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15 October 2012

Lynn Overtree, Stewardship Manager
Land Trust of Santa Cruz County
617 Water Street
Santa Cruz, CA 95060

Re: Glenwood - 2012 Monitoring Report for the Ohlone Tiger Beetle

Dear Lynn:

This letter report summarizes the findings of my 2012 monitoring activities on the endangered Ohlone Tiger beetle (OTB) at the Glenwood Preserve in Scotts Valley. Comparisons to findings from 2003 through 2012 surveys are also provided.

SURVEY METHODS

Surveys were conducted during 2012 to monitor adult and larval life stages of the OTB. Although the Land Trust of Santa Cruz County, budgeted to pay for only a portion of my monitoring visits, I made additional visits in 2012 at no charge to maintain a similar sampling scheme as has been used in recent years so the monitoring results would be comparable with those of past years. This section describes my methods and data analysis for monitoring of OTB life stages.

Adult OTB Counts.

In most years, adults of the OTB can be active from mid-January to mid-May, although annual variation occurs in the duration of adult activity period, as well as starting and ending dates. In 2000 (i.e., prior to implementation of the formal management plan at Glenwood), a transect route was established along existing trails in the southeastern portion of the Glenwood study site to monitor adult OTBs. The transect route was divided into six segments or intervals (A-F in Figure 1) based on landmarks or prominent vegetation in the field. Total length of the transect route is 1,105 feet, with interval A measuring 254 feet, B 156 feet, C 101 feet, D 360 feet, E 61 feet, and F 173 feet. Trail segment G was created after the water trough was installed in the western end of the beetle pasture.

The entire transect route was walked once daily on each of 15 survey dates, which spanned from the beginning to the end of the 2012 adult season and occurred at approximately weekly intervals. As OTB adults were observed within 15 feet on either side of the centerline of the trail (i.e., a 30 ft. wide belt transect), the location of each individual was obtained using a hand held global positioning system (GPS), and information about each individual's sex and observed behavior was recorded. The tally

of all observed adults along the transect route on a particular survey date comprised the daily transect count. The transect counts along this route establish the starting and ending dates of the OTB's adult season, plus the magnitude and shape of the seasonal population curve for the transect route.

OTB Larval Burrows.

The same trail intervals that were used for the adult surveys were checked for larval burrows throughout the 2012 survey period. In addition, surveys of barren or sparsely vegetated areas within the adjacent grasslands were also checked for burrows. The position of every active larval burrow was mapped in July 2012 using a mapping grade GPS manufactured by Trimble. Coordinates for all burrows were differentially corrected to improve their positional accuracy. The diameter of the mouth of every larval burrow was also measured to determine the instar of the larva associated with each burrow.

RESULTS

Adult OTB Counts.

In 2012, the first adult OTBs were observed on February 2, which was 3 days earlier than when the first adult beetles were observed in 2011. Adult counts were performed while walking along the transect route, as illustrated in Figure 1, on 15 days between January 25 and May 13. This same transect route has been used since 2000 to facilitate comparison of seasonal adult counts. All survey dates are listed in Table 1. These dates were selected because weather conditions were suitable for adult OTBs to be active, i.e., sunny and temperatures $\geq 62^{\circ}$ F.

Table 1 summarizes the numbers of adult OTBs that were observed on each survey date throughout 2011 by transect interval. A total of 177 adult observations occurred throughout 2012, compared to 106 in 2011, 81 in 2010, 127 in 2009, 116 in 2008, 157 in 2007, 98 in 2006, 78 in 2005, 239 in 2004, and 372 during 2003. Since beetles were not marked, captured, or otherwise handled to permit individual recognition, it is possible some individuals were observed more than once on a particular survey date or on different survey dates during the 2012 adult season.

The average number of OTB adults observed per site visit was 11.8/survey visit in 2012, compared to 6.2 in 2011, 5.0 in 2010, 7.9 in 2009, 8.3 in 2008, 8.7 in 2007, 6.5 in 2006, 5.1 in 2005, 19.9 in 2004, and 24.8 in 2003. Observed OTB adult numbers in 2012 increased about 1.7 times compared to 2011.

The duration of the adult activity period was about 102 days in 2012. This number compared to 106 days in 2011, 92 days in 2010, 97 days in 2009, 90 days in 2008, 77 days in 2007, 99 days in 2006, 71 days in 2005, 60 days in 2004 and about 70 days in 2003.

Transect Survey Date	OTB Numbers by Transect Interval (A-F, see Figure 1)							Daily Transect Totals
	A	B	C	D	E	F	G	
24 Jan.	0	0	0	0	0	0	0	0
2 Feb.	0	0	2	4	4	0	0	10
10 Feb.	0	1	2	2	5	0	0	10
17 Feb.	0	1	4	5	5	0	0	15
21 Feb	0	2	2	2	2	1	0	9
3 March	0	1	5	8	6	1	3	24
10 March	0	2	3	7	3	1	2	18
21 March	0	4	3	6	6	2	2	23
30 March	0	2	5	7	1	1	1	17
8 April	0	1	2	4	3	1	0	11
15 April	0	1	5	4	2	1	0	13
20 April	0	2	2	3	1	0	0	8
29 April	0	0	5	2	1	0	0	8
5 May	0	0	3	3	2	0	1	9
13 May	0	1	1	0	0	0	0	2
Seasonal Totals	0	18	44	57	41	8	9	177

OTB Larval Burrows.

A total of 1,229 larval burrows, including 7 plugged burrows, were observed during my July 2012 mapping of the burrows. Figure 2 illustrates the locations of these burrows. As detailed in Table 2, most of these burrows (n = 1,061) supported mature, third instar larvae of the OTB, with burrow diameters ranging in size from 3.6 to 6.0 mm. The remaining 168 larvae in burrows were first (n = 60) or second (n = 108) instars, measuring <3.6 mm in Table 2). The correlations between burrow size and larval instar number were determined by lab rearing studies by Dr. Knisley and reported in Knisley and Arnold (2004, Biology and conservation of *Cicindela ohlone*, the Ohlone Tiger Beetle. Final report to U.S. Fish & Wildlife Service). The 1,229 burrows in 2012 represents an increase of 2.87 times compared to 2011 burrow numbers (Table 2) and are the largest number of burrows observed at Glenwood throughout this 10-year monitoring period.

Figure 3 illustrates the locations of all larval burrows at the Glenwood site between 2003 and 2012. Note that the occupied area in 2003 of 0.21 acre is about two to three times greater than in subsequent years, until 2008, when it was 0.20 acre. In 2009, the area of occupation increased slightly to 0.22 acre; however, in 2010 the area of occupation declined to 0.15 acre. In 2011 the occupied area increased slightly to 0.17 acre, but in 2012 the occupied area doubled to 0.34 acre. Nearly all of the occupied area in recent years has been off-trail, whereas during the initial years of the formal management of Glenwood, most burrows were located on the trail. The observed shift in the larval burrows from on-trail to off-trail locations has occurred as the horse grazing has opened up additional bare to sparsely-vegetated ground in off-trail, grassland areas.

Table 2. Comparison of Numbers of OTB Burrows by Larval Instar Between 2003 and 2012 at Glenwood				
Larval Survey Year	Observed Numbers by Larval Instar			
	1.5-2.3 mm 1 st Instar	2.4-3.5 mm 2 nd Instar	3.6-6.0 mm 3 rd Instar	Totals
2003 (July)	3	21	532	556
2004 (June)	2	57	288	347
2005 (July)	2	23	142	167
2006 (June)	7	38	226	271
2007 (July)	18	58	227	303
2008 (June)	48	90	445	583
2009 (June)	34	47	389	470
2010 (August)	13	42	356	411
2011 (June)	17	38	373	428
2012 (July)	60	108	1,061	1,229

The winter and spring of 2012 was relatively dry compared to 2010 and 2011. Also, the grazing management at Glenwood has successfully opened up more bare ground, which provided additional areas for larvae to colonize. These factors probably explain the dramatic increase in larval burrow numbers that were observed during July 2012.

MANAGEMENT RECOMMENDATIONS

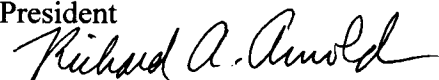
Figure 4 of this report contains two graphs that illustrate the number of OTB larval burrows observed annually since 2003 and the densities of larval burrows. Lines illustrating the annual averages for the period of 2003 through 2012 are also provided. The observed number of OTB larval burrows have exceeded the average of 468/year in three of the 10 years of this monitoring program, while burrow densities have exceeded the average of 6.25 burrows/100 ft.² in five of the 10 years.

These findings suggest that during the past several years of monitoring, the observed fluctuations in numbers of OTB adults and larvae, along with the beetle's area of occupation, are probably within the normal range of annual OTB population variation at Glenwood. Although the area occupied by larval burrows, doubled in 2012 to 0.34 acres, it still remains extremely small to support a population of the OTB. For this reason I recommend that the grazing program continue in the manner that has been followed for the past couple of years to maintain as much bare ground within the beetle pasture as possible.

If you have any questions about my report, just contact me.

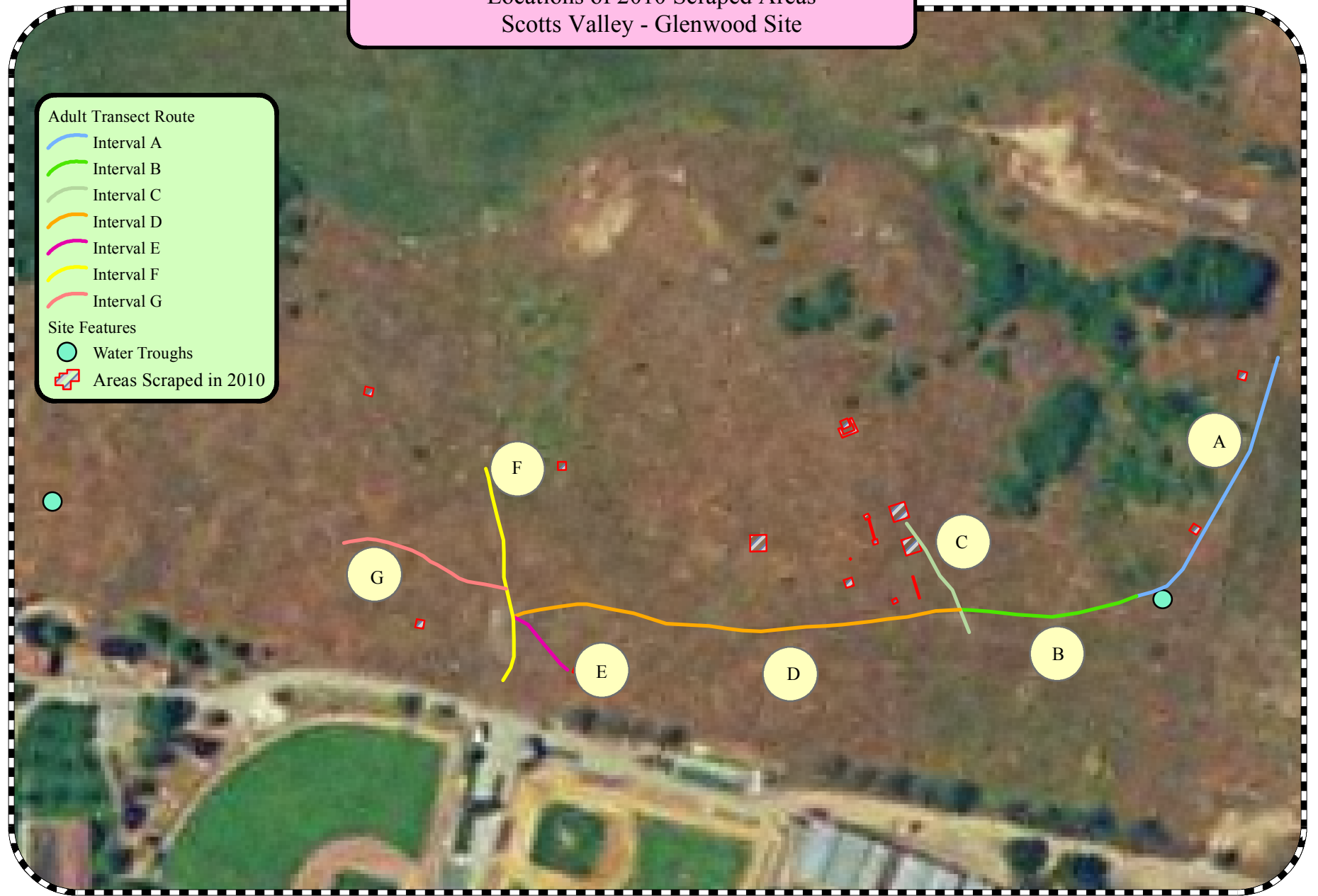
Sincerely,

Richard A. Arnold, Ph.D.
President



2012 Ohlone Tiger Beetle Study
Adult transect route intervals A - G
Locations of 2010 Scraped Areas
Scotts Valley - Glenwood Site

FIGURE 1.

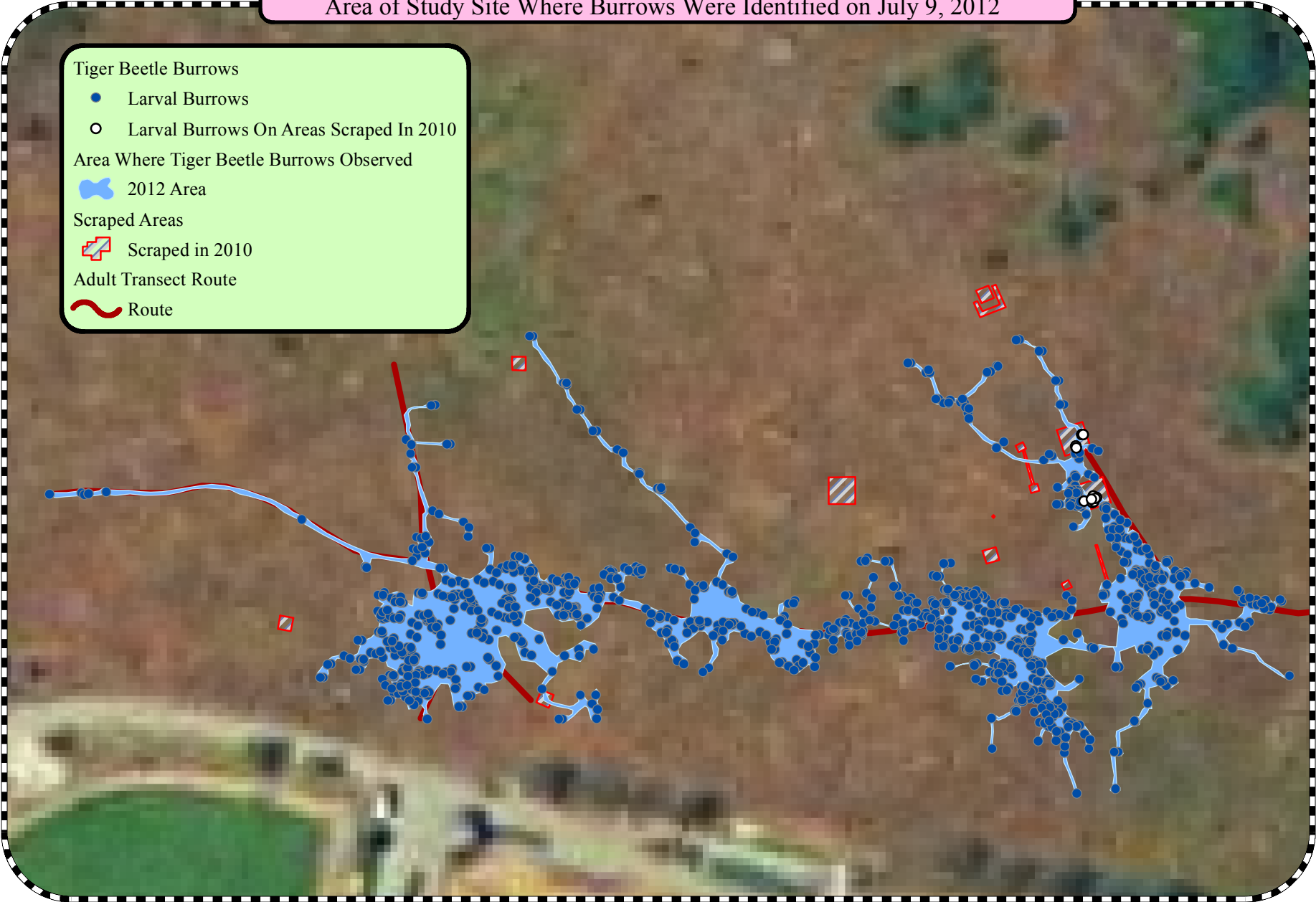


0 75 150 300 Feet



2012 Ohlone Tiger Beetle Study
Scotts Valley - Glenwood Site
Area of Study Site Where Burrows Were Identified on July 9, 2012

FIGURE 2



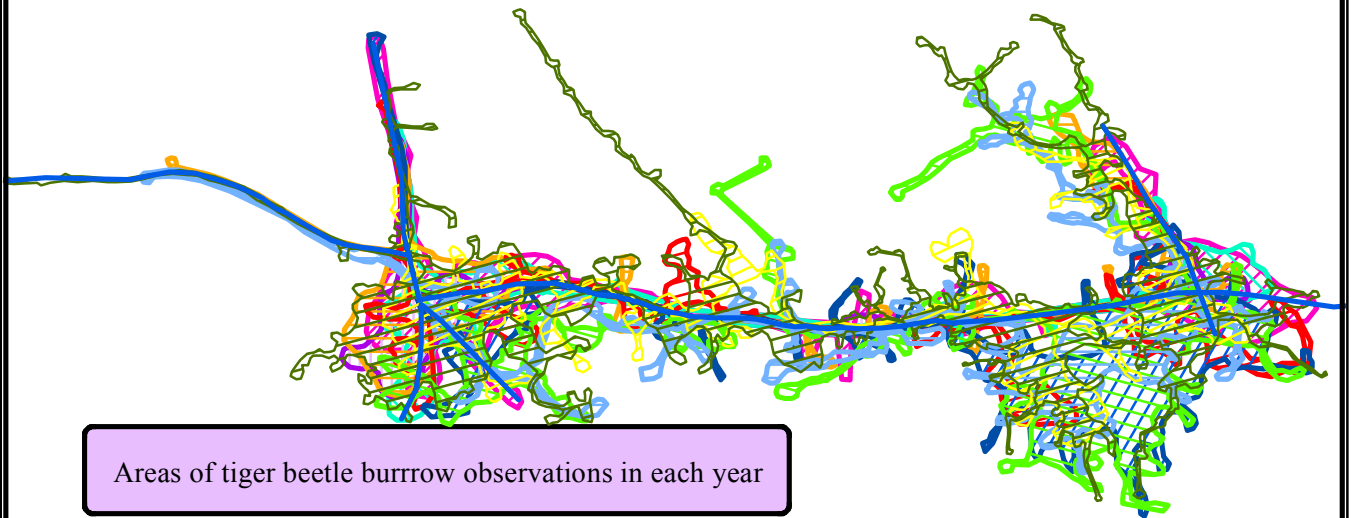
- Tiger Beetle Burrows
 - Larval Burrows
 - Larval Burrows On Areas Scraped In 2010
- Area Where Tiger Beetle Burrows Observed
 - 2012 Area
- Scraped Areas
 - Scraped in 2010
- Adult Transect Route
 - Route

0 40 80 160 Feet



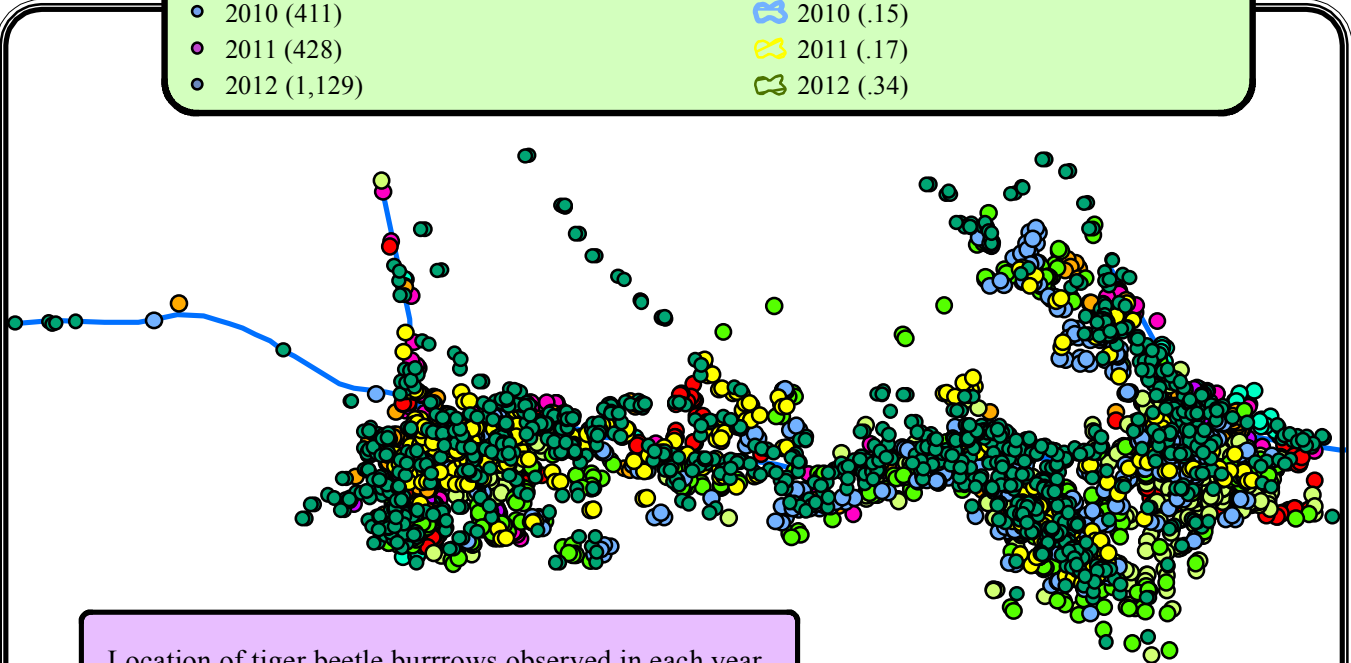
2012 Ohlone Tiger Beetle Study
 Scotts Valley - Glenwood Site
 Comparison of Burrow Locations 2003 - 2012

FIGURE 3



Areas of tiger beetle burrow observations in each year

Burrows, Year & (Number) of burrows observed	Area, Year and (Acres) of beetle observations
• 2003 (546)	• 2003 (.21)
• 2004 (364)	• 2004 (.12)
• 2005 (167)	• 2005 (.07)
• 2006 (271)	• 2006 (.12)
• 2007 (303)	• 2007 (.10)
• 2008 (583)	• 2008 (.20)
• 2009 (470)	• 2009 (.22)
• 2010 (411)	• 2010 (.15)
• 2011 (428)	• 2011 (.17)
• 2012 (1,129)	• 2012 (.34)



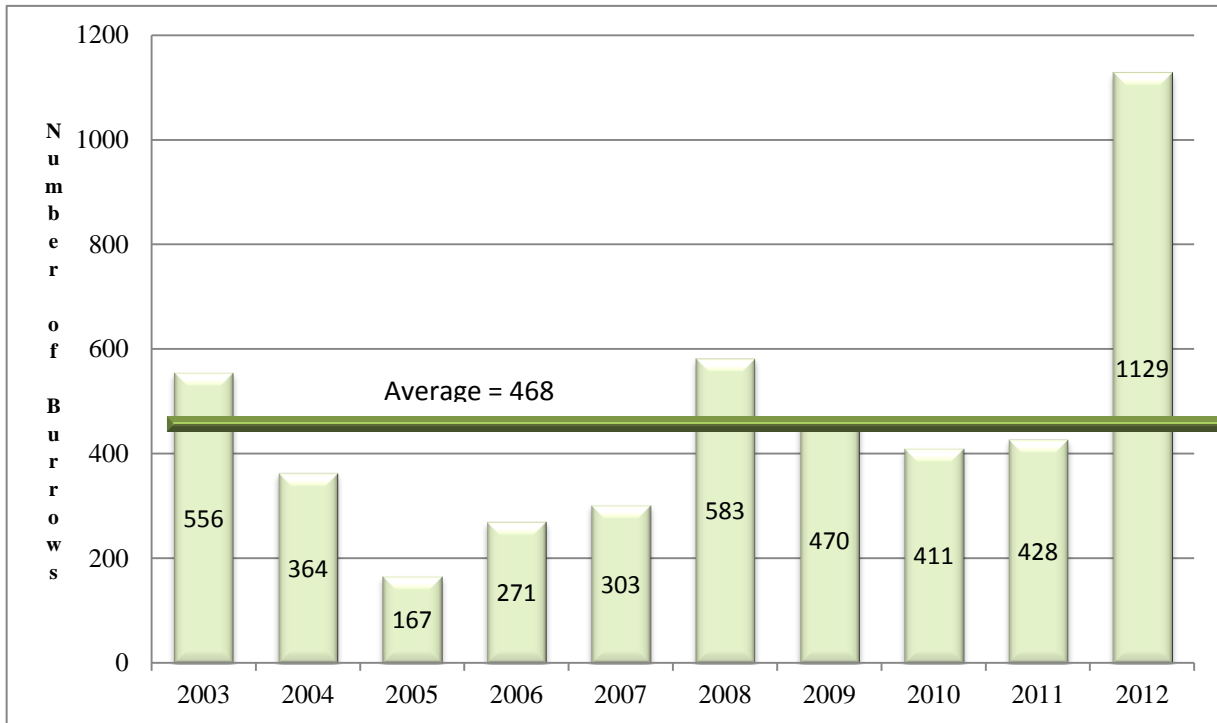
Location of tiger beetle burrows observed in each year

0 50 100 200 Feet



FIGURE 4

Graph showing the Number of Ohlone Tiger Beetle Burrows Observed 2003 - 2012
On the Scotts Valley - Glenwood Site



Graph showing the Number of Ohlone Tiger Beetle Burrows Observed per 100 Sq. Ft. of Burrow Area
On the Scotts Valley - Glenwood Site

