

Final Report
San Diego County Eye Gnat Research and
Education Project 2012-13
Escondido/Jacumba

Biology and Control of the Eye Gnat
Liohippелates collusor

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RESEARCH PROJECT GOALS 2012-13 ESCONDIDO

- Determine the sources of the populations of eye gnats affecting the residents in Escondido through emergence traps
- Determine the optimum type of egg bait and the age of the bait that is most effective
- Continue grid trapping to document the population dynamics
- Provide pertinent publications and information for educational purposes
- Provide additional services as needed on eye gnat related issues

RESEARCH PROJECT GOALS 2012-13 JACUMBA

- Determine the population levels of adult eye gnats after farming operations ceased

BACKGROUND

Eye gnats are prevalent in the Southern United States, primarily in parts of California and Arizona. In San Diego County, specifically in the Jacumba and Escondido areas, they have been a problem for many years and are the source of numerous citizen complaints to Departments of Environmental Health - Vector Control, and Agriculture Weights and Measures. Research has determined that local agriculture is the source of the problem, and the community residents are looking to the County for a solution. Eye gnats are problems in other agricultural areas in Southern California and have been extensively studied for more than a century. These nuisance problems have been successfully addressed by identifying the source, altering land management practices, implementing integrated pest management (IPM), and conducting a sound public outreach and education program.

Benefit to the County

In utilizing our technical and expert resources with UCCE, we can more efficiently offer the County's residents easier access to current and applicable information and educational opportunities to understand and manage the eye gnat problem. Increased awareness of this problem, its causes and possible solutions will assist county departments in dealing with citizen complaints.

Introduction

The eye gnat (*Liohippелates* and *Hippelates* spp.) has been a nuisance pest since the turn of the 20th century. Eye gnats have created problems in cultivated areas such as the Imperial and San Joаquin valleys of California. In addition, they are present in many desert areas of California, such as the Mojave Desert, and could create problems if and when such areas are intensively cultivated and irrigated. *Liohippелates collusor* (Townsend), formerly known as *Hippelates collusor* in the scientific literature is the primary species in southern California.

Problems are heightened when irrigated agriculture is in close proximity to urban areas. Research has shown that irrigated agriculture provides good reproductive potential for eye gnat production (Mulla 1963). However, female gnats need a protein food source (mucus, blood, scabs, etc.) in order to produce their young and that protein source is largely unavailable in agriculture. Therefore, since eye gnats can disperse approximately 4 miles both upwind and downwind, humans and domesticated animals living in close proximity to eye gnat producing areas can become a food source.

EXECUTIVE SUMMARY

Introduction

All of the research was conducted off the Be Wise Ranch property during 2012. Therefore, our resources were diverted to properties in the vicinity of Be Wise Ranch, and they will benefit all persons in San Diego County.

EYE GNAT ATTRACTION OF DIFFERENT EGG PRODUCTS OVER TIME

- Either fresh or 1 week aged powdered eggs provided the best attractant for adult eye gnats.

USE OF EMERGENCE TRAPS TO DETERMINE OFF-FARM EYE GNAT SOURCES

- Adult eye gnats were found to emerge in very small numbers from irrigated turf located in parks and golf courses. No gnats were found in riparian or lake shoreline environments.

ADULT EYE GNAT POPULATION DENSITY STUDY IN ESCONDIDO

- Eye gnat trap counts closely follow patterns seen in Jacumba with large numbers close to the farm and dwindling numbers further away.

ADULT EYE GNAT CAPTURE-MARK-RECAPTURE DISPERSAL STUDIES

- Several attempts to mark eye gnats with florescent dust failed. Florescent dust at exceptionally low rates caused eye gnat mortality.

ADULT EYE GNAT POPULATION DENSITY STUDY IN JACUMBA AFTER FARMING ACTIVITY CEASED

- Eye gnats were still present in Jacumba but in very low numbers following cessation of farming, lack of irrigation for an extended period, and following an application of conventional pesticide to growing fields.

EXTENSION ACTIVITY

- Meetings were attended and data shared to community leaders, the farm, and the county. More information was made available on the Internet. A Pest Note for eye gnats was submitted for publication to the UC Agriculture and Natural Resources (ANR) Publications Division.

Recommendations for the Eye Gnat Nuisance Prevention Plan for Be Wise Ranch in Escondido 2013-14 Based on Research Conducted During 2012-13

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The key to reducing huge eye gnat populations to background levels is finding the source and implementing all possible eye gnat abatement methods. The following recommendations are based on the current knowledge of the situation and the research conducted in Escondido in 2010-13 and in Jacumba during 2008-2010.

- The results from one of our studies (*Use of Eye Gnat Mass Trapping as an Effective Means of Reducing Migration*, Final Report San Diego Eye Gnat Research and Education Project 2011) provide some indication that a line of traps can reduce eye gnat numbers migrating from the farm as they move into the community. This study needs repeating but coupled with the fact that this is one of the management tools used by the Coachella Valley Vector Control District, this method seems a way to, in part, reduce eye gnat populations reaching the community.
- Laboratory research this last year indicated that organic pesticides in standard glass vial assays could kill adult eye gnats. Glass vials are coated with diluted insecticides and the insects are exposed to the pesticides in the vials for 24 to 48-hours. Glass vial trials are typically used to detect insecticide resistance in insect populations. Although these results are conducted in the laboratory, there is a good possibility that the use of organic pesticides, in part, will reduce eye gnat populations.
- Recent laboratory research has indicated that eye gnat larvae are exceptionally adept at moving through sandy soil. We have found that placing eye gnat eggs on the surface of sand with a food source at a depth of 24 inches, the eye gnat larvae are able to reach the food source, develop to the late instar, which can then migrate through the sand to the surface to pupate. Therefore, attempting to bury the eye gnat larvae by deep tilling or another method likely will not succeed in reducing eye gnat populations.

Specific Recommendations for the 2013 Cropping Season in Escondido

Many of the recommendations have already been studied, suggested, and reiterated below. A Best Management Practice (BMP) document has been developed and is available on the County of San Diego Department of Environmental Health (DEH) website. The BMP outlines a number of different tactics that can be used to reduce eye gnat populations, and each one can be used individually to some effect. However, if greater abatement methods are needed, the tactics recommended in the BMP can be compounded to greater effect.

Barriers

The 36" high silt fence barriers should continue to be a viable method of exclusion.

Trapping

Removing the adult eye gnats from the population is a highly effective tactic in reducing eye gnat population numbers in Coachella Valley and in Jacumba. Therefore, they should remain as a viable method of eye gnat population reduction.

- Research conducted during 2012-13 indicated that the most attractive bait product is powdered egg diluted in water (1/2 cup powdered egg to one gallon of water).

Chemical Control

Laboratory studies conducted in small scale trials indicate that mortality to adults will occur with the use of organic pesticides. At present, applications of registered organic oils such as Ecotrol/Ecotec (rosemary oil and peppermint oil) or an application of Entrust (spinosad) should be applied every other week to production crops throughout the cropping cycle. Applications of Ecotec or Entrust will reduce, in part, eye gnat adult populations.

Cultural Control Methods

- Reduce organic matter production as much as possible. Crop residues should remain on the soil surface until they are completely dried out. They should be collected and removed from the production areas and never be tilled into the soil.
- Weed control needs to be by herbicides or by hand, not tilling.

EYE GNAT ATTRACTION OF DIFFERENT EGG PRODUCTS OVER TIME

Objective

Determine which egg product and at what age it was most effective in attracting adult eye gnats.

Materials & Methods

Experimental Unit: UCCE 4-hole collar traps were used in this and in previous studies (Bethke et al. 2010) (Figure 1 & 2).

Experimental Design: There were four replicates per treatment placed in a randomized complete block design located on a hillside next to the farm.

Treatments: Various egg products were tested both as fresh and aged one week until putrefied. The products tested were real eggs, powdered egg, egg substitute i.e. “Eggbeaters”, and just egg whites. All products were mixed at 5 eggs per 1-gallon water. When real eggs are kept in a glass jar exposed to sunlight for over a week, the product turns red. In field observations, it was observed that the bait became ineffective at this point. Table 1 shows the products tested and the dates of the test. Only four products were tested at a time. The last column is the average of all the tests.

Insect Source: Eye gnats present in the natural environment.

Sampling: The upper portion of the traps were collected after 48 hours and placed in a freezer overnight to kill all gnats. The contents of the jars were counted the following morning.

Results

Powdered egg gave the best results in attracting adult eye gnats. Bait that had been aged one week (“old”) provided better results over fresh products. Thus, 1/2 cup of powdered egg mixed with 1-gallon water and aged for 1 week provided the best results in attracting adult eye gnats.

Table 1. Mean number of adult eye gnats caught per four collar traps per testing period.

Product	8/8-8/10	8/15-8/17	8/28-8/30	9/5-9/7	9/12-9/14	10/9-10/12	Mean
Fresh Powder	136.0	117.5	16.2	32.8	21.8	27.8	58.7
Fresh Egg	X	48.3	X	X	8.0	6.2	20.82
Fresh Subst.	X	X	3.6	9.0	X	X	6.3
“Old” Powder	156.6	105.6	13.8	24.4	X	X	75.1
“Old” Egg	17.2	166.0	X	X	0.6	25.2	52.3 ¹
“Old” Subst.	X	X	23.0	8.2	X	35.2	22.1
“Old” Whites	34.6	X	X	X	X	X	34.6
“Red” Eggs	X	X	X	X	2.4	X	2.4

X = Test was not performed for this testing period (columns) using these egg baits (rows).

¹ The variance in these samples is largely due to one capture date (8/15-8/17). It is unclear why so many eye gnats were captured on that date.

USE OF EMERGENCE TRAPS TO DETERMINE OFF-FARM EYE GNAT SOURCES

Objective

This trial was designed to reexamine previously studied areas and new habitats that may be sources for breeding eye gnats.

Materials and Methods

Experimental Unit: Emergence trap consisting of a PVC frame (2' X 2' X 1') covered with a cotton mesh and painted black. On one side of the frame was a collection station consisting of a funnel and 1-pint glass mason jar (Figure 3). A small vial of egg bait was placed in the collection jar to lure insects.

Experimental Design: Sixteen traps were placed in groups of four (Figure 4) where applicable. At the winery, the sixteen traps were placed in a single row under the drip emitters (Figure 5). In the riparian area south of the farm, traps were placed as close as possible to the dried stream. See Figure 6 for the test locations.

Sampling: Trap jars were collected once a week, placed in an oven to dry and the contents counted.

Results

Table 2 is a summary of all the emergence work done in the past three years in the Escondido area surrounding the Be Wise Ranch in search of alternate sources of emerging eye gnats. The results confirm the findings by Dr. Mir Mulla (Mulla 1962) in that the primary source for eye gnats is irrigated and tilled farmland. Eye gnats have also been documented to deposit eggs in managed turf, which is also confirmed at the park and golf course. However, there is a significantly greater number of eye gnats/trap/day observed emerging from tilled farmland (data not shown) as compared to the managed turf.

Table 2. Mean number of eye gnats/trap/day captured in selected locations in South Escondido. Letters in parenthesis correlate to location found in Figure 6.

Location	Date Sampled	Total Days	# Traps	# Gnats	Eye gnats/trap/day
The Vineyard golf course (J)	May 8 - 30, 2012	22	16	8	0.023
Kit Carson Park (K)	May 31 - June 27, 2012	28	14	11	0.028
Lake Hodges waterline (E)	June 8 - August 24, 2010	77	4	0	0
Lake Hodges waterline (L)	June 27 - August 1, 2012	28	16	1	0.002
Orfilia Winery (M)	August 2 - 15, 2012	13	16	0	0
Riparian area east of Lake Hodges (N)	August 20 - 28, 2012	8	3	0	0

ADULT EYE GNAT POPULATION DENSITY STUDY IN ESCONDIDO

Objective

This trial was designed to establish a baseline and observe chronological changes on the range of adult eye gnat populations using a **global positioning system (GPS)** grid pattern.

Materials and Methods

Experimental Unit: Modified PVC based 4-hole collar traps were used for monitoring. The lower portions of the trap are painted flat black and the top portion is clear plastic (Figure 2). Traps were attached to 3' wooden stakes using electrical tape. Putrefied egg was added to the lower PVC container as bait.

Experimental Design: Twenty-four collar traps were placed on a 5-trap by 5-trap grid pattern approximately one-half mile apart in south Escondido (Figure 7). Trap numbers in Table 10 correspond to the numbers on the pins in Figure 7. Trap #7 is not present in the study because Lake Hodges precluded its placement.

Sampling: Trap tops were collected for a five consecutive day period for four consecutive months during July-October, 2012. Trap tops were removed and replaced with a clean trap top. The trap tops with the eye gnats were placed in a Ziploc bag to prevent any gnats from escaping, brought back to the laboratory, and placed in the freezer overnight. Eye gnats were separated from other fly species, counted and recorded.

Analysis: Data are presented using descriptive statistics. Selected data sets were pooled (elevation and location) in search of trends.

Results

Table 3 lists the average number of eye gnats captured/trap/day in traps located a half mile apart on a grid delineated by GPS coordinates (Figure 7). The area studied was south Escondido, an area plagued by eye gnats and in close proximity to an organic farm.

As was the case in Jacumba (Bethke et al. 2009) eye gnats are concentrated around the farm, and in areas of human activity such as residential areas, schools, parks, etc. (Table 4). In 2011 (Bethke et al. 2011), the highest concentration of eye gnats (Mean no. 600.5, traps 13, 14, 18 and 19) was found in the vicinity of Sonata/San Pasquel Rd, the residential community in close proximity to and north and west of the organic farm. This is also one of the areas, which produces some of the greatest number of complaints from residents and homeowners associations. Traps within a "half mile of the farm" and "within residential areas" contained the next highest mean number of eye gnats (>300/trap/day).

In 2012, trap #8 located near the southwestern part of the farm averaged 108 gnats/trap/day while trap #20 near the northern part of the farm recorded 110 gnats/trap/day. There was an anomalous trap capture associated with trap #22 in 2011. In 2012, the number of gnats caught in trap #22 was more representative of the surrounding environment. All indications are that patterns of trap catch mimics what was observed in Jacumba in that eye gnats are concentrated in an area in close proximity to the farm and in residential areas.

Traps counts in 2012, showed an overall decrease of 92% in the number of adult gnats caught compared to 2011. It also demonstrates how the population can fluctuate between months and years. Traps located next to the farm and with a half mile of the farm recorded the highest average number of eye gnats caught.

Table 3. Mean number of eye gnats/trap/day captured in traps placed a half-mile apart on a grid delineated by GPS coordinate.

Trap #	October 2011	July 2012	August 2012	September 2012	October 2012
1	86.5	1.5	1	1.8	4.7
2	25	2.5	28	14	0
3	183.3	24	93	55.5	16
4	417	12	19	13.7	11.5
5	50	6.5	2.7	0	6
6	15	0	4	0.5	1
8	130.5	200	202	22	8.7
9	44	2	70.5	10	3.5
10	283	3	10	0.3	0.3
11	289.8	13.5	23.7	14.7	4.8
12	63	2.5	3.5	1.3	15.3
13	317.3	0.5	9.5	17.7	5
14	271.7	3.5	12.6	5.75	0
15	354	36.5	43.7	52.5	15.3
16	4.3	0	n/a	n/a	n/a
17	167.8	0	1.5	1.5	0.8
18	763.3	1.5	6.3	5	52.7
19	1050	1.5	164	112.2	6.2
20	386	1.5	103	283.7	52
21	8.7	2	1	6	5.5
22	1083	2	26	24.5	0.8
23	119.3	0.5	4	4	12.7
24	384	1	8	29.2	18
25	81	1	11	20	3
Mean	274.06	13.29	36.87	30.25	10.6

n/a = no samples were taken

Table 4. Grouping of selected traps into areas of interest in 2012.

Description of Area	Trap Numbers	# of Traps	Mean Gnats/Trap/Day	Importance
Proximity to Organic Farm	8, 9, 10, 15, 20	5	56.03	Population potential near the farm
South of farm (Highland Valley Rd)	2, 3, 4, 5	4	19.89	Proximity to the farm but across open space
West of I-15	1, 6, 11, 21	4	5.36	Furthest from the farm, across freeway
Traps within a half mile of the farm	3, 4, 5, 13, 14, 19, 25	7	22.62	Half mile proximity to farm
Traps greater than a mile of the farm	1, 17, 21, 22, 23	5	5.08	Mile proximity to farm
Traps in open areas	2, 3, 4, 5, 6, 12, 17, 22	8	12.60	Natural environment
Traps within residential areas	11, 13, 14, 19, 21, 24, 25	7	17.89	Residential landscaping

ADULT EYE GNAT CAPTURE-MARK-RECAPTURE DISPERSAL STUDIES

Objective

To determine the distance and direction of eye gnat dispersal.

Materials and Methods

We collected live eye gnats from traps used in Escondido for these trials. Large numbers of gnats were needed. A common method of marking gnats or other insects so that they can be tracked is to coat a glass vial with florescent dust. First the gnats are anesthetized using CO₂. Then the gnats are placed in the coated glass vial and rolled until the gnats are coated with the florescent dust. Following the dusting procedure, we placed the gnats into a separate container with a food source and observed recovery of the gnats.

Results

There was 100% mortality each time we tried to dust the gnats even though we reduced the amount of dust in the glass vials to exceptionally low levels. This was attempted four times, once for each of four colors, at different dates using approximately 50 eye gnats/vial.

The results are not unusual since it is well known that insecticidal dusts can cause desiccation and mortality of insects. The florescent dust we used was very fine and similar to the desiccating dusts. Desiccating dusts are commonly used to control insects that are pests of homeowners such as cockroaches.

ADULT EYE GNAT POPULATION DENSITY STUDY IN JACUMBA AFTER FARMING ACTIVITY CEASED

Objective

This trial was designed to determine the population of adult eye gnats in Jacumba using the same methods used during research studies from 2008-2010.

Materials and Methods

Field Conditions: There were significant changes in the Jacumba area including the cessation of organic farming that could have a significant impact on the eye gnat nuisance. The changes included: 1) the cessation of tilled soil, 2) the lack of fresh organic matter incorporation, 3) the cessation of irrigation practices, and 4) an application of conventional pesticides to the soil surface by the farm to reduce eye gnat adult emergence.

Experimental Unit: Modified PVC based 4-hole collar traps were used for monitoring. The lower portions of the trap are painted flat black and the top portion is clear plastic (Figure 2). Traps were attached to 3' wooden stakes using electrical tape. In previous testing a 4-hole collar trap, glass Mason jar design was used to collect samples in 2008, 2009 & 2010. However, the flat black painted PVC 4- hole collar trap (Figure 2) was used during the 2012 collection. Putrefied egg was added to the lower PVC container as bait.

Experimental Design: We used the same experimental design that was used in 2008. Collar traps were placed in a grid pattern 1,000 feet apart extending from the east end of the farm to the west end of the town of Jacumba, and from the north end of the farm to the Mexican border (Figure 8). In 2010, only the in-town traps were monitored.

Experimental Sampling: Following the 48-hour period, the traps were collected, capped and brought back to the laboratory so that the number of eye gnats could be counted. Numerous other fly species are also recovered in the trapping. Eye gnats and other dipteran species were separated, counted and recorded.

Results

Even though the conditions in the Jacumba area had changed significantly as mentioned above, adult eye gnats were still captured in the majority of our collar traps. However, the numbers captured were markedly reduced (Table 5) compared to years past. The population averaged a 98% reduction from October 2008 to October 2012. The four-month period during 2012 averaged 1.7 gnats/trap/day. The population was still higher “in town” (traps 1-12) where the average was 2.5 gnats/trap/day. This is most likely due to the presence and attraction of humans and domesticated animals as a food source and also due to irrigated landscape and gardens.

Table 5. The average number of gnats caught per trap per day.

Trap #	Oct. 28-30 2008*	Oct. 21-23 2009*	Oct. 27-29 2010*	July. 25-27 2012**	Aug. 29-31 2012**	Sept. 25-27 2012**	Oct. 31- Nov. 2 2012**
1	167.5	245.5	0.5	11.5	0	0	0.5
2	103.5	9	0	4	0	0	2.5
3	176.5	1.5	0.5	1	1	2	2
3.5	n/a	n/a	n/a	0	1	0	0
4.5	32	12	n/a	0	0	0	0
5	50	16	1	1.5	1	0	0
6	169	24	n/a	0	1	0.5	0
7	221	173.5	0.5	1.5	6.5	0	12.5
8	94.5	82.5	n/a	3.5	0.5	0.5	0
9	346	37.5	0	15	16	5	6
10	339.5	29.5	3	0	4	2	0.5
11	145.5	61	2.5	5	3.5	0	2
12	56	37	n/a	2	3	1.5	0
13	64	n/a	n/a	n/a	0.5	0	0
14	154.5	n/a	n/a	1.5	0	0	1.5
15	177	n/a	n/a	18	7	0	2.5
16	285.5	14	n/a	0.5	29	0	25.5
17	22.5	10	n/a	5.5	3	0.5	0.5
20	167	0	n/a	1.5	0	2.5	1.5
21	56	19.5	n/a	1	2.5	1.5	2.5
22	97	0	n/a	0	0	1.5	0
23	116.5	0.5	n/a	1	2	0	0.5
24	78	0	n/a	0	0.5	1.5	0.5
25	103.5	1.5	n/a	1	1	0	1.5
26	41.5	2.5	n/a	0	0.5	0	0.5
28	14	12	n/a	2.5	0	0	0.5
29	43.5	49.5	n/a	0	0.5	0.5	0.5
30	30.5	26.5	n/a	2.5	0	0.5	0.5
32	80	0	n/a	0.5	0.5	0	1.5
33	75	1.5	n/a	0.5	0.5	1	0.5
35	14.5	0	n/a	2.5	0.5	2.5	0
37	16.5	21	n/a	3.5	0	0.5	1
38	0	23.5	n/a	1	0	0	0
39	14	0.5	n/a	0.5	2.5	0.5	0
40	71.5	6	n/a	0.5	0	2	0
41	107.5	1.5	n/a	0	0	2.5	0
42	8.5	15.5	n/a	0	0.5	0	0
47	n/a	n/a	n/a	2	0	1	0.5
mean	91.44	20.56	0.88***	2.01	2.28	0.74	1.66

* Utilized UCCE 4-hole glass Mason jar trap

** Utilized UCCE 4-hole flat black painted PVC trap

*** Average is for in-town traps only.

n/a = data not taken

Extension Activity

ADDITIONS TO THE SAN DIEGO EYE GNAT RESEARCH AND EDUCATION PROJECT
WEB SITE (<http://ucanr.org/eyegnats>)

2011 County Eye Gnat Report Research Report, 2011

Eye Gnat Research and Education Symposium, 2012

Eye Gnat BMPs

EYE GNAT PRESENTATIONS AND PUBLICATIONS

Bethke, J. A., Vander Mey, A., and I. DeBonis. Final Report: San Diego County Eye Gnat Research and Education Project 2011. In fulfillment of San Diego County Contract #532716. 36pgs. Available online: <http://ucanr.org/eyegnatshttp://cesandiego.ucanr.edu/files/142469.pdf>

Bethke, J. A. 2012. Best Management Practices: Eye Gnat Control on Organic Farms, San Diego County Eye Gnat Research and Education Project, Department of Environmental Health, San Diego County, CA. 17pp. Online:
http://www.sdcounty.ca.gov/deh/pests/pdf/Eye_Gnats/6_Best_Management_Practices_103112.pdf

San Diego County Eye Gnat Research and Education Symposium 2012

Sponsored by University of California Cooperative Extension, San Diego County Department of Environmental Health, and the Department of Entomology at UC Riverside

Presentations and videos are available online:

[HTTP://CESANDIEGO.UCANR.EDU/FLORICULTURE -
NURSERY/SAN DIEGO COUNTY EYE GNAT RESEARCH AND EDUCATION PROJEC
T/](http://cesandiego.ucanr.edu/floriculture_-_nursery/san_diego_county_eye_gnat_research_and_education_project/)

SELECTED REFERENCES

- Bethke, J. A., B. Vander Mey, T. P. Salmon, & V. J. Mellano. 2008. Biology and Control of the Eye Gnat *Liohippelates collusor*. Final Report San Diego County Eye Gnat Research and Education Project 2008, County Contract #523836. 29pgs.
- Bethke, J. A., B. Vander Mey and I. DeBonis. 2009. Biology and Control of the Eye Gnat *Liohippelates collusor*. Final Report: San Diego County Eye Gnat Research and Education Project 2009. County Contract #532716.
- Bethke, J. A., B. Vander Mey and I. DeBonis. 2010. Biology and Control of the Eye Gnat *Liohippelates collusor*. Final Report: San Diego County Eye Gnat Research and Education Project 2010. County Contract #532716 Amendment #1.
- Bethke, J. A., Vander Mey, A., and I. DeBonis. 2011. Final Report: San Diego County Eye Gnat Research and Education Project 2011. In fulfillment of San Diego County Contract #532716. 36pgs.
- Mulla, M. S. 1962. The breeding niches of *Hippelates* gnats. Ann. Ent. Soc. Amer. 55(4): 389-393.
- Mulla, M. S. 1963. An ecological basis for suppression of *Hippelates* eye gnats. Journal of Economic Entomology. 56(6): 768

APPENDIX I

Photo Images

Figure 1. Components used to make improved collar traps. Bait jar, 3-inch PVC collar with $\frac{3}{4}$ inch holes, plastic champagne glass, 3-inch drainage pipe used to connect 32-ounce pinch grip plastic container.



Figure 2. Assembled collar trap.



Figure 3. Emergence trap showing glass mason jar used for collecting the insects.



Figure 4. Emergence traps set up in quads on turf. A collar trap was placed in the middle to catch adult eye gnats in that area.



Figure 5. Emergence traps placed in Orfilia grapevine row.



Figure 6. Location of emergence traps in Escondido, CA.



Figure 7. Grid showing location and trap ID# of collar traps in Escondido, CA. The colors represent the average number of gnats per trap averaged over the four months sampled. Green = 1-27, Yellow = 28-55, Orange = 56-83, Red = 84-110.

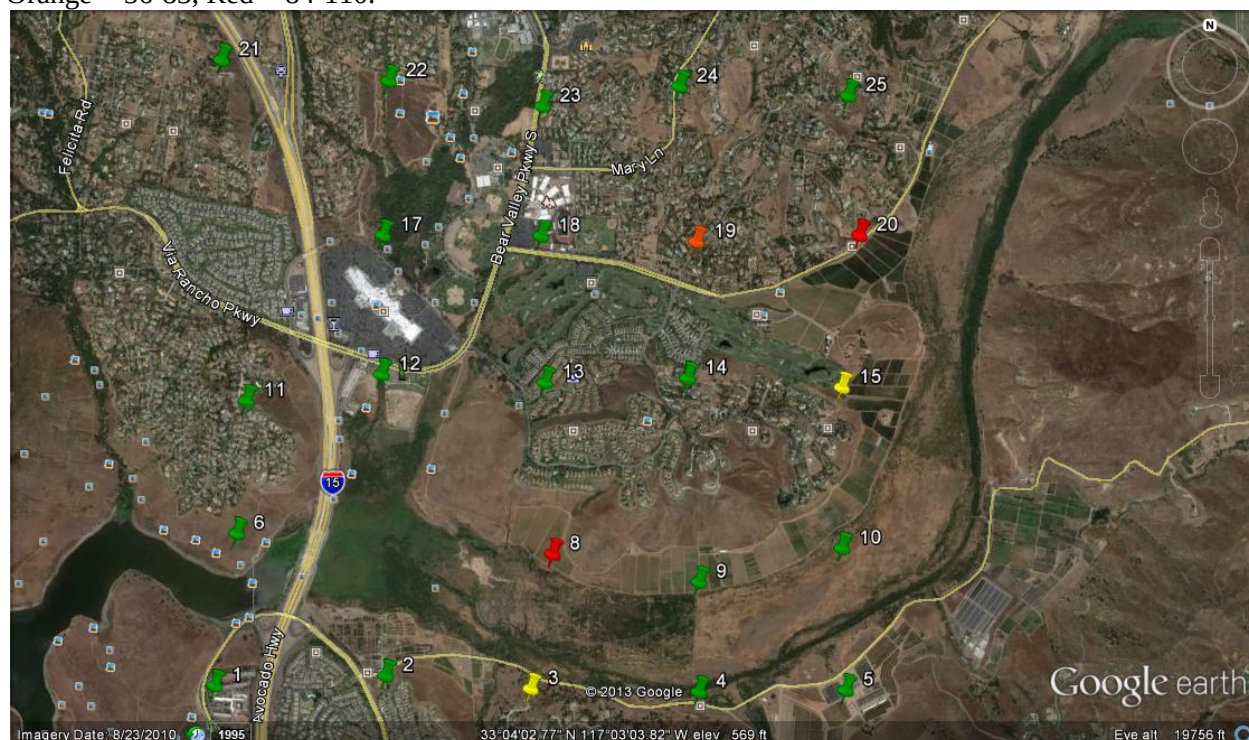
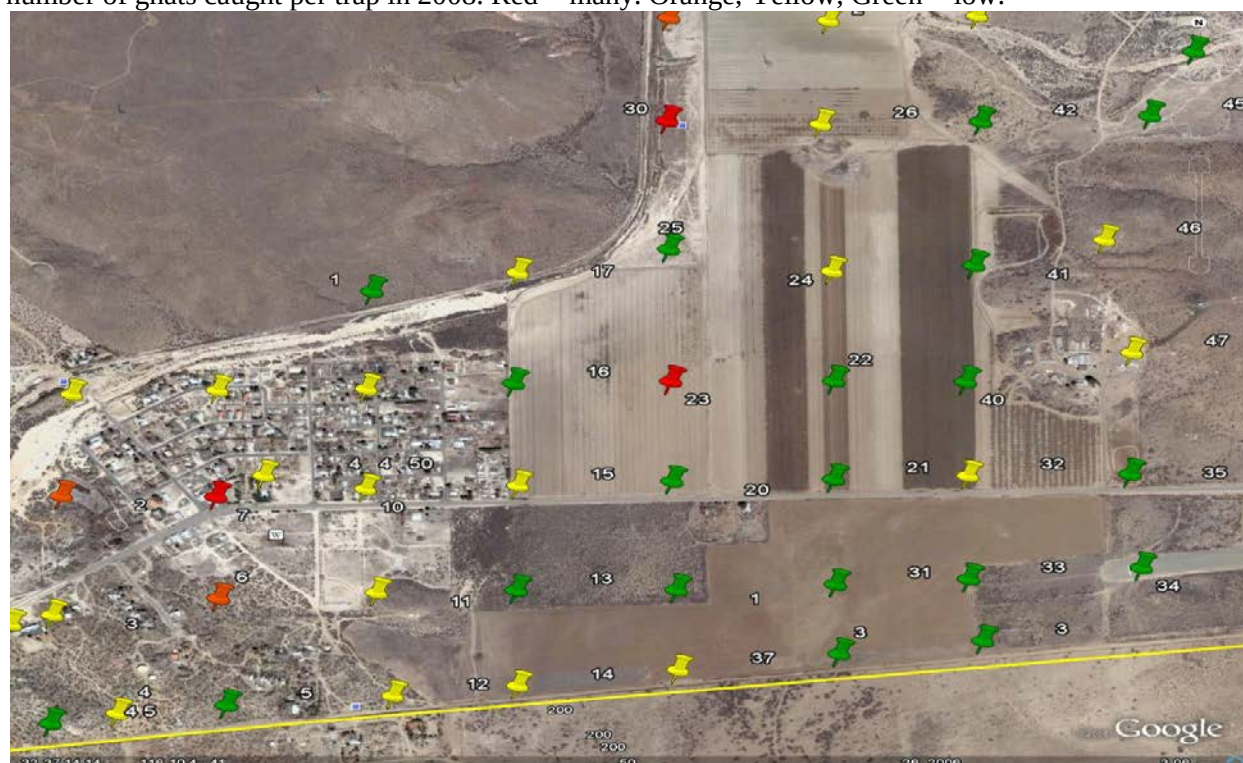


Figure 8. Grid showing location and trap ID# of collar traps in Jacumba, CA. Colors represent relative number of gnats caught per trap in 2008. Red = many. Orange, Yellow, Green = low.



APPENDIX II

2012 VISITS TO ESCONDIDO

May 3 – Set up emergence and collar traps at The Vineyard Golf Course
May 10 – Collect gnats from traps
May 16 – Collect gnats from traps
May 23 – Collect gnats from traps
May 30 – Collect gnats from traps and move emergence cages to Kit Carson
June 1 – Check traps
June 7 – Collect gnats from traps
June 13 – Collect gnats from traps
June 19 – Collect gnats from traps
June 25 – Set up emergence traps at Lake Hodges and collect gnats
July 3 – Collect gnats from traps and set up bait test
July 5 – Collect bait test
July 11 – Collect gnats from traps and set up bait test
July 13 – Collect bait test
July 17 – Collect gnats from collar traps
July 19 – Set up grid trial
July 20 – Pickup grid trial
July 24 – Collect gnats from traps
July 25 – Collect gnats from traps
August 1 – Collect gnats from traps and set up bait test, set up emergence at winery
August 3 – Collect gnats from bait test
August 8 – Collect gnats from traps and set up bait test
August 10 – Collect gnats from bait test
August 15 – Collect gnats from traps and set up bait test, pick up emergence cages
August 17 – Collect gnats from bait test
August 20-24 – Collect gnats from grid trial every day
August 28 – Set up bait test
August 30 – Collect gnats from bait test
September 5 – Collect gnats and set up bait test
September 7 – Pick up bait test
September 12 – Collect gnats from traps and set new bait test
September 14 – Pick up bait test
September 17-21 – Collect gnats from grid traps
September 24 – Collect gnats from grid traps
October 2 – Collect gnats from traps
October 9 – Collect gnats from traps and set up bait test
October 12 – Pick up bait test
October 18 – Collect gnats from traps
October 22-26 – Collect gnats from grid trial once a day

APPENDIX III

Weather for Escondido, CA

Daily Report

Rendered in English Units.

May 1, 2012 - October 31, 2012

Printed on February 14, 2013

Escondido SPV - South Coast Valleys - Station 153. This station is located at the San Diego Zoo Safari Park approx. 2.5 miles NW of farm.

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
05/01/2012	0.06	0.01	248	14.7	64.9	55.1	59.2	95	74	85	54.8	4.4	107.2	64.4
05/02/2012	0.06	0.00	240	14.0	66.8	55.3	58.8	91	68	83	53.6	3.1	74.7	63.8
05/03/2012	0.14	0.00	456	14.3	71.0	55.5	60.9	90	61	79	54.2	4.1	99.3	63.9
05/04/2012	0.20	0.00	632	14.2	75.5	47.0	61.5	93	53	76	53.9	3.7	90.5	64.9
05/05/2012	0.20	0.00	625	13.4	76.6	46.9	60.1	93	50	76	52.4	4.1	100.2	65.5
05/06/2012	0.17	0.00	530	13.4	74.2	44.9	58.3	95	55	80	52.3	4.5	107.7	65.4
05/07/2012	0.19	0.00	582	13.9	79.1	46.0	60.7	94	51	77	53.4	4.1	98.4	65.6
05/08/2012	0.20	0.00	584	14.6	81.2	48.3	62.9	94	47	75	54.7	3.9	93.5	66.3
05/09/2012	0.23	0.00	643	13.7	82.9	42.1	62.4	96	40	71	52.9	4.1	98.1	66.6
05/10/2012	0.21	0.00	623	14.6	77.4	49.3	62.1	94	52	77	54.7	4.8	115.3	67.4
05/11/2012	0.22	0.00	635	13.4	76.3	53.0	62.6	89	47	69	52.4	5.3	127.5	68.0
05/12/2012	0.22	0.00	647	13.9	82.6	50.5	63.6	92	38	69	53.3	4.5	107.9	68.6
05/13/2012	0.19	0.00	574	14.5	82.3	49.0	62.0	93	44	76	54.4	3.7	89.4	68.9
05/14/2012	0.22	0.00	615	14.1	82.5	48.5	63.6	94	42	70	53.7	4.3	102.7	69.2
05/15/2012	0.25	0.00	685	12.1	82.0	43.8	62.7	94	32	62	49.7	4.7	112.7	69.4
05/16/2012	0.25	0.00	668	13.2	88.5	42.6	65.9	94	32	61	51.8	4.0	97.0	69.7
05/17/2012	0.24	0.00	639	15.4	83.8	48.8	65.1	94	47	73	56.1	5.9 Y	141.6 Y	70.8
05/18/2012	0.22	0.00	625	13.2	76.9	53.7	63.2	88	42	67	51.8	5.6	135.2	71.6
05/19/2012	0.22	0.00	619	14.6	82.6	53.3	64.5	89	40	70	54.7	5.2	125.3	71.6
05/20/2012	0.24	0.00	655	15.8	86.2	54.2	67.6	91	43	69	56.9	4.3	104.3	72.4
05/21/2012	0.25	0.22	681	15.3	89.2	48.7	66.0	96	36	70	55.9	4.1	98.9	72.4
05/22/2012	0.24	0.11	661	15.1	83.3	48.1	63.6	97	47	75	55.5	4.9	118.4	71.1
05/23/2012	0.20	0.00	607	15.1	74.6	51.0	61.2	97	60	82	55.6	4.7	113.1	69.4
05/24/2012	0.19	0.00	567	15.0	73.2	57.2	63.8	92	60	74	55.4	4.8	116.1	70.1
05/25/2012	0.07	0.02	238	13.1	65.7	52.5	58.5	90	68	78	51.8	6.0 Y	145.3 Y	69.6
05/26/2012	0.20	0.00	604	10.8	66.3	46.9	57.1	88	52	68	46.6	5.8 Y	138.8 Y	67.9
05/27/2012	0.22	0.00	662	12.3	75.0	44.6	59.8	91	47	70	50.1	4.4	105.5	67.8
05/28/2012	0.24 R	0.00	689	13.9	81.7	45.6	63.6	95	44	69	53.4	3.9	94.7	68.4
05/29/2012	0.25	0.00	702	13.2	80.3	44.3	63.3	96	38	66	51.8	4.2	102.5	69.0
05/30/2012	0.23	0.00	680	14.5	77.8	51.3	63.6	92	53	72	54.5	4.6	111.7	69.7
05/31/2012	0.24	0.00	679	15.7	83.8	52.6	66.3	93	48	71	56.7	4.1	99.0	70.5
Tots/Avg	6.26	0.36	590	14.0	78.2	49.4	62.4	93	49	73	53.5	4.5	108.8	68.4

Escondido SPV - South Coast Valleys - Station 153.

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
06/01/2012	0.23	0.00	689	17.0	82.0	-- S	69.1	95	56	70	58.9	6.3 Y	151.6 Y	72.2
06/02/2012	0.23	0.00	687	15.4	79.7	53.3	63.8	91	54	76	56.2	5.1	122.0	72.8
06/03/2012	0.22	0.00	674	15.9	77.1	57.2	64.8	87	59	76	57.0	5.3	127.1	73.7
06/04/2012	0.18	0.00	584	16.4	72.6	57.1	63.0	97	69	84	58.0	4.9	118.6	74.1
06/05/2012	0.22	0.00	709	15.2	72.4	52.8	62.5	97	58	78	55.7	5.0	119.6	72.2
06/06/2012	0.22	0.00	675	13.5	77.5	45.9	61.7	95	49	72	52.6	3.9	94.9	72.1
06/07/2012	0.24	0.00	693	14.6	80.4	46.7	63.9	95	50	72	54.7	4.0	96.9	72.6
06/08/2012	0.22	0.00	643	15.1	78.0	49.0	61.9	96	58	80	55.6	4.7	113.4	73.2
06/09/2012	0.20	0.00	616	14.6	74.4	49.8	61.0	95	61	80	54.7	4.4	106.7	73.3
06/10/2012	0.21	0.00	648	14.6	74.8	52.6	62.2	92	58	77	54.7	5.0	121.5	74.0
06/11/2012	0.21	0.00	651	15.0	76.7	48.3	61.7	95	60	80	55.4	4.1	99.7	74.4
06/12/2012	0.23	0.00	688	16.5	79.2	54.2	65.3	92	59	78	58.1	4.2	102.4	75.7
06/13/2012	0.21	0.00	621	16.0	79.6	54.8	64.2	92	55	78	57.1	4.4	107.0	76.4
06/14/2012	0.22	0.00	659	15.0	77.5	54.9	64.2	88	55	73	55.5	4.6	110.6	76.9
06/15/2012	0.17	0.00	538	15.1	71.5	58.6	63.1	84	64	77	55.7	4.4	106.7	76.8
06/16/2012	0.23	0.00	675	15.8	79.3	51.7	65.7	93	55	73	56.9	4.1	99.0	77.4
06/17/2012	0.25	0.00	702	15.8	89.8	46.4	67.2	96	39	70	56.9	3.4	82.5	77.7
06/18/2012	0.23	0.00	648	16.8	87.2	53.6	67.6	95	42	73	58.5	3.4	81.8	78.8
06/19/2012	0.24	0.00	693	15.6	82.2	52.4	66.3	93	47	71	56.6	4.3	104.2	79.4
06/20/2012	0.24	0.00	690	14.9	81.1	53.1	66.1	93	46	68	55.3	4.8	116.3	79.4
06/21/2012	0.23	0.00	651	15.2	81.4	53.7	65.5	93	47	71	55.8	4.7	113.1	79.6
06/22/2012	0.25	0.00	676	15.0	84.0	52.7	66.9	93	39	67	55.5	4.8	115.5	79.9
06/23/2012	0.25	0.00	687	14.8	82.2	51.6	66.7	94	40	66	55.0	5.1	123.0	80.0
06/24/2012	0.25	0.00	703	14.4	82.2	49.0	64.4	97	39	70	54.3	4.8	115.7	79.1
06/25/2012	0.25	0.00	694	13.3	82.3	47.6	63.8	97	35	66	52.1	4.8	115.6	75.7
06/26/2012	0.27	0.00	718	11.8	85.0	44.6	64.6	98	24	57	48.9	4.8	114.7	70.8
06/27/2012	0.27 R	0.00	698	12.9	87.0	47.0	67.3	91	27	57	51.4	4.5	107.7	72.3
06/28/2012	0.26	0.00	692	14.7	86.5	50.1	68.2	95	37	62	54.9	4.1	99.0	74.1
06/29/2012	0.27	0.00	713	13.7	87.1	48.6	68.1	96	33	58	53.0	4.2	100.5	75.3
06/30/2012	0.26	0.00	704	14.2	85.8	46.8	66.2	91	42	65	54.0	4.5	109.4	75.9
Tots/Avgs	6.96	0.00	671	15.0	80.5	51.2	64.9	94	49	72	55.3	4.6	109.9	75.5

Escondido SPV - South Coast Valleys - Station 153.

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
07/01/2012	0.24	0.00	678	16.4	80.9	54.3	67.3	93	52	72	57.9	4.7	113.9	77.0
07/02/2012	0.22	0.00	633	16.6	80.3	55.0	66.4	93	56	75	58.3	5.6 Y	134.4 Y	77.9
07/03/2012	0.21	0.00	612	16.3	76.7	55.0	65.7	91	58	76	57.8	4.9	117.8	78.1
07/04/2012	0.20	0.00	599	16.8	75.2	61.2	66.2	87	63	77	58.6	4.9	118.0	78.8
07/05/2012	0.18	0.00	538	16.5	76.9	55.7	65.5	90	61	77	58.1	4.2	101.4	79.0
07/06/2012	0.22	0.00	636	16.5	81.9	51.9	66.1	95	54	75	58.0	3.8	92.4	78.9

07/07/2012	0.23	0.00	638	16.1	85.7	51.5	67.0	95	44	71	57.4	3.4	82.3	79.3
07/08/2012	0.25	0.00	668	15.1	89.5	49.2	69.2	96	36	62	55.7	3.5	84.5	79.6
07/09/2012	0.26 R	0.00	674	15.1	90.0	50.5	71.6	94	32	57	55.5	3.4	81.8	80.2
07/10/2012	0.26 R	0.00	654	16.3	94.9	54.8	73.1	92	30	58	57.7	3.8	90.7	81.0
07/11/2012	0.23	0.00	565	17.5	92.6	56.1	72.4	94	35	64	59.7	4.0	95.4	81.4
07/12/2012	0.06	0.00	214	20.0	87.6	59.2	70.3	96	56	79	63.4	2.5	61.3	80.2
07/13/2012	0.14	0.00	411	21.4	86.6	60.8	71.0	97	55	83	65.5	3.4	81.7	78.5
07/14/2012	0.23	0.00	627	20.5	85.1	61.6	70.8	97	55	80	64.2	4.9	117.5	78.4
07/15/2012	0.22	0.00	625	17.5	80.6	55.7	67.8	91	54	76	59.8	4.7	113.8	78.7
07/16/2012	0.22	0.00	642	15.6	76.5	56.3	65.1	88	56	74	56.6	4.7	112.3	78.2
07/17/2012	0.23	0.00	661	15.4	79.3	53.8	66.3	92	53	70	56.1	4.3	103.8	77.9
07/18/2012	0.23	0.00	609	14.8	86.5	48.7	69.3	95	34	60	55.0	3.7	89.4	77.5
07/19/2012	0.25	0.00	648	16.4	88.2	55.0	71.9	88	43	61	57.8	4.1	100.0	78.2
07/20/2012	0.25 R	0.00	624	18.2	88.9	-- S	77.1	90	38	57	60.9	4.6	109.9	80.0
07/21/2012	0.24	0.00	642	18.8	87.1	56.4	71.4	94	50	72	61.8	4.0	95.6	79.3
07/22/2012	0.23	0.00	629	18.9	85.1	58.9	70.7	93	55	74	62.0	4.3	104.0	79.8
07/23/2012	0.23	0.00	636	18.0	84.2	57.2	69.4	95	48	73	60.4	4.0	97.5	79.8
07/24/2012	0.23	0.00	632	16.6	84.1	53.0	67.2	95	46	73	58.2	3.6	87.2	79.5
07/25/2012	0.23	0.00	637	16.0	85.9	50.8	66.7	95	46	72	57.2	3.9	93.0	79.1
07/26/2012	0.24	0.00	653	15.9	85.7	53.8	68.6	93	40	67	57.1	3.8	92.4	79.3
07/27/2012	0.24	0.00	656	15.6	85.4	52.4	68.3	94	39	66	56.5	4.4	105.3	79.4
07/28/2012	0.25	0.00	660	14.8	88.0	52.8	69.2	93	34	61	55.1	4.1	100.1	79.5
07/29/2012	0.22	0.00	610	16.0	84.0	50.3	66.1	95	42	73	57.2	4.5	108.6	78.8
07/30/2012	0.22	0.00	597	17.8	84.7	55.5	68.5	96	49	75	60.2	4.6	111.5	77.3
07/31/2012	0.19	0.00	510	18.6	86.3	59.9	70.4	97	46	73	61.4	4.4	106.2	75.2
Tots/Avgs	6.85	0.00	607	17.0	84.7	54.9	68.9	93	47	70	58.7	4.2	100.1	78.9

Escondido SPV - South Coast Valleys - Station 153.

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
08/01/2012	0.24	0.00	603	17.2	87.7	57.4	72.3	92	34	64	59.3	4.5	108.3	76.1
08/02/2012	0.24	0.00	614	18.2	85.3	58.0	71.4	93	46	69	60.8	5.0	120.7	76.4
08/03/2012	0.22	0.00	584	17.6	82.0	60.3	68.8	90	53	73	59.8	5.1 Y	122.0 Y	76.3
08/04/2012	0.22	0.00	608	17.8	83.4	58.9	69.5	90	52	72	60.2	4.4	106.3	76.2
08/05/2012	0.21	0.00	585	19.0	86.6	56.6	70.5	93	53	74	62.0	3.6	85.7	76.1
08/06/2012	0.23	0.00	606	20.3	91.8	58.0	74.6	95	47	69	63.9	3.5	85.5	76.5
08/07/2012	0.22 R	0.00	555	20.5	93.4	61.6	76.4	93	43	66	64.2	3.8	92.7	77.1
08/08/2012	0.24 R	0.00	605	20.2	94.8	61.3	77.1	92	42	64	63.8	3.5	85.3	77.3
08/09/2012	0.23	0.00	577	20.7	92.4	61.0	77.0	92	43	65	64.4	3.6	86.4	77.5
08/10/2012	0.24	0.00	596	22.1	96.2	64.0	78.7	90	42	66	66.4	4.0	96.0	77.8
08/11/2012	0.24	0.00	578	21.3	94.7	64.3	78.6	91	41	64	65.3	3.8	92.9	78.2
08/12/2012	0.22	0.00	545	21.4	97.0	64.6	79.4	90	42	62	65.4	3.4	81.5	78.5
08/13/2012	0.22 R	0.00	555	21.1	96.2	64.1	79.0	88	41	62	65.0	3.3	80.5	78.8
08/14/2012	0.24	0.00	604	19.9	95.1	60.8	77.1	93	41	63	63.3	3.5	83.5	78.8
08/15/2012	0.20	0.00	523	20.1	89.8	58.1	73.6	92	49	71	63.7	3.6	86.7	78.2
08/16/2012	0.17	0.00	451	20.6	90.4	65.6	75.5	90	49	68	64.3	3.3	79.5	78.0
08/17/2012	0.20	0.00	523	21.6	94.2	63.8	75.7	97	47	71	65.7	4.0	96.6	77.5
08/18/2012	0.23 R	0.00	577	19.5	90.7	63.8	76.2	97	39	63	62.8	3.6	86.6	76.4
08/19/2012	0.22 R	0.00	567	18.5	90.4	62.6	75.7	85	44	61	61.2	3.5	84.9	76.2

08/20/2012	0.22 R	0.00	564	20.7	89.7	61.6	74.7	90	51	70	64.4	4.0	97.6	76.1
08/21/2012	0.20	0.00	543	21.1	86.2	61.3	72.2	94	59	78	65.0	4.4	106.1	76.1
08/22/2012	0.14	0.00	402	20.7	84.0	63.4	70.8	93	64	81	64.5	3.5	85.3	75.8
08/23/2012	0.18	0.00	516	21.8	83.3	65.5	72.4	91	66	80	66.0	4.0	97.6	75.7
08/24/2012	0.14	0.00	579	21.4	77.6	-- S	71.5	92	72	81	65.4	5.3 Y	128.9 Y	76.6
08/25/2012	0.14	0.00	445	19.3	79.8	54.2	67.5	95	65	84	62.5	3.5	85.5	76.4
08/26/2012	0.21	0.00	609	17.3	84.7	55.6	69.0	95	48	71	59.4	3.5	83.5	76.1
08/27/2012	0.22	0.00	590	15.7	91.2	50.8	70.4	96	37	62	56.7	3.0	72.3	75.8
08/28/2012	0.14	0.00	387	17.5	92.7	54.3	72.9	90	43	63	59.7	2.6	61.8	75.6
08/29/2012	0.21	0.00	549	19.1	92.4	57.8	75.2	92	45	64	62.3	3.3	78.8	76.0
08/30/2012	0.21 R	0.00	500	19.8	92.2	63.9	76.4	91	40	64	63.3	3.9	94.8	77.0
08/31/2012	0.24 R	0.00	559	17.3	95.8	59.6	75.7	92	30	57	59.4	3.9	94.4	77.5
Tots/Avg	6.48	0.00	552	19.7	89.7	60.4	74.1	92	47	68	62.9	3.8	91.9	76.9

Escondido SPV - South Coast Valleys - Station 153.

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
09/01/2012	0.25	0.00	584	12.8	96.9	51.8	73.5	91	17	46	51.2	3.9	93.5	77.1
09/02/2012	0.22	0.00	535	12.0	94.1	51.6	71.6	86	18	45	49.4	3.4	82.6	76.3
09/03/2012	0.24	0.00	560	14.1	95.3	53.2	73.6	88	21	50	53.8	3.8	90.6	76.1
09/04/2012	0.21	0.00	513	15.7	97.7	57.2	71.4	96	25	60	56.7	4.0	95.7	76.7
09/05/2012	0.20	0.00	462	15.1	92.7	60.3	72.6	97	21	55	55.6	4.3	103.8	75.5
09/06/2012	0.21 R	0.00	515	15.1	89.8	58.0	73.0	81	27	54	55.6	3.9	95.1	75.2
09/07/2012	0.20	0.00	503	17.6	88.3	58.0	73.1	85	42	63	59.9	3.7	89.6	75.4
09/08/2012	0.19	0.00	482	18.8	90.7	60.1	73.5	86	45	67	61.7	3.6	87.0	75.6
09/09/2012	0.10 R	0.00	281	21.2	89.7	62.6	74.4	91	53	73	65.2	3.1	75.5	75.6
09/10/2012	0.13 R	0.00	379	23.4 Y	86.9	64.9	75.4	90	60	78 Y	68.1 Y	3.0	73.2	76.0
09/11/2012	0.02	0.00	128	22.8 Y	76.2	67.5	71.0	92	79	88 Y	67.2 Y	3.7	89.5	76.4
09/12/2012	0.15	0.00	421	22.4 Y	87.2	63.8	73.1	93	60	80 Y	66.8 Y	3.1	76.0	76.2
09/13/2012	0.18	0.00	491	21.9 Y	91.1	61.3	74.9	92	48	74 Y	66.1 Y	2.9	70.8	76.4
09/14/2012	0.27	0.00	525	12.9	99.9	55.0	78.4	95	14	39	51.3	5.4 Y	131.1 Y	75.4
09/15/2012	0.25	0.00	530	11.3	98.4	59.5	78.8	71	16	34	47.8	4.5	108.4	74.1
09/16/2012	0.19	0.00	509	15.0	91.0	52.0	70.4	87	35	59	55.4	3.5	83.4	73.1
09/17/2012	0.18	0.00	494	17.6	86.2	55.9	69.2	94	49	72	59.8	3.2	76.1	72.9
09/18/2012	0.16	0.00	472	17.3	85.7	53.0	67.9	94	47	74	59.3	3.0	73.3	72.6
09/19/2012	0.17 R	0.00	491	17.2	88.2	51.8	69.0	94	44	71	59.3	2.7	66.4	72.3
09/20/2012	0.18 R	0.00	485	18.0	91.5	52.7	71.0	94	42	70	60.6	2.8	68.5	72.1
09/21/2012	0.15 R	0.00	427	19.7	84.5	56.4	68.9	94	59	82	63.1	3.0	72.3	72.6
09/22/2012	0.11 R	0.00	364	20.0	86.2	57.8	66.3	97	51	91	63.5	2.4	58.6	72.8
09/23/2012	0.16 R	0.00	459	17.3	97.4	55.0	70.3	98	33	68	59.4	2.3	56.4	71.9
09/24/2012	0.18	0.00	475	15.2	87.1	51.6	68.0	91	42	65	55.8	3.3	79.1	71.0
09/25/2012	0.16 R	0.00	469	15.5	80.4	47.0	63.2	95	57	78	56.4	3.4	82.1	69.9
09/26/2012	0.15	0.00	451	16.8	81.8	55.7	66.0	95	52	77	58.6	3.4	81.4	69.7
09/27/2012	0.16	0.00	457	17.2	86.0	52.5	67.4	95	48	75	59.3	3.0	73.5	69.7
09/28/2012	0.16	0.00	457	16.5	88.2	51.5	68.1	96	41	70	58.0	3.0	73.1	69.8
09/29/2012	0.16	0.00	431	15.3	87.7	51.6	68.1	94	37	65	56.0	2.8	67.5	69.4
09/30/2012	0.17 R	0.07	455	15.1	92.3	50.1	70.3	94	30	60	55.6	2.7	65.9	69.1
Tots/Avg	5.26	0.07	460	17.0	89.6	56.0	71.1	92	40	66	58.5	3.4	81.3	73.6

Escondido SPV - South Coast Valleys - Station 153.

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
10/01/2012	0.17 R	0.08	457	15.6	98.5 Y	49.3	71.3	93	32	60	56.6	2.3	56.5	69.0
10/02/2012	0.18 R	0.13	452	14.7	95.5	47.8	70.0	95	28	58	54.8	2.6	62.5	69.0
10/03/2012	0.17 R	0.31	451	14.6	90.2	48.7	67.8	92	35	63	54.8	2.7	64.0	68.6
10/04/2012	0.13	0.26	402	16.3	81.2	49.8	63.6	96	55	81	57.7	3.2	76.7	68.6
10/05/2012	0.12	0.37	384	16.0	79.7	51.2	64.1	96	57	79	57.2	3.7	89.8	68.1
10/06/2012	0.12	0.17 H	353	15.6	83.0	49.5	63.8	96	49	77	56.5	3.1	73.8	67.7
10/07/2012	0.14	0.24	413	16.2	81.7	50.1	64.2	95	53	79	57.5	3.2	77.2	67.6
10/08/2012	0.11	0.05	354	17.3	81.2	56.8	65.5	94	57	81	59.4	3.8	91.3	67.9
10/09/2012	0.12	0.00 R	374	16.3	78.9	32.0 Y	66.8	92	47	72	57.7	4.6	111.9	68.7
10/10/2012	0.12	0.00	365	14.9	76.3	53.4	63.3	93	51	75	55.2	4.1	98.1	68.3
10/11/2012	0.06	0.19	230	13.8	67.0	51.3	57.1	96	66	87	53.1	3.2	76.4	67.7
10/12/2012	0.07	0.11	253	13.6	70.2	50.5	58.4	97	54	82	52.7	3.4	81.8	66.4
10/13/2012	0.13	0.00	428	13.5	78.9	46.5	61.2	94	42	73	52.5	2.9	69.9	66.0
10/14/2012	0.16	0.00	431	12.8	91.9	44.5	66.3	97	29	58	51.2	3.1	74.1	66.8
10/15/2012	0.17	0.00	434	12.5	90.7	48.1	67.8	91	26	54	50.4	3.3	80.5	67.6
10/16/2012	0.15	0.00	428	13.6	91.9	49.1	64.7	97	26	65	52.7	2.8	66.9	67.9
10/17/2012	0.21 R	0.00	419	10.2	99.1 Y	48.3	74.3	98	12	35	45.1	4.5	108.4	66.1
10/18/2012	0.08	0.00	225	17.5	77.0	56.0	67.6	93	53	76	59.7	4.4	105.7	67.0
10/19/2012	0.12	0.00	401	17.3	79.6	49.5	65.0	96	59	82	59.4	3.4	83.1	67.2
10/20/2012	0.01	0.00	92	18.0	70.9	60.4	64.0	94	75	89	60.6	2.9	70.8	68.3
10/21/2012	0.05	0.05	200	17.2	71.1	59.5	62.8	96	70	88	59.2	2.7	64.6	68.2
10/22/2012	0.07	0.01	273	15.5	70.4	55.4	61.2	96	66	84	56.4	3.3	78.6	68.4
10/23/2012	0.07	0.00	265	12.9	67.4	50.5	57.5	93	64	80	51.3	3.1	75.9	67.4
10/24/2012	0.11	0.00	381	12.2	71.9	46.9	57.9	93	53	75	49.9	3.3	80.4	66.3
10/25/2012	0.12	0.00	390	10.6	76.9	41.6	58.0	92	41	64	46.0	3.0	73.0	65.6
10/26/2012	0.23	0.00	402	5.4	84.5	40.8	70.6	90	14	21	28.8	7.6 R	183.1 R	65.2
10/27/2012	0.14	0.00	400	7.7	86.3	37.4 Y	60.3	79	22	43	37.8	2.8	68.3	64.8
10/28/2012	0.14	0.00	395	7.7	83.8	38.6	59.6	83	23	44	37.8	2.7	66.0	64.4
10/29/2012	0.13	0.00	385	8.9	83.1	40.1	58.9	80	28	52	41.4	2.6	63.3	64.1
10/30/2012	0.12 R	0.00	379	10.5	80.4	37.4 Y	56.8	92	35	66	45.7	2.5	59.5	63.9
10/31/2012	0.10 R	0.00	368	12.3	73.6	37.9 Y	55.5	96	56	82	50.1	3.0	73.4	63.5
Tots/Avg	3.82	1.97	361	13.6	81.1	47.7	63.4	93	44	69	51.9	3.3	80.8	67.0

Flag Legend		
A - Historical Average	I - Ignore	R - Far out of normal range
C or N - Not Collected	M - Missing Data	S - Not in service
H - Hourly Missing or Flagged Data	Q - Related Sensor Missing	Y - Moderately out of range
Conversion Factors		
Ly/day/2.065=W/sq.m	inches * 25.4 = mm	(F-32) * 5/9 = c
mph * 0.447 = m/s	mBars * 0.1 = kPa	--