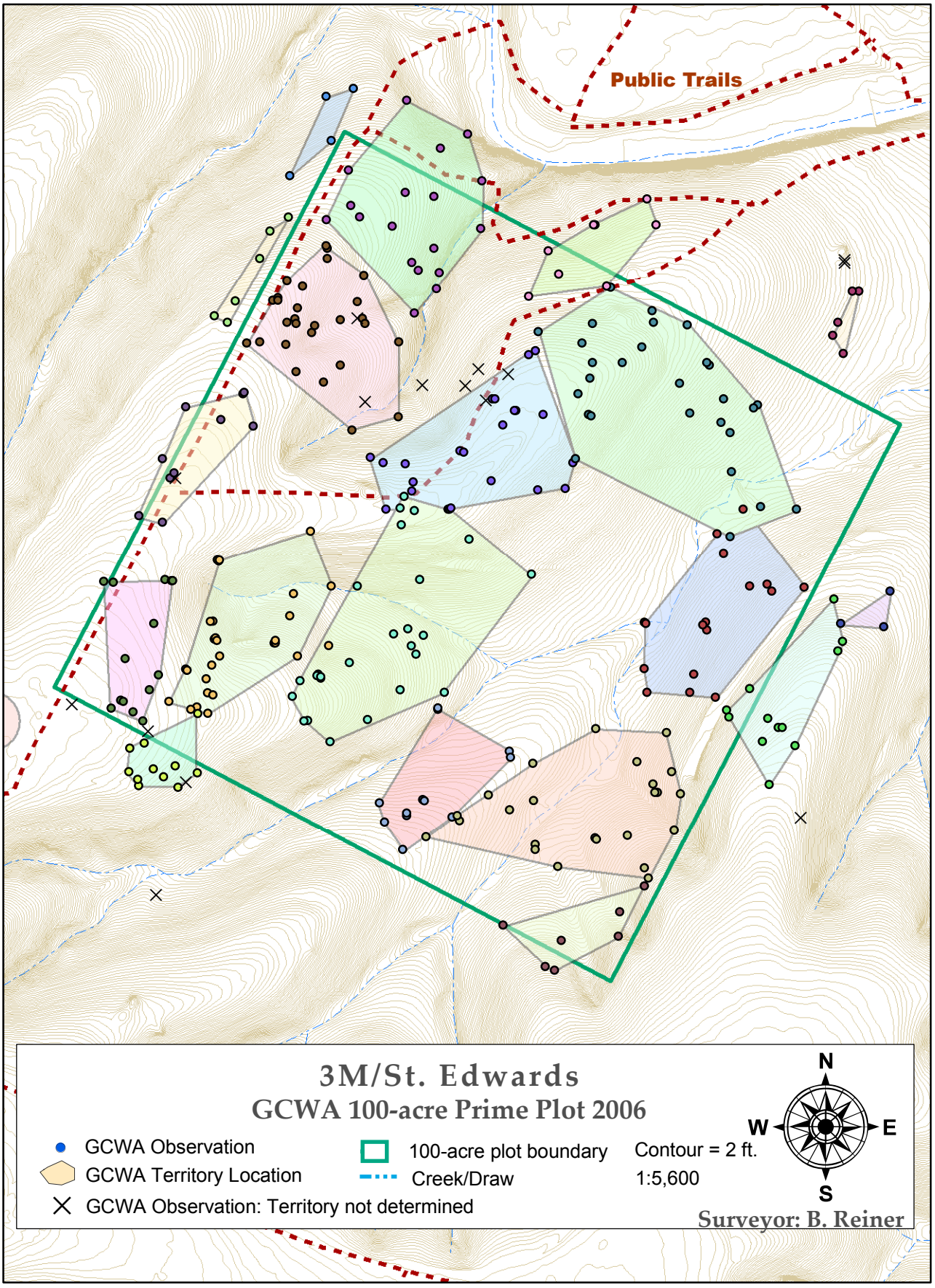

Public Trails
3M/St. Edwards
GCWA 100-acre Prime Plot 2006
GCWA Observation
GCWA Territory Location
GCWA Observation: Territory not determined
100-acre plot boundary
Creek/Draw
Contour = 2 ft.
1:5,600
N
W
E
S
Surveyor: B. Reiner

Figure 1

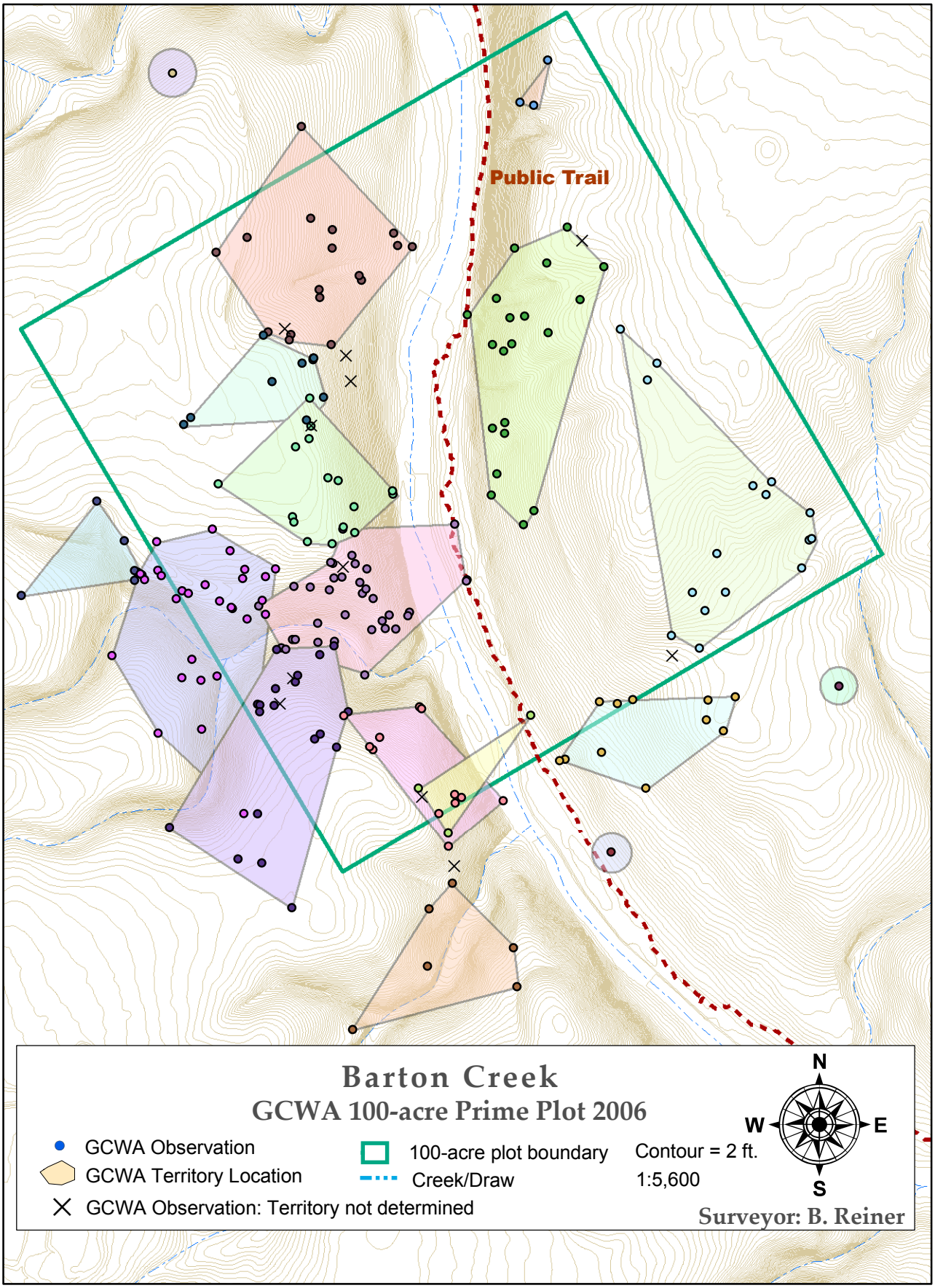

Public Trail
Barton Creek
GCWA 100-acre Prime Plot 2006
GCWA Observation
GCWA Territory Location
GCWA Observation: Territory not determined
100-acre plot boundary
Creek/Draw
Contour = 2 ft.
1:5,600
N
W
E
S
Surveyor: B. Reiner

Figure 2

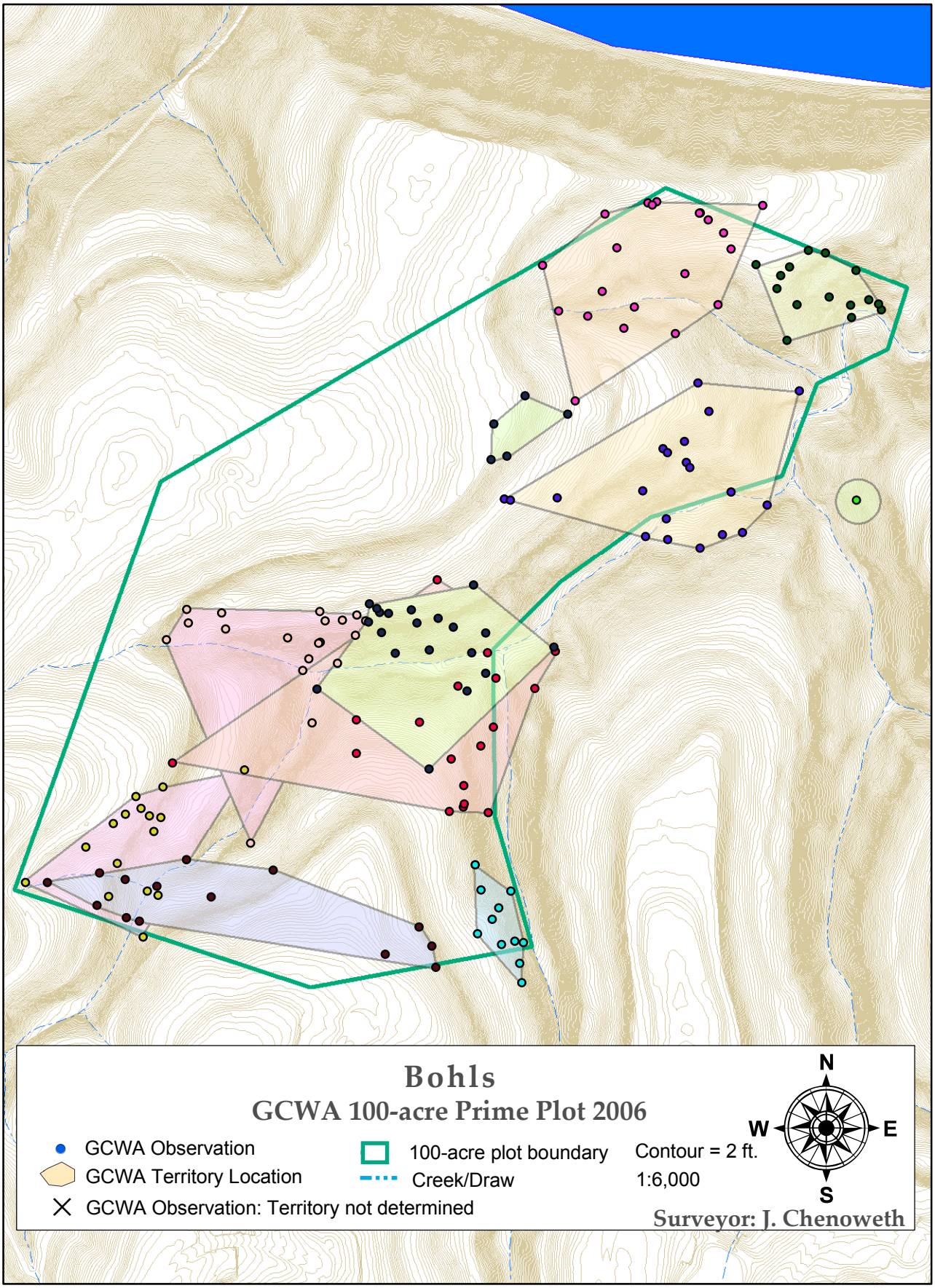

Bohls
GCWA 100-acre Prime Plot 2006
GCWA Observation
GCWA Territory Location
GCWA Observation: Territory not determined
100-acre plot boundary
Creek/Draw
Contour = 2 ft.
1:6,000
N
W
E
S
Surveyor: J. Chenoweth

Figure 3

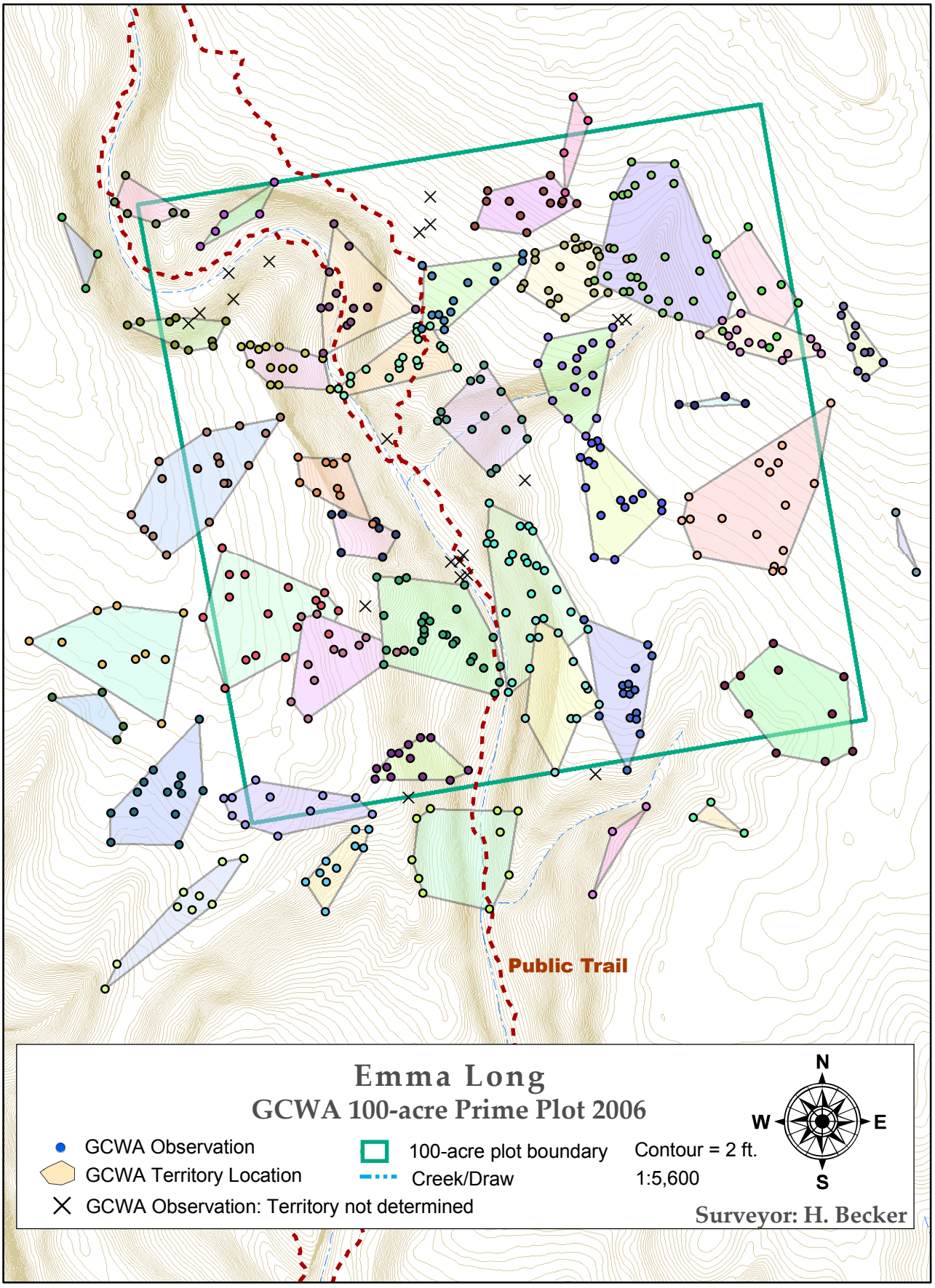

Public Trail
Emma Long
GCWA 100-acre Prime Plot 2006
GCWA Observation
GCWA Territory Location
GCWA Observation: Territory not determined
100-acre plot boundary
Creek/Draw
Contour = 2 ft.
1:5,600
N
W
E
S
Surveyor: H. Becker

Figure 4

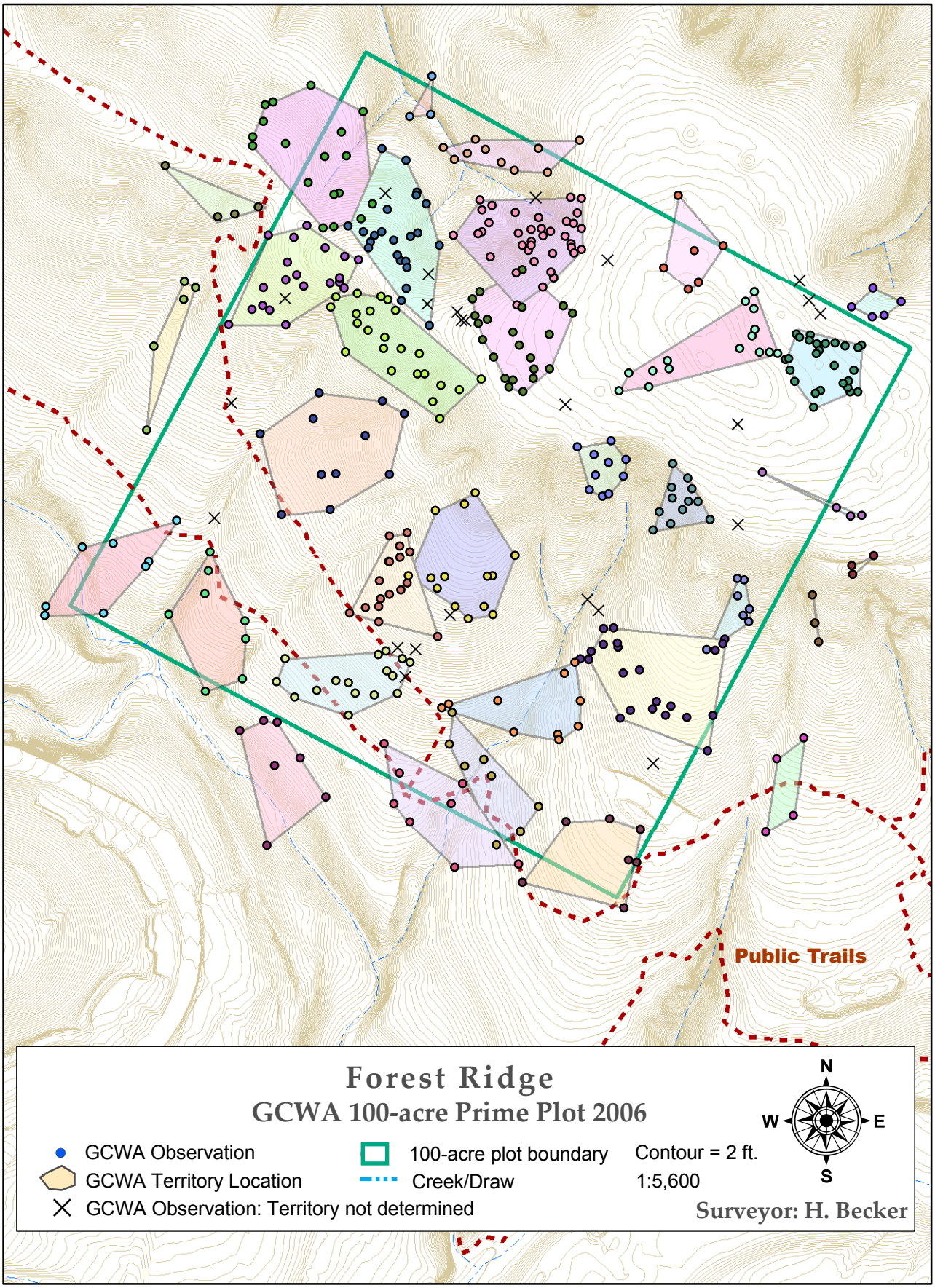

Public Trails
Forest Ridge
GCWA 100-acre Prime Plot 2006
GCWA Observation
GCWA Territory Location
GCWA Observation: Territory not determined
100-acre plot boundary
Creek/Draw
Contour = 2 ft.
1:5,600
N
W
E
S
Surveyor: H. Becker

Figure 5

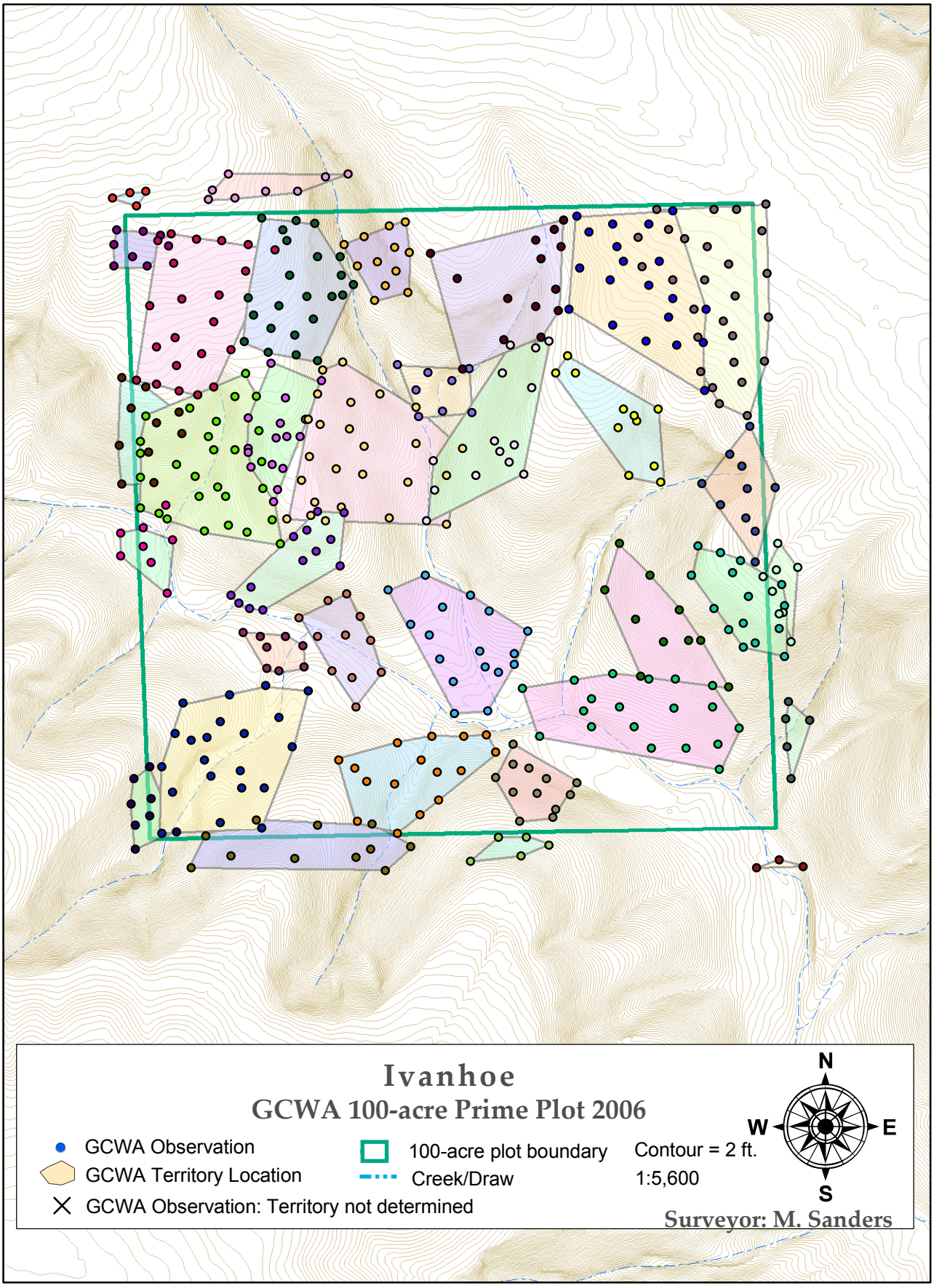

Ivanhoe
GCWA 100-acre Prime Plot 2006
GCWA Observation
GCWA Territory Location
GCWA Observation: Territory not determined
100-acre plot boundary
Creek/Draw
Contour = 2 ft.
1:5,600
N
W
E
S
Surveyor: M. Sanders

Figure 6

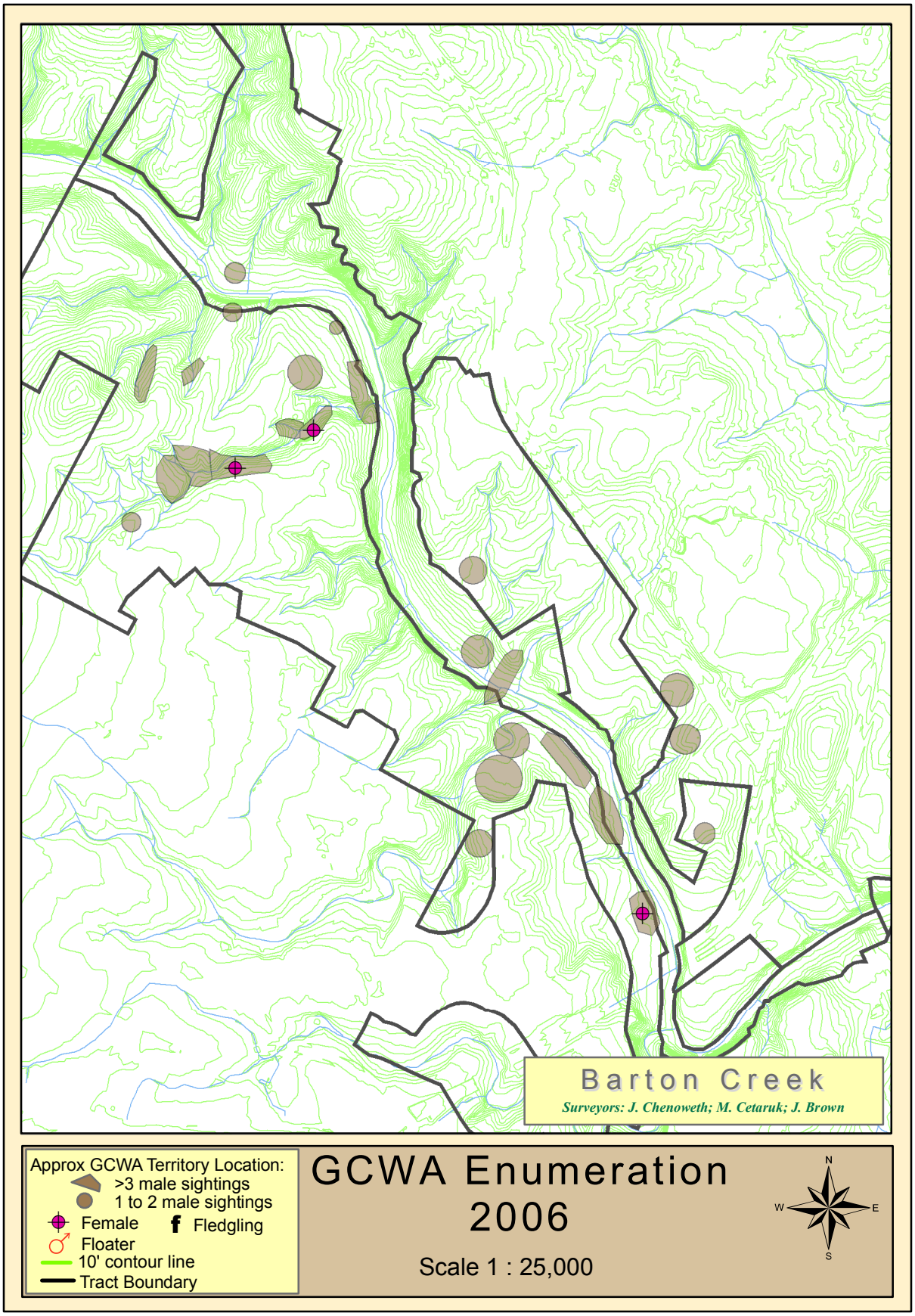

Barton Creek
Surveyors: J. Chenoweth; M. Cetaruk; J. Brown
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale 1 : 25,000
N
W
E
S

Figure 7

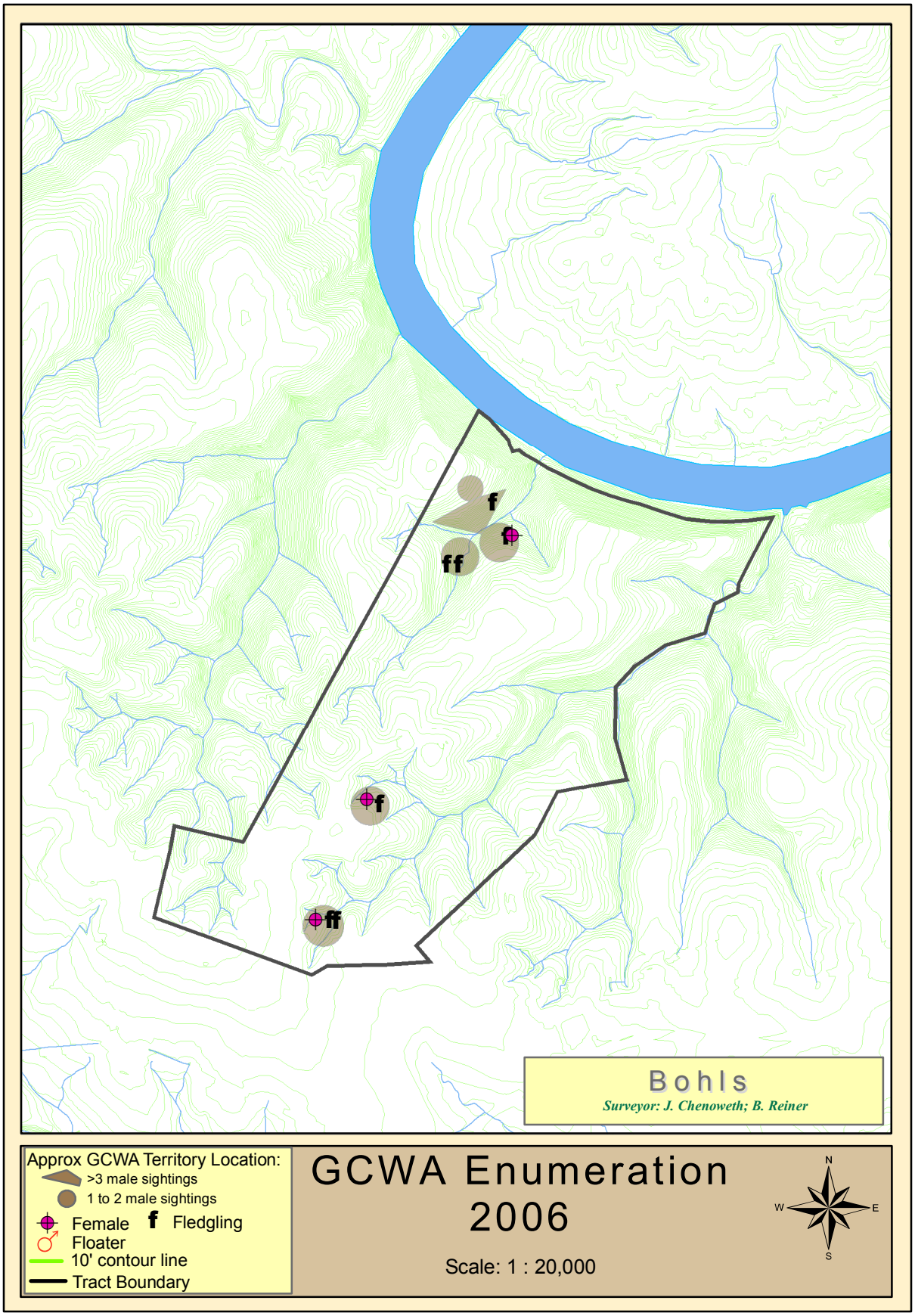

f
f
ff
f
ff
Bohls
Surveyor: J. Chenoweth; B. Reiner
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
f Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 20,000
N
W
E
S

Figure 8

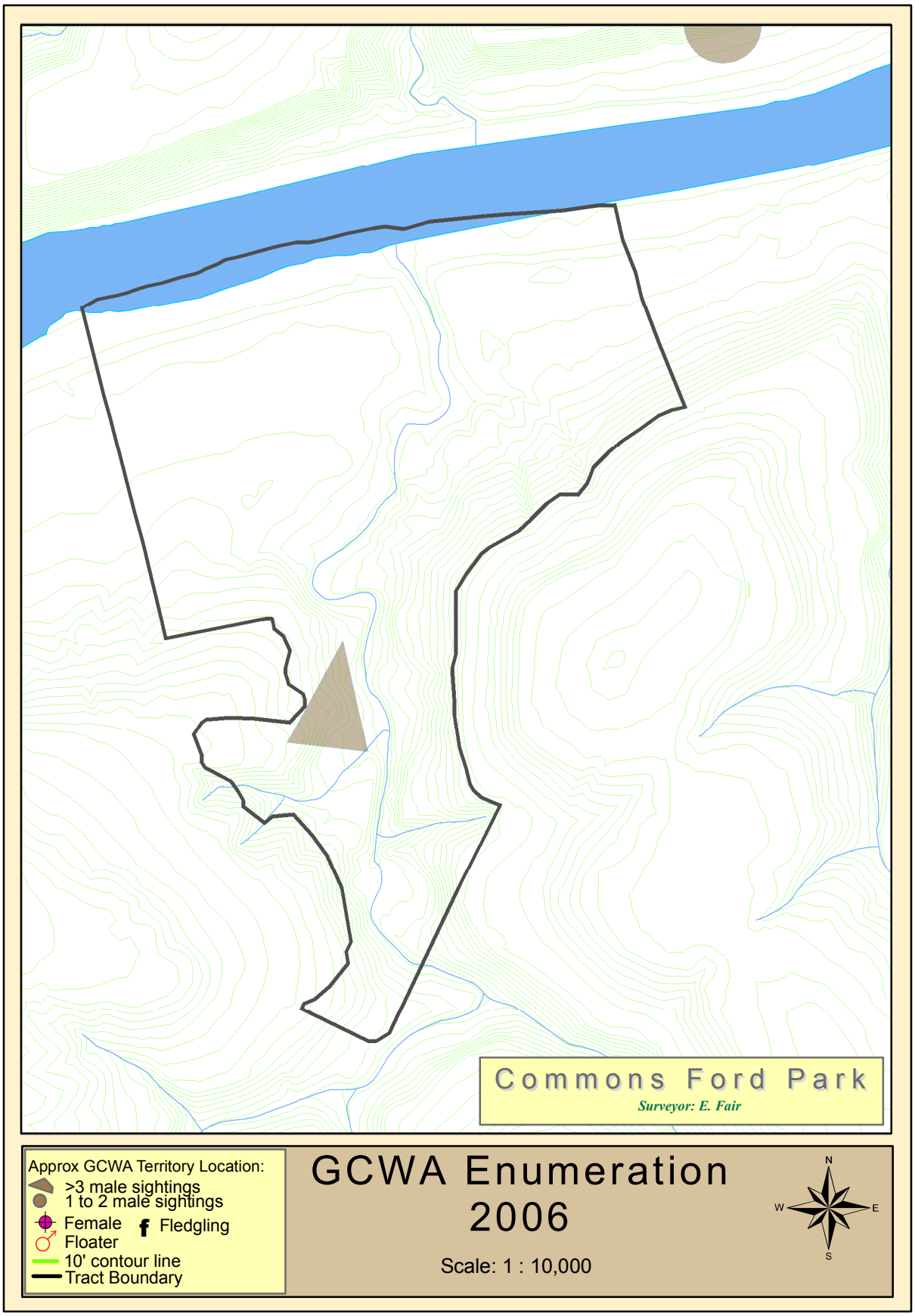

Commons Ford Park
Surveyor: E. Fair
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 10,000
N
W
E
S

Figure 9

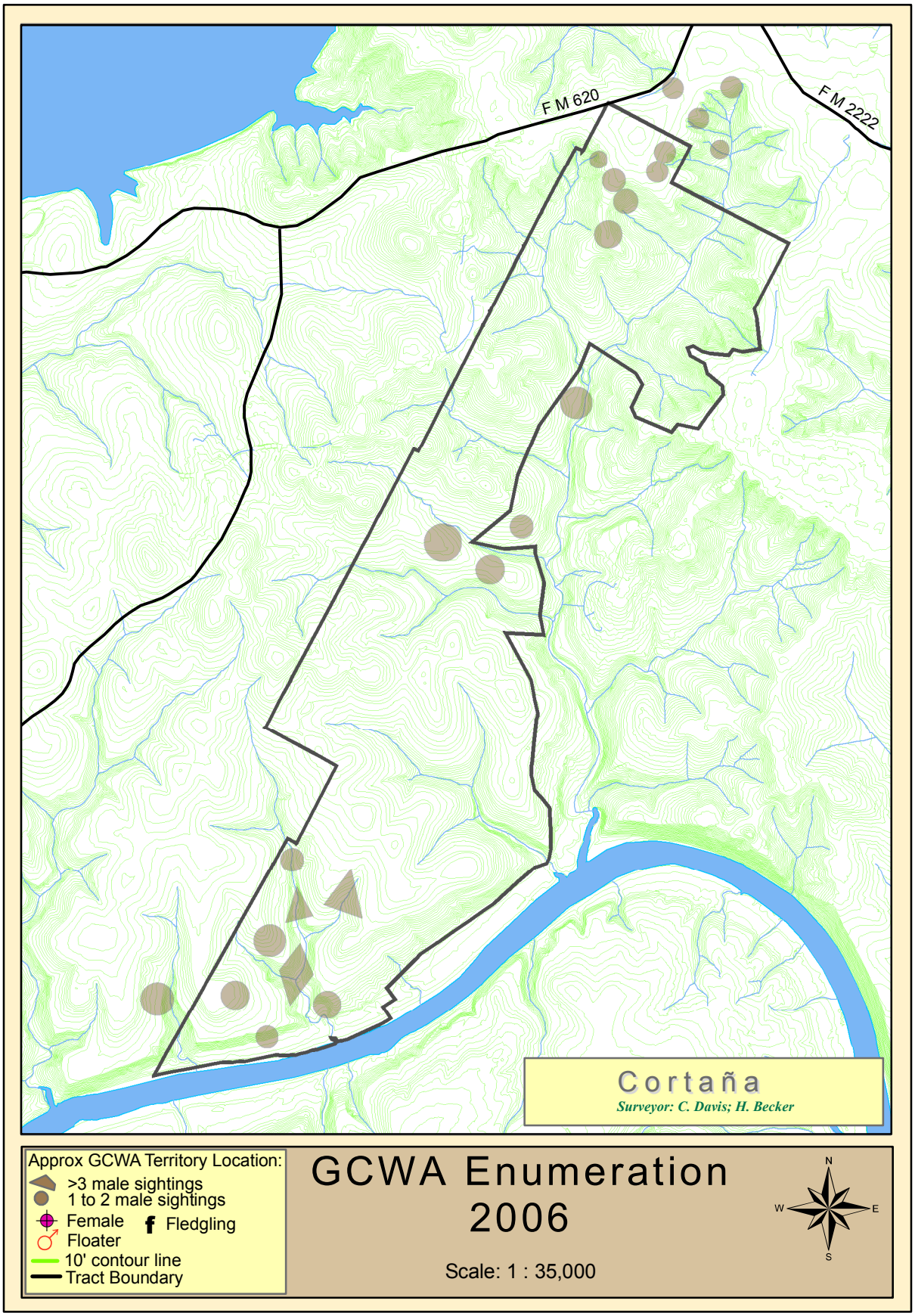

F M 620
F M 2222
Cortaña
Surveyor: C. Davis; H. Becker
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 35,000
N
W
E
S

Figure 10

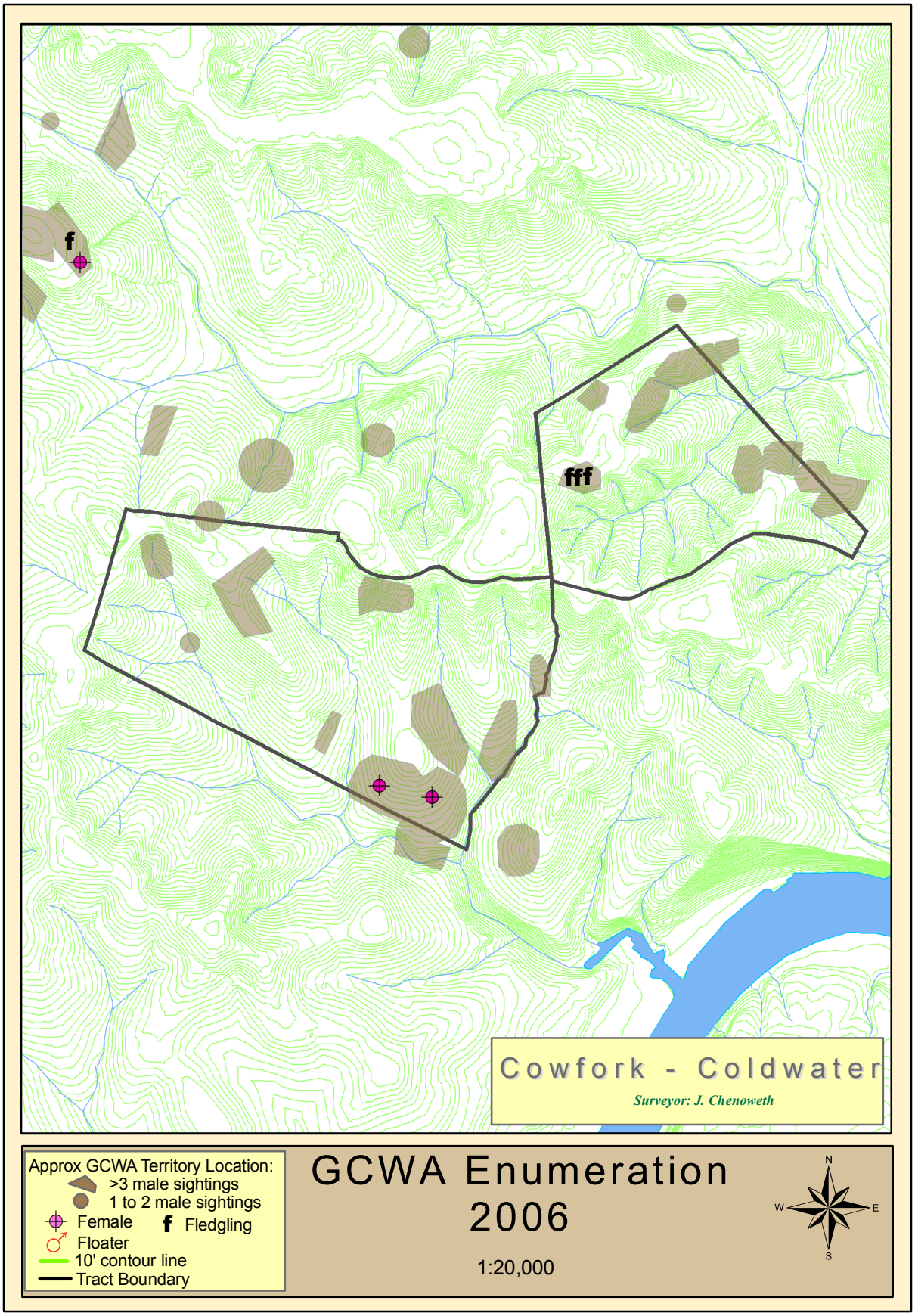

f
fff
Cowfork - Coldwater
Surveyor: J. Chenoweth
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
f Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
1:20,000
N
W
E
S

Figure 11

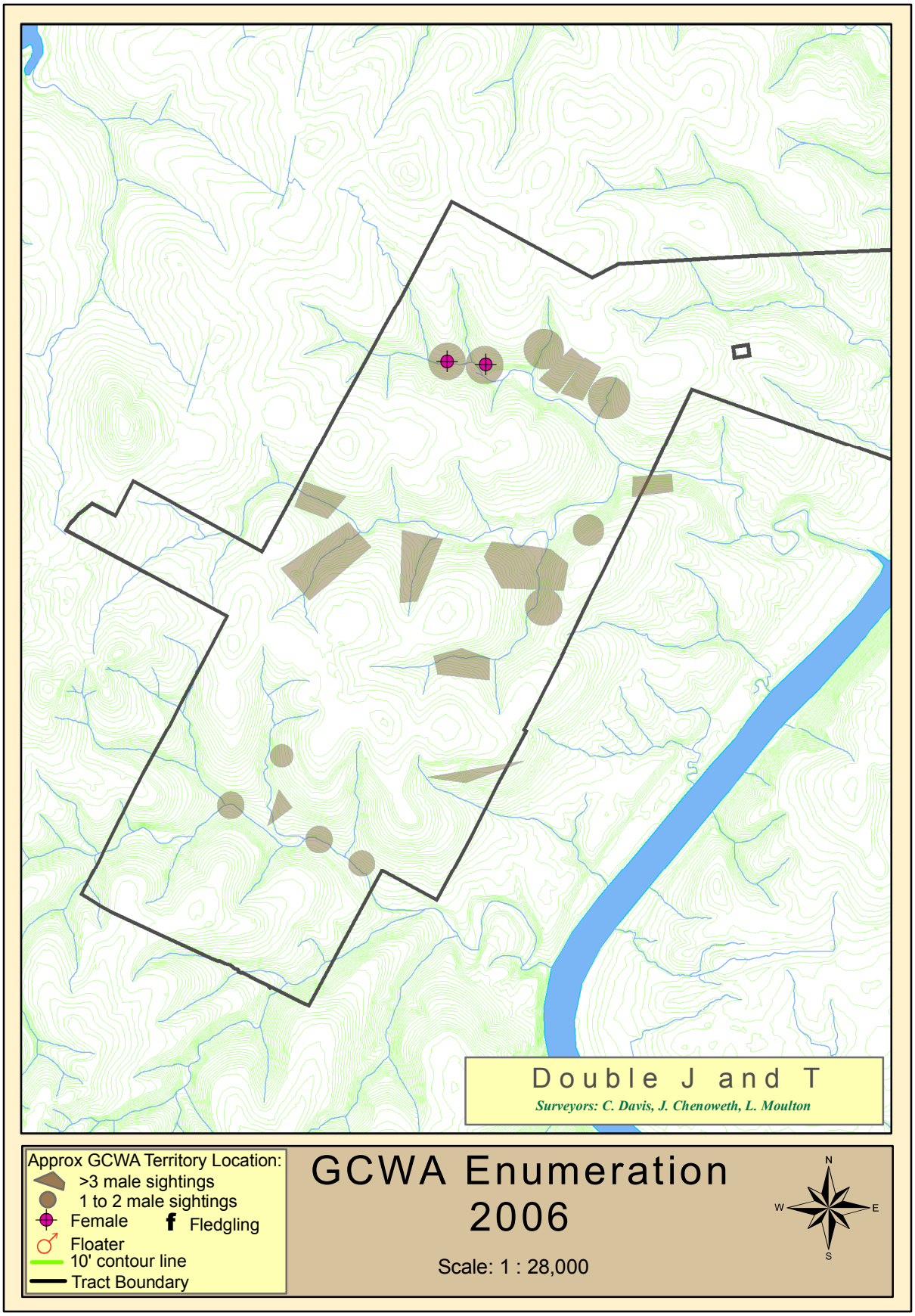

Double J and T
Surveyors: C. Davis, J. Chenoweth, L. Moulton
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 28,000
N
W
E
S

Figure 12

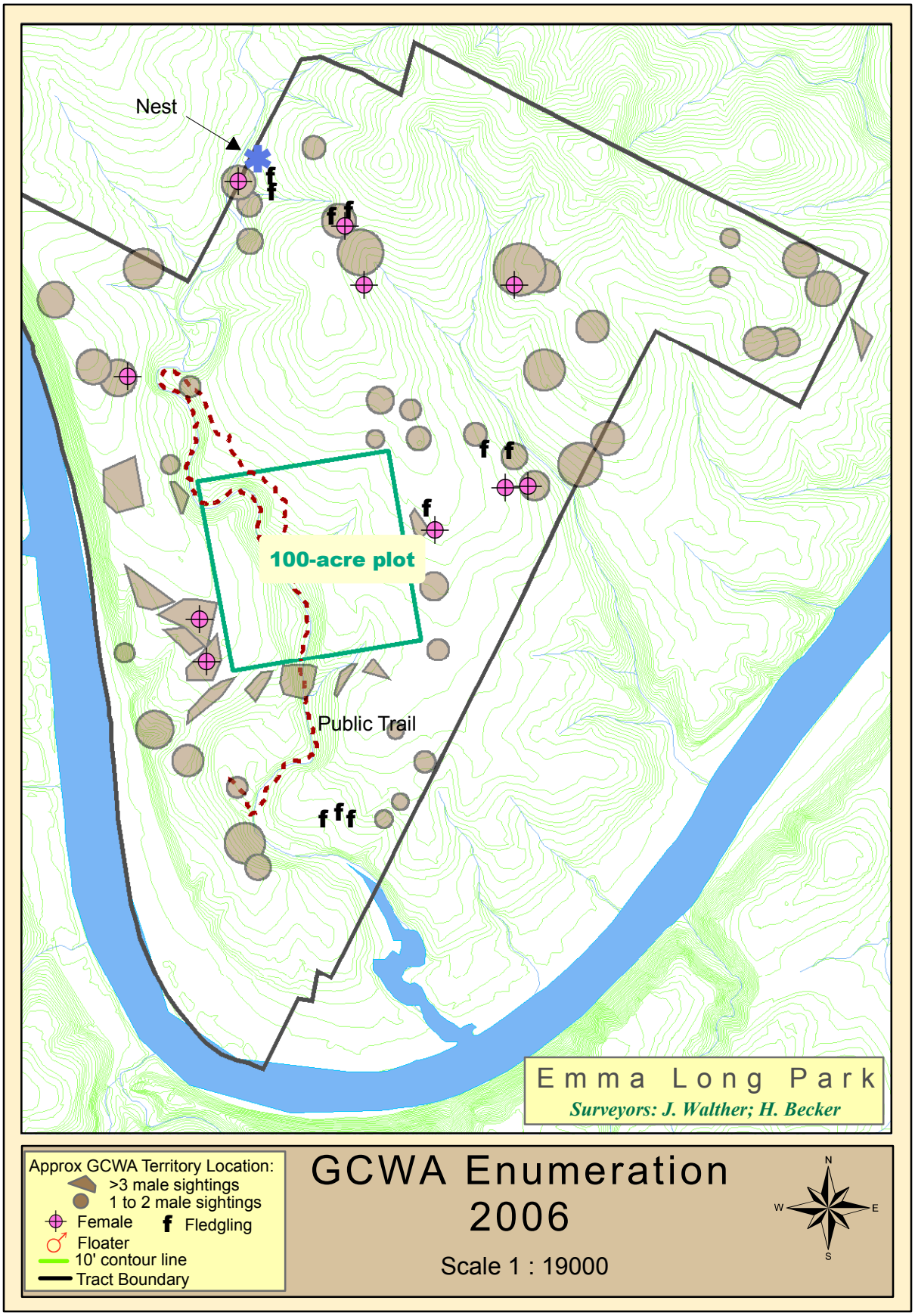

Nest
100-acre plot
Public Trail
Emma Long Park
Surveyors: J. Walther; H. Becker
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
f Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale 1 : 19000
N
W
E
S

Figure 13

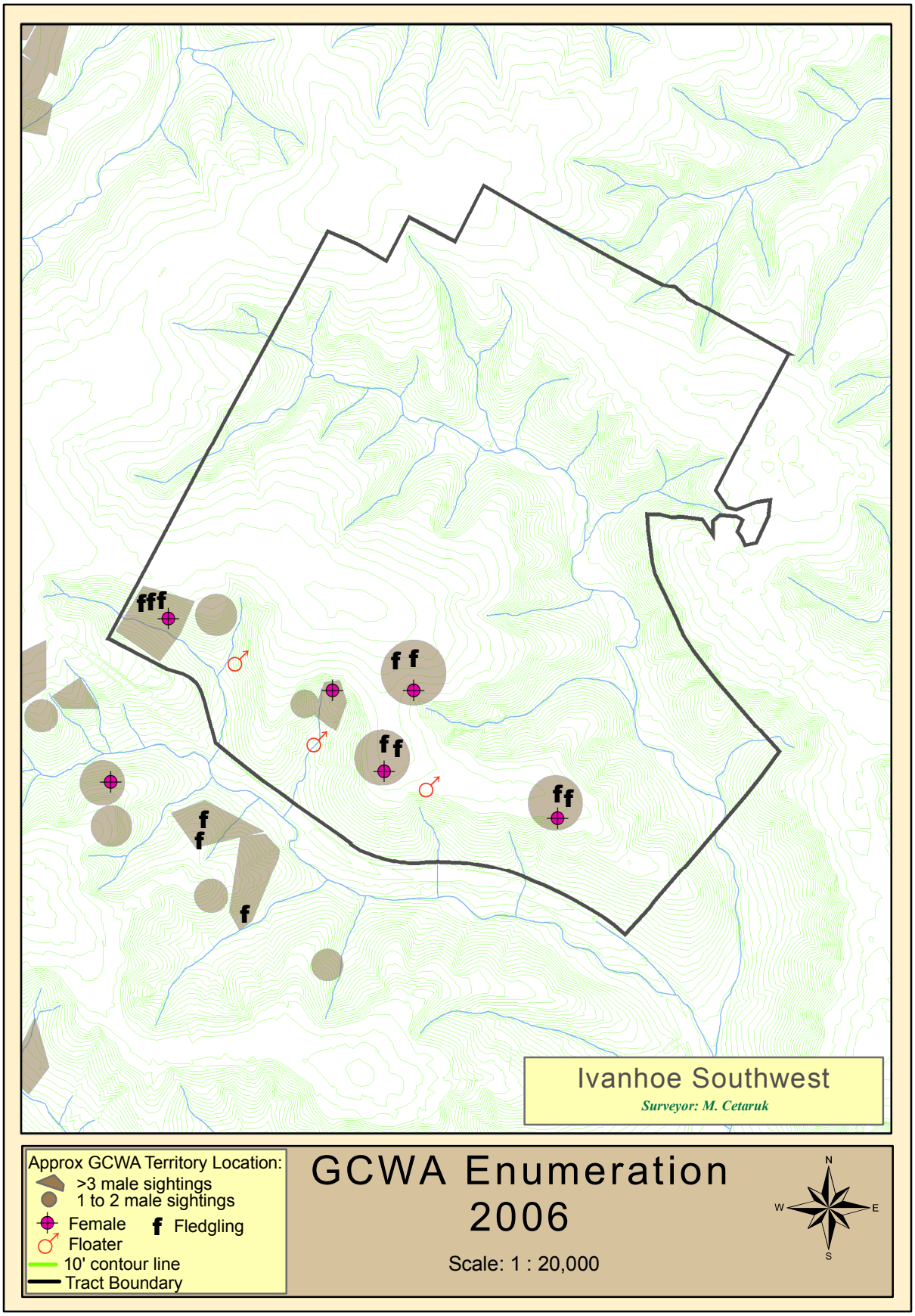

fff
f f
f f
ff
f
f
f
Ivanhoe Southwest
Surveyor: M. Cetaruk
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
f Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 20,000
N
W
E
S

Figure 14

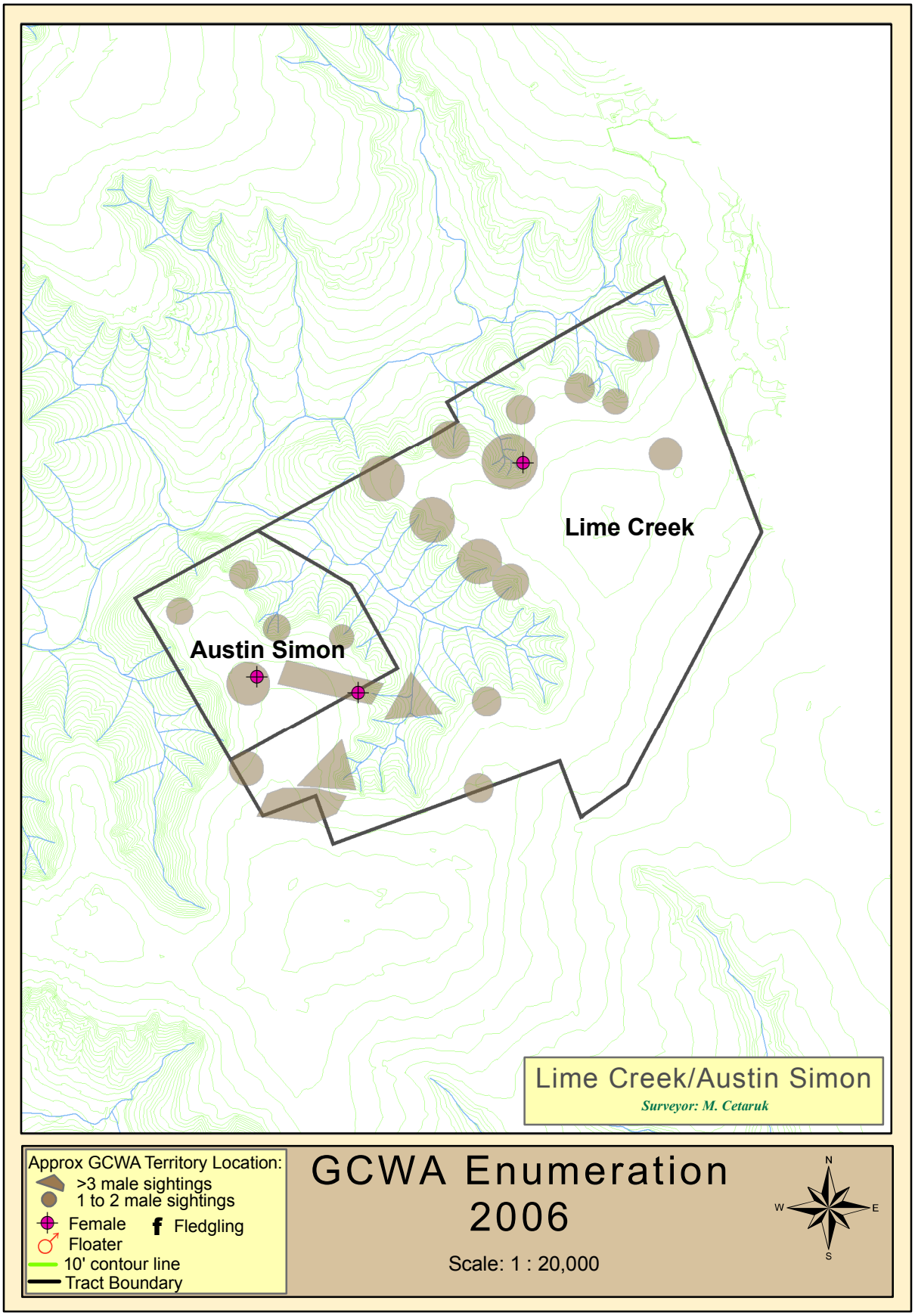

Lime Creek
Austin Simon
Lime Creek/Austin Simon
Surveyor: M. Cetaruk
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 20,000
N
W
E
S

Figure 15

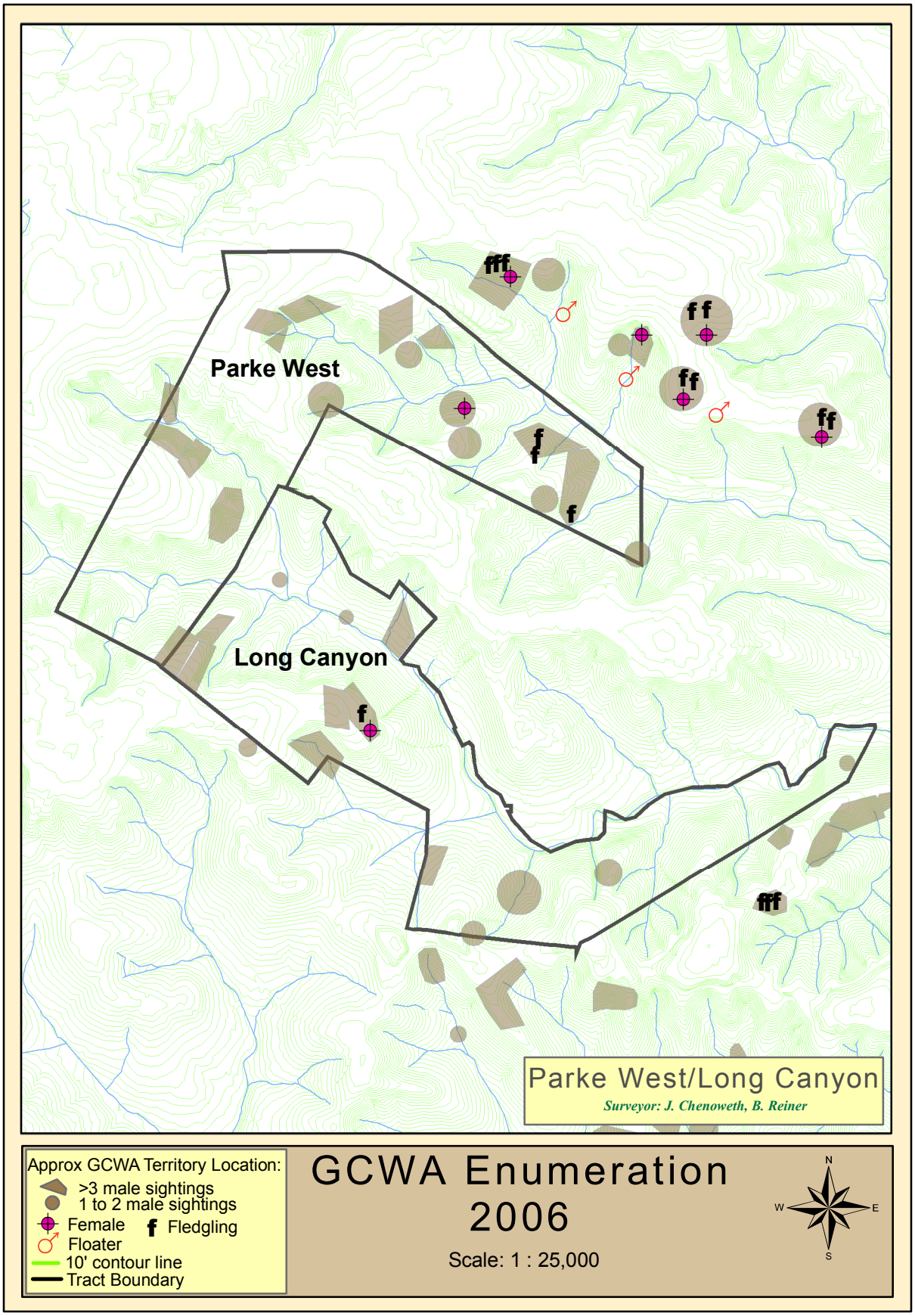

Parke West
Long Canyon
fff
f f
ff
ff
f
f
f
f
fff
Parke West/Long Canyon
Surveyor: J. Chenoweth, B. Reiner
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
f Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 25,000
N
W
E
S

Figure 16

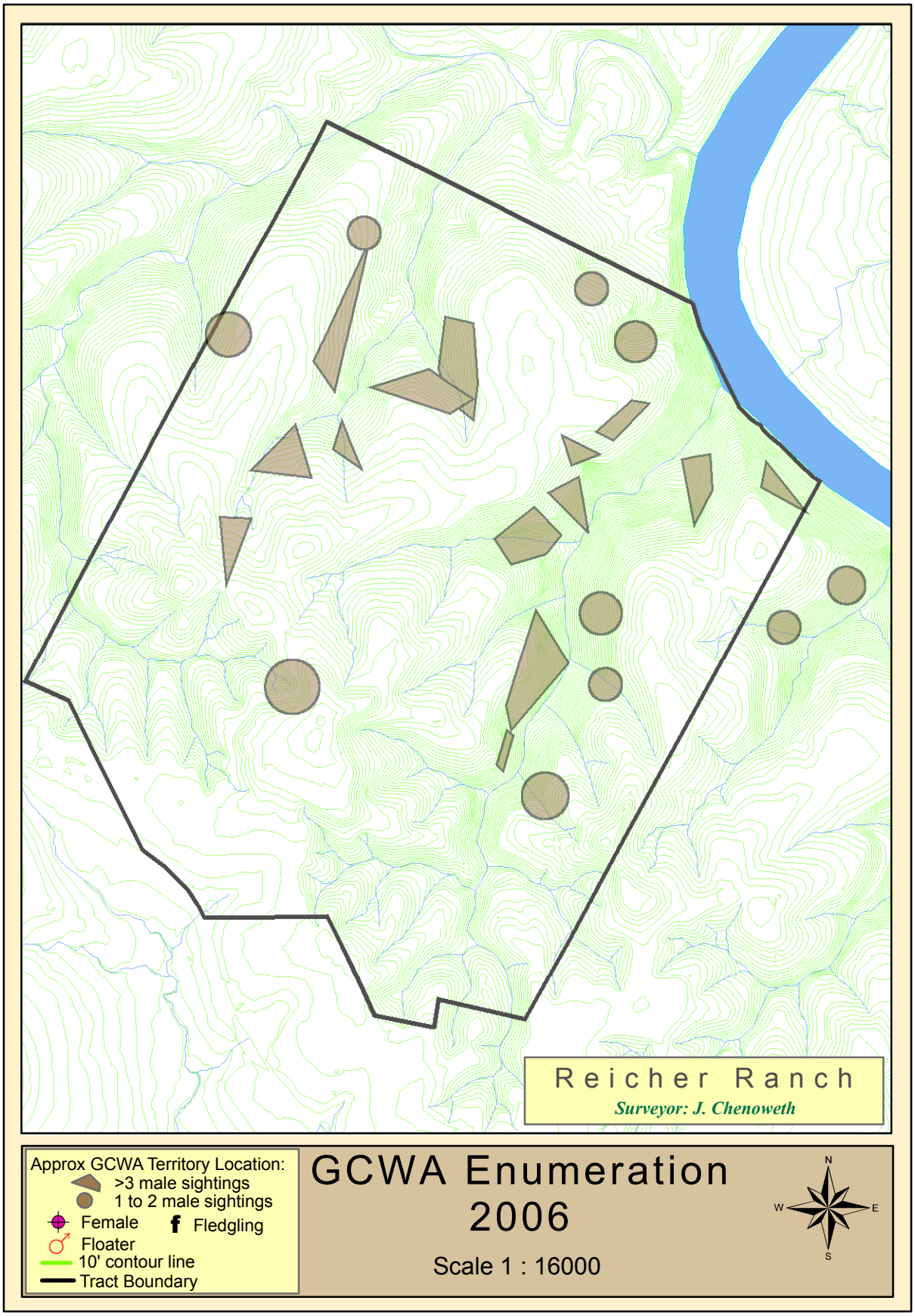

Reicher Ranch
Surveyor: J. Chenoweth
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale 1 : 16000
N
W
E
S

Figure 17

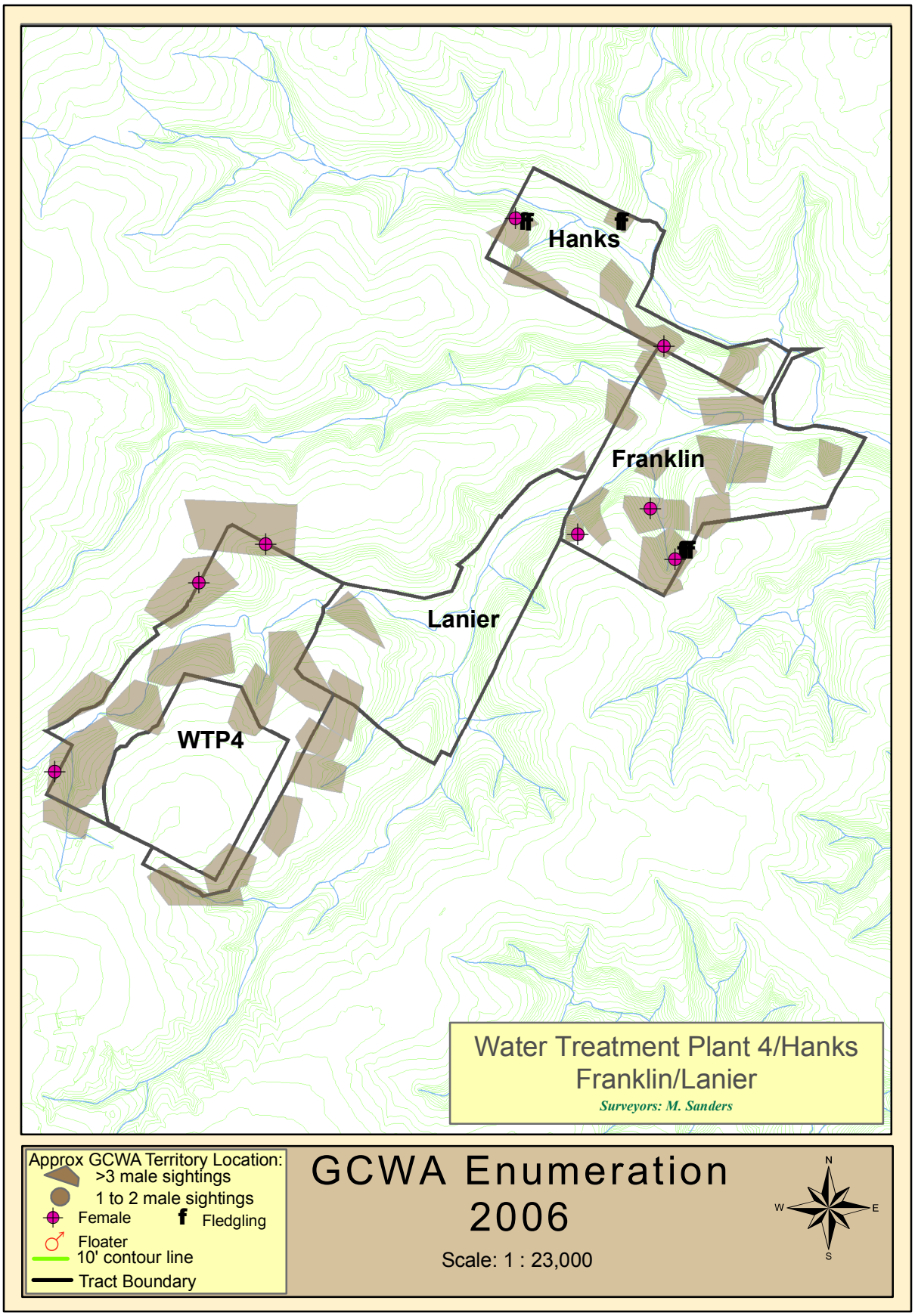

Hanks
Franklin
Lanier
WTP4
Water Treatment Plant 4/Hanks
Franklin/Lanier
Surveyors: M. Sanders
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 23,000
N
W
E
S

Figure 18

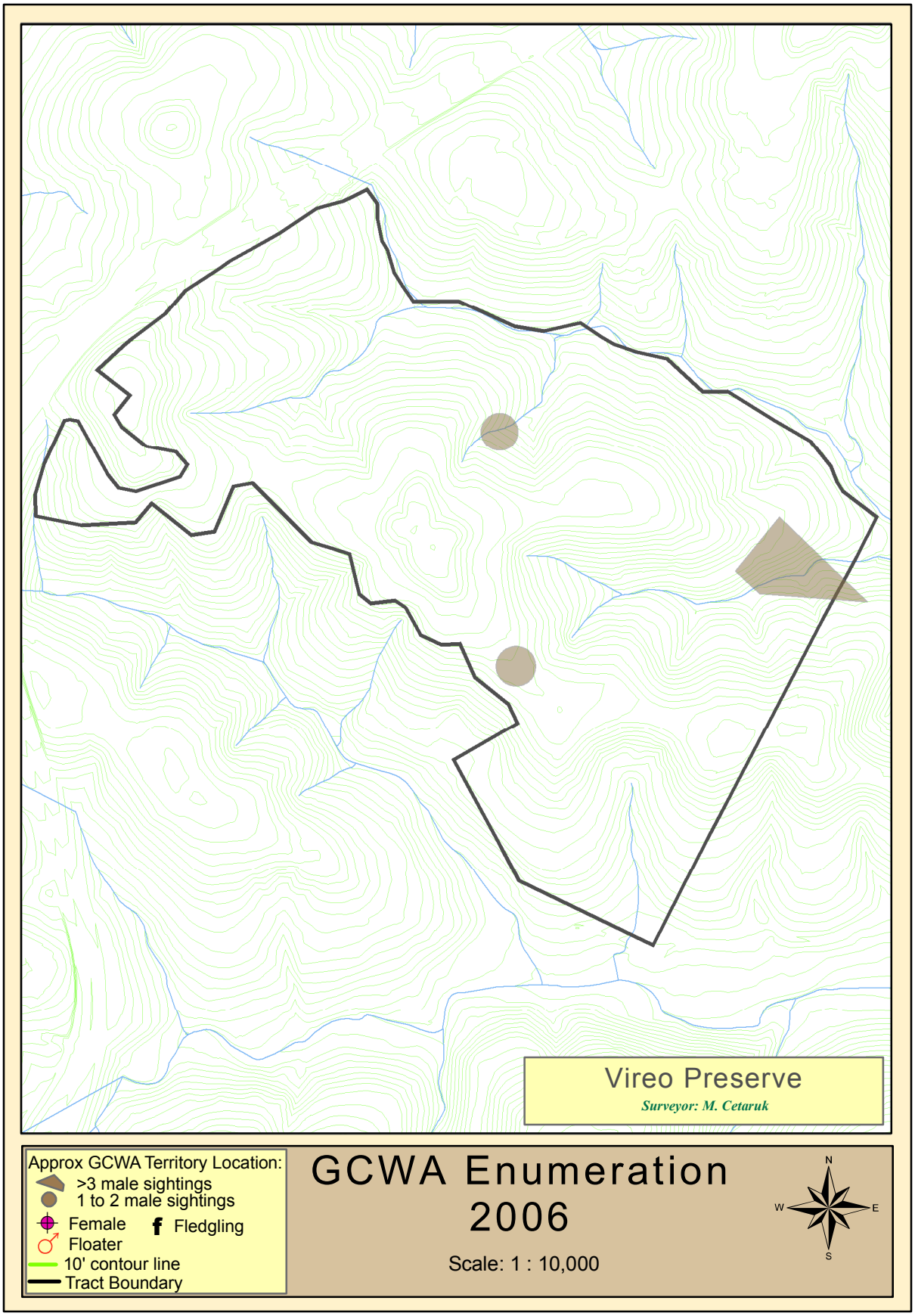

Vireo Preserve
Surveyor: M. Cetaruk
Approx GCWA Territory Location:
>3 male sightings
1 to 2 male sightings
Female
Fledgling
Floater
10' contour line
Tract Boundary
GCWA Enumeration
2006
Scale: 1 : 10,000
N
W
E
S

Figure 19

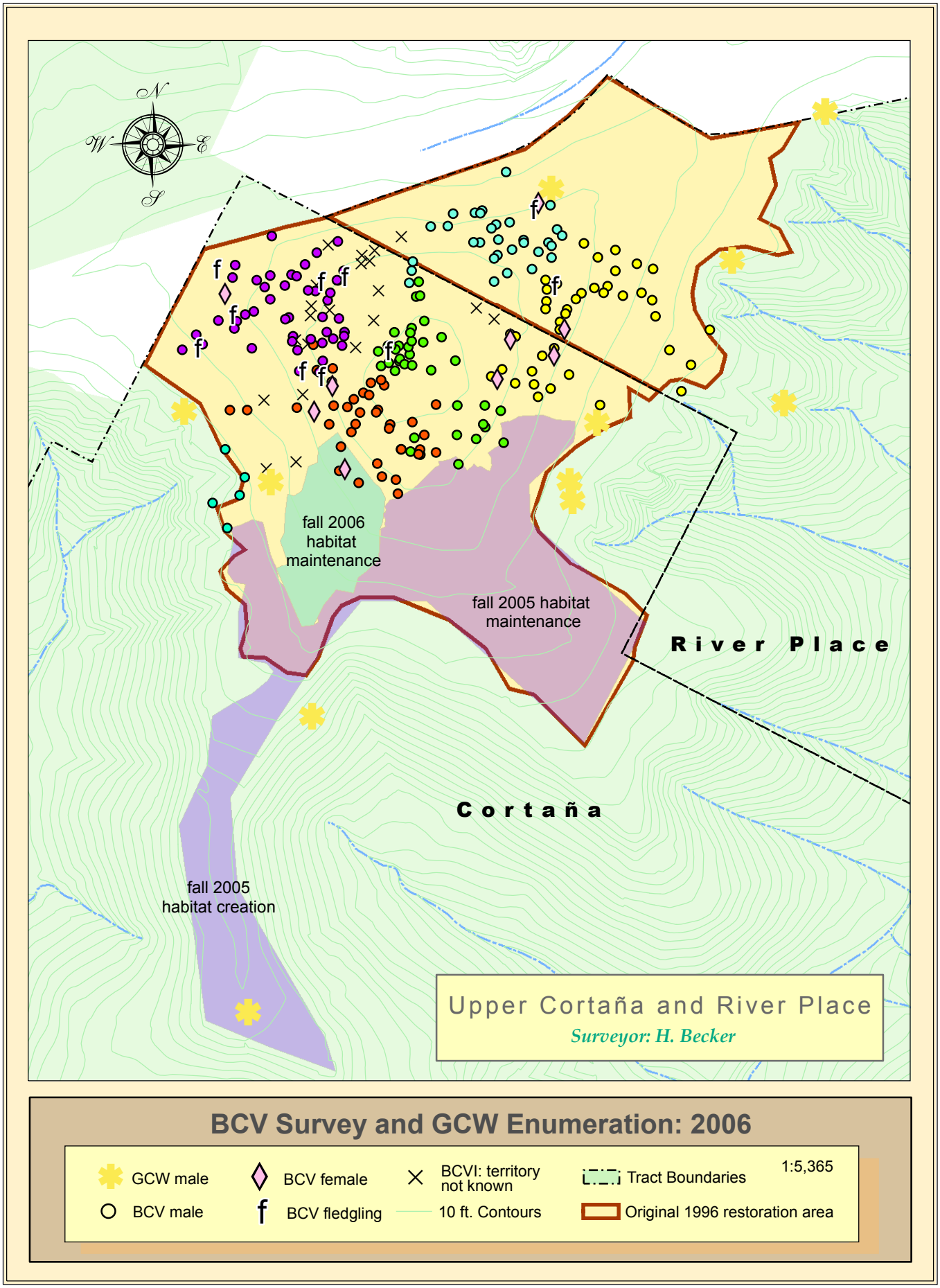

N
W
E
S
fall 2006
habitat
maintenance
fall 2005 habitat
maintenance
River Place
Cortaña
fall 2005
habitat creation
Upper Cortaña and River Place
Surveyor: H. Becker
BCV Survey and GCW Enumeration: 2006
GCW male
BCV male
BCV female
BCV fledgling
BCVI: territory
not known
10 ft. Contours
Tract Boundaries
Original 1996 restoration area
1:5,365

Figure 20