

UNIVERSITY OF CALIFORNIA, SANTA CRUZ

**Syrphidae: A Guide to Natural History and Identification of Common Genera in Santa Cruz County**

A Senior Project submitted in partial satisfaction of the requirements for the degree of

BACHELOR OF ARTS

in

ENVIRONMENTAL STUDIES

by

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**ABSTRACT:** The Syrphidae (hoverflies) are one of the most biologically diverse taxa in the order Diptera. Hoverflies offer ecosystem services such as pollination, aphid biocontrol, and breaking down decaying organic matter, but the significance for their conservation goes beyond such services. The purpose of this project was to create a resource that helps local naturalists and the wider community develop an interest and awareness of common hoverflies in the Santa Cruz area. I hope this peaks enough curiosity for people to go outside and explore syrphids in their larval and adult homes and subsequently advocate for their conservation. Although a few guides on hoverflies of North America exist, there are none that explicitly cover hoverflies found in California. I used the Randall Morgan Insect Collection to analyze Syrphidae data and determine common genera, host plants, and monthly distributions from 1991-1999. In this guide, I provide a thorough natural and life history of hoverflies, an identification guide to 15 genera, and additional information on plant hosts and times of year when they may be found.

**KEYWORDS:** Hoverflies, Syrphidae, Natural History, Identification, Yearly Distribution, California, Randall Morgan

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# Guide to Syrphidae Genera Found in Santa Cruz County

Tribe: Eristalini

## *Eristalis*

### Description and Identification Features

This genus is commonly represented in the Santa Cruz area. The species in *Eristalis* are often referred to as the drone flies because of their resemblance to male honey bees or drones. They are both broad bodied, have similar coloration, big eyes, and a rounded abdomen. *Eristalis tenax* (Fig. 5a) is recognized as the “cosmopolitan fly” because of its wide distribution throughout the world. The males of *E. tenax* are territorial and aggressive when patrolling for a mate. They behave pugnaciously toward other males and different species. Some will even dart into bumblebees and chase them away from their mating territory. This aggressive behavior often discourages other pollinators from foraging in the same area and could have a negative effect on plant fitness.

*Eristalis* are bulky flies with long, black, brown, and yellow hairs throughout portions of their body. They also display very short hair on the bottom half of the arista. The lack of patterns and markings on the scutum can help differentiate from a similar genus, *Palpada*. A distinguishing feature of this genus is the lack of hair below the posterior spiracle on the metepisternum (Miranda et al., 2013).



Figure 1a. *Eristalis tenax*, a highly abundant, honey bee mimic. From Lloyd Spitalnik 2006.



Figure 5b. *Eristalis arbustorum*, distinguished by white tergal borders. From bugguide.net user iNaturalist/Odophile 2017.

## ***Eristalis* (continued)**

### **Local plants where you could find *Eristalis***

*Eristalis* showed a strong preference for *Baccharis pilularis* or coyote brush. The genus *Eriogonum* was widely noted but naked buckwheat was the flower mostly visited. This plant blooms in the spring, which corresponds with the heightened abundance of *Eristalis* in May. *Ericameria* and the plant CA goldenrod where also highly visited. This plant and coyote brush bloom in the fall which is when *Eristalis* abundance peaked.

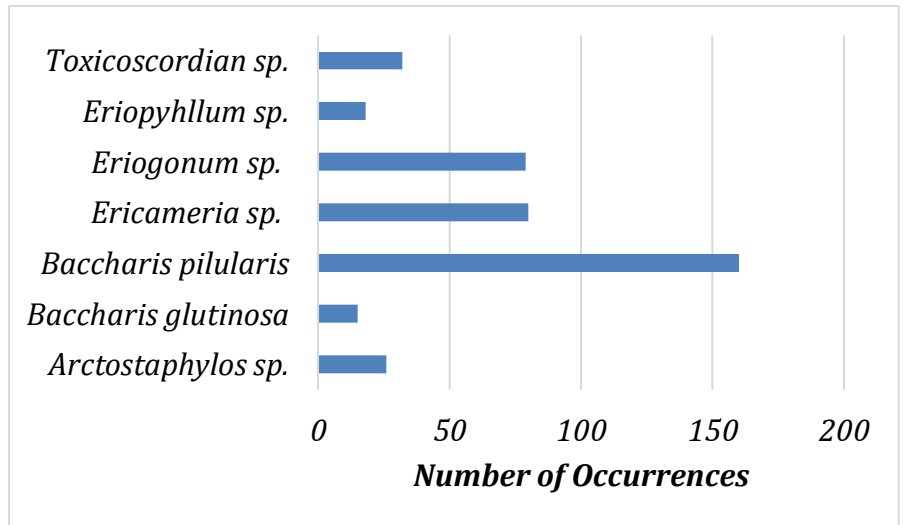


Figure 2. Plant genera and species most visited by *Eristalis* from 1991-1999 in Santa Cruz County.

# Merodon

## Description and Identification Features

The species *Merodon equestris*, or the “Narcissus Bulb Fly” in the genus *Merodon* is the only species in our region and is considered an introduced pest (Miranda et al., 2013, p. 247). This bumblebee mimic lays her eggs at the base of narcissus plants so when larvae emerge they can feed by tunneling through the plant bulb. This species occurs in different color morphs. Some combinations include: black, yellow, and pale yellow as well as a variation of orange and pale yellow (Fig. 7a).

This genus has similar coloration to other genera like *Volucella* but can be distinguished by its concave face with slight swelling directly below the antennal base (Fig. 7c) (Miranda et al., 2013). Additionally, a recessive M1 vein on the wing (Fig. 7b) and a forward-facing triangular plate on the hind femur, can assure the identification of this species.

## Local plants where you could find *Merodon*

Many of the specimen for this genus were not collected from a plant or the plant name was not noted. Flowers this species was recorded on include: two occurrences visiting hairy rock rose, and one occurrence for cut leaf geranium and *Syringa* sp.



Figure 3a. *Merodon equestris*, orange, black, and pale-yellow morph. From bugguide.net user Animal Guy.



Figure 7b. Female *M. equestris* with distinct recessive M1 vein. From University of California Santa Cruz.



Figure 7c. Concave face on *M. equestris*, with slight swelling directly below the antennal base. From Correa 2019.

## ***Sphecomyia***

### **Description and Identification Features**

The species in *Sphecomyia* are outstanding wasp and yellow jacket mimics. *S. vittata* displays long black antennae (Fig. 8a) and are aptly nicknamed the “long-horned yellow jacket fly.” *S. brevicornis* (Fig. 8b) can be distinguished by the somewhat elongated antennae, stripe and lack of yellow, pollen-like dust on the scutellum (Hauser et al., 2019).

The species in this genus have nearly cone shaped, downward projected faces (Fig. 8b). This feature can help distinguish it from *Temnostoma* which is a similar genus but lacks a produced face (Miranda et al., 2013, p. 78). The elongated antennae can also help distinguish it from other yellow jacket mimics which have short antennae. *Sphecomyia* has solid black eyes unlike *Spilomyia*, a similar wasp mimic, which has intricate dotted eye markings.

### **Local plants where you could find *Sphecomyia***

Not many species of this genus are represented in RMIC but, plants where this genus was recorded include: *Arctostaphylos* sp., toyon, and arroyo willow.



Figure 4a. *S. vittata*, distinguished by long black antennae. From Benoit Guenard 2008.



Figure 8b. *S. brevicornis* displaying downward projecting cone-shape face, a distinguishing *Sphecomyia* feature. From Andy Kulikowski 2018.

## *Spilomyia*

### Description and Identification features:

The species in this genus are large wasp mimicking flies with yellow and black abdominal patterns. Not only does this genus look like wasps but they also behave like wasps to fool predators into thinking they're noxious and unpalatable. Similar to the way wasps sway their long antennae, *Spilomyia* rests on its four posterior legs, lifts their darkly colored two front legs, and waves them around to make itself look even more like a wasp (Thompson, 1997). They also wag their wings back and forth to mimic the way wasps beat their wings as a warning signal that they're ready to attack.

The eyes on *Spilomyia* species are a distinctive characteristic which usually display vertical, and irregular stripes or blotches (Fig. 9b). Most species in this genus also have a 'v' mark on the thorax (Fig. 9a). Below the antennal base, the species in this genus have a straight rather than concave or greatly projected face (Miranda et al., 2013). A key feature that distinguishes this genus from similar wasp mimics like *Spehcomyia* and *Temnostoma* is the pre-apical spur found on the hind femur, which other genera lack (Fig. 9c) (Miranda et al. 2013).



Figure 5a. Female *S. interrupta* with distinctive "v" mark on thorax. From bugguide.net user iNaturalist/ Odophile 2018.



Figure 9b. Female *S. interrupta* with distinctive eye markings. From bugguide.net user iNaturalist/ Odophile 2018.



Figure 9c. Distinctive preapical spur found on hind femur of *Spilomyia* species. From Correa 2019

## ***Spilomyia* (continued)**

### **Local plants where you could find *Spilomyia***

The specimen that were collected on a plant visited *Baccharis pilularis* (coyote brush) and *Perideridia kelloggii* (Kellogg's yampah) which both develop white flowers. The former is wind pollinated and the latter is an umbel shaped flower which are both characteristics preferred by most syrphids (Gilbert, 1980).

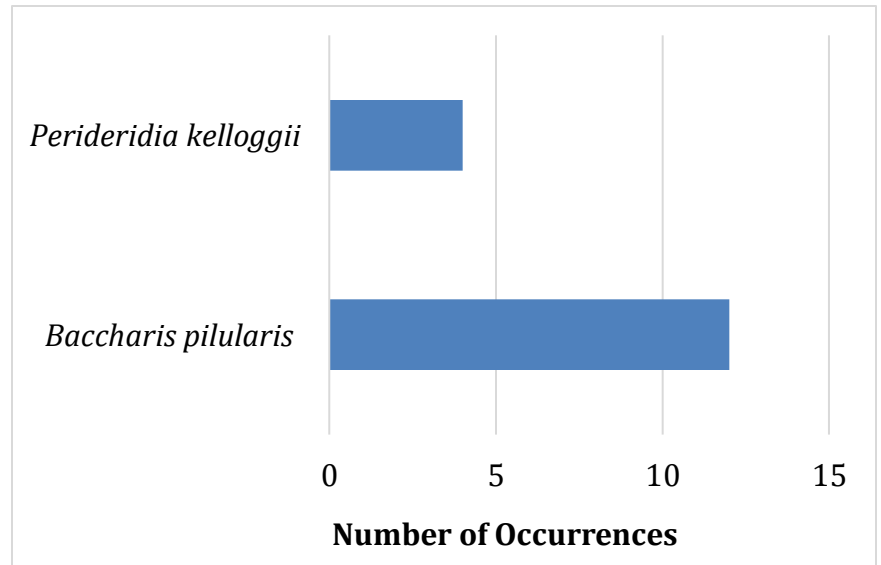


Figure 6. Plant species most visited by *Spilomyia* species from 1991-1999 in Santa Cruz County.

Tribe: Volucellini

## *Copestylum*

### Description and Identification Features

This genus includes species of diverse colors and sizes but all with a similar shape. Some species mimic bumble bee colors and others display a beautiful metallic sheen on their abdomen. Adults can be found on flowers, but larvae tend to develop and feed on decaying organic matter like rotting cacti and are sometimes found in water filled bracts of *Heliconia* plants. (Marcos-Garcia & Perez-Banon, 2001).

Some species in this genus resemble *Volucella* but can be distinguished by their plumose arista, which is the bristle covered in small fine hairs located between the fly's eyes (Fig. 11b). Another distinctive characteristic of this genus is a protruding oral margin under the front of the head. *Ornidia*, another genus with metallic colored species may be similar but *Copestylum* has a wholly microtrichose, or very finely haired wing, and a strongly curved M1 vein (Miranda et al., 2013)

### Local plants where you could find *Copestylum*

Of the six specimens collected in RMIC, five were found on a flower, and four were collected in October. Two of these occurrences were on coyote brush flowers and one occurrence on *Montanoa sp.*, goldenrod, and strawberry tree. Incidentally, during the recent 2018/19 UCSC Grassland Insect Collection, *Copestylum mexicanum* was collected from a male coyote brush flower in October. This may suggest that 28 years later this plant and time of year might still be preferred.



Figure 7a. *Copestylum mexicanum* displaying metallic sheen on thorax and dark base of wings. From bugguide.net user Dvoribird 2016.



Figure 11b. Close up showing plumose arista and protruding oral margin on *C. mexicanum*. From Correa 2019.



## ***Volucella***

### **Description and Identification Features**

The species in this genus are broad bodied robust flies that have an uncanny resemblance to bumble bees. Their great mimicry allows them to enter the nests of bumblebees and lay their eggs. Once the eggs are hatched the larvae feed on dead bees and other decayed matter in the nests (Shepherd et al., 2003).

Their face is anteroventrally produced, or points downward, and long hairs cover the thorax and abdomen (Miranda et al., 2013). A distinguishing feature of this genus is the M1 vein that is strongly curved towards the base of the wing.

### **Local plants where you could find *Volucella***

The plant this specimen was collected from was *Salvia mellifera*, or black sage. This is a great source of honey and is a popular flower among bumble bees as well.



*Figure 8a. Volucella sp. displaying black and yellow colors with long hairs throughout its body. From bugguide.net user Joseph V Higbee 2016.*



*Figure 12b. Volucella bombylans with downward pointing mouth parts and dark colored wings. From Nevin Cullen 2018.*

Tribe: Xylotini

## Syritta

### Description and Identification Features

There are around seventy species of *Syritta* worldwide and two species are found in North America, *S. pipiens* and *S. flaviventris*. The larvae of this genus live in wet decaying organic matter like manure or compost (Balaban et al., 2018a).

*S. pipiens* is known as the “thick-legged hoverfly” and can be recognized by the spiny ridges along the front edge of the hind femur (Fig. 13a) (Miranda et al., 2013). A feature present on some individuals of *Syritta* are two small white spots directly behind the head, on the thorax (Balaban et al., 2018a). This feature is more pronounced on some individuals and more faded on others. Interestingly, one sure way to identify *S. flaviventris* is if it lacks a spurious vein, a feature that distinguishes syrphids from other flies (Miranda et al., 2013). *S. flaviventris* also has a tubercle located at the base of the hind femur which *S. pipiens* lacks.

### Local plants where you could find *Syritta*

The specimen collected from flowers specialized among three abundant plants. There were 11 visitors for *Persicaria sp.* and coyote brush. While naked buckwheat received 12 visitors.



Figure 9a. *Syritta pipiens* with distinctive spiny ridges on the hind femur. From John Lampkin 2016.



Figure 13b. *S. pipiens* displaying two pronounced white spots behind its head, where the thorax begins. From Peter Chen 2010.

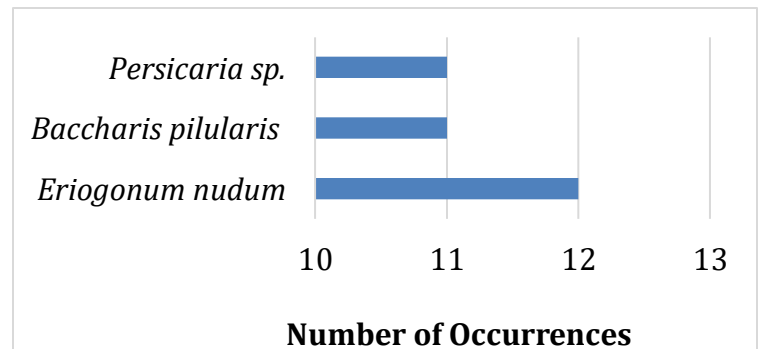


Figure 10. Plant species most visited by *Syritta* species from 1991-1999 in Santa Cruz County.

**Subfamily: Syrphinae**

**Tribe: Syrphini**

## ***Allograpta***

### **Description and Identification Features**

The name *Allograpta* is derived from the phrase “allo” which in Greek means “another kind of strange” and “grapta” which means “marked.” This refers to the unique patterns and markings *Allograpta* species display on their abdomen (Mengual et al., 2009). Most flies in this genus have a skinny and gradually tapered abdomen (Fig. 15b). They also have well developed slightly dense fringe on the subscutellum. This genus can be identified by a combination of characteristics which include: 1) hairless eyes 2) front part of anepisternum is hairless 3) hairless calypter 4) abdomen without pre-marginal sulcus 5) front to middle of metacoxa is hairless 6) metathoracic pleuron hairless (Mengual et al., 2009).

### **How to tell *A. obliqua* from *A. exotica*?**

It can be hard to tell apart *A. exotica* from *A. obliqua* since they both have similar markings on their abdomen. *A. exotica* has a black stripe down the middle of its face while *A. obliqua* face is completely yellow (Hauser, 2013). The katepisternum, located on the lateral surface of the mesothorax, is black and yellow on *A. obliqua*.



Figure 11a. Female *A. obliqua* with hairless calypter. From Gary McDonald 2010.

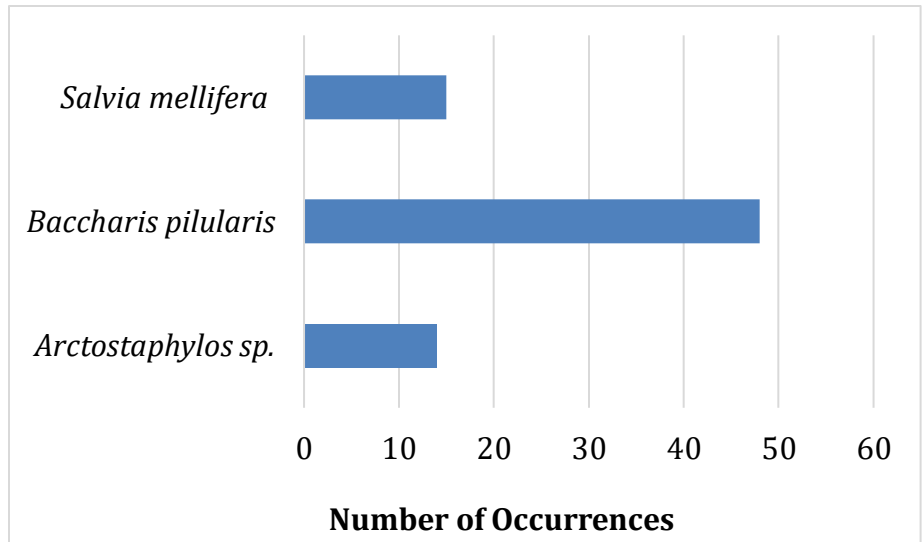


Figure 15b. Female *A. exotica* displaying gradually tapered abdomen with distinctive patterns. From Ken Wolgemuth 2019.

## ***Allograpta* (continued)**

### **Local plants where you could find *Allograpta***

The most visited flower for this genus was coyote brush (*Baccharis pilularis*). Other common plants visited by this genus include: *Salvia Mellifera* or black sage and *Arctostaphylos sp.*



*Figure 12.* Plant species most visited by *Allograpta* species from 1991-1999 in Santa Cruz County.

# Syrphus

## Description and Identification Features

*Syrphus* are medium sized black and yellow flies with yellow bands on the abdomen. Females have an entirely yellow/orange hind femur. These bands vary between individual species and may be completely solid or incomplete. A closer look at the calypter reveals a distinctive feature. The upper surface of the lower calypter is covered in long yellowish white hairs. This feature can help distinguish it from similar genera like *Parasyrphus* which also have complete abdominal

yellow bands but lack the yellow hairs on the calypter (Miranda et al., 2013).

A combination of features distinguishes *S. ribesii* from other species. Generally, this species' face is straight and not produced forward. The length of its face is about as long as its eye height. Their facial tubercle is distinct upward and downward and have a confluent antennal pit in the middle (Mengual et al., 2009). Another distinctive feature of *S. ribesii* are the basal cells on wings that are completely covered with microtrichia (Moisset et al., 2017).



Figure 13a. Basal cells on wings of *S. ribesii* are covered in microtrichia. From Ken Childs 2016.



Figure 17b. Male *S. opinator* with dense, long, and yellowish white hairs on the lower calypters. From Gary McDonald 2009.

## Local plants where you could find Syrphus

Similar to other genera, *Syrphus* mostly preferred Coyote brush and *Arctostaphylos* sp.

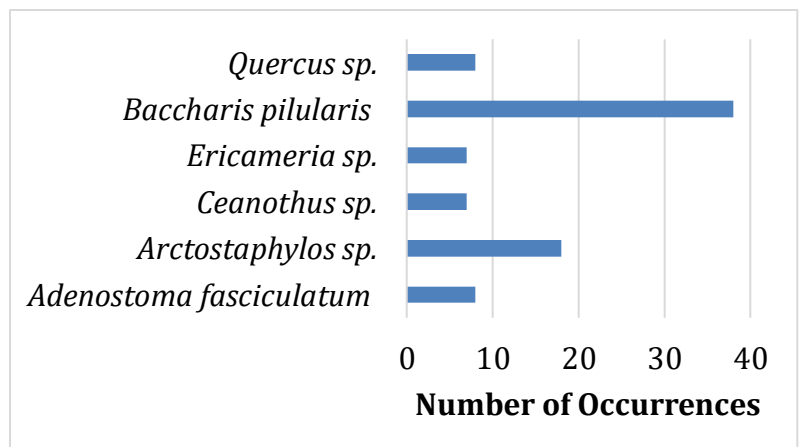


Figure 14. Plant species most visited by *Syrphus* species from 1991-1999 in Santa Cruz County.

## ***Dasysyrphus***

### **Description and Identification Features**

North America hosts 36 of the 43 *Dasysyrphus* species that are currently identified. Larvae are arboreal thus adults are often found in or around forests (Locke & Skevington, 2013). The species in this genus are medium sized, about 5.0 - 11.7 mm, compared to the similar sized genus, *Toxomerus* whose body size range from 5-13 mm (Miranda et al., 2013).

One distinctive feature is the lateral grooves located on tergites 3 and 4. The anterior margin of the bands usually do not reach the tergite margin (Miranda et al., 2013). Other distinguishing features include a combination of visibly hairy eyes, densely microtrichose wings, and a bare metasternum (Miranda et al., 2013).



*Figure 15. Dasysyrphus* sp. displaying lateral grooves that do not completely reach the tergite margin. From Natalie McNear 2009.

### **Local plants where you could find *Dasysyrphus***

Plants this genus was recorded on include: red osier dogwood, false baby star, and Fremont's star lily. The most common habitats were riparian forest and chaparral. Though these plants are all from different families, their flowers have a couple features in common: white color flowers and radial symmetry. This trend can suggest *Dasysyrphus* may have a preference toward flowers with these characteristics.

## ***Lapposyrphus***

### **Description and Identification Features**

There are two species of *Lapposyrphus* in this region, *L. lapponicus*, and *L. aberrantis*. This fly resembles several of the other *Syrphini* tribe members with the black and yellow bands across the abdomen. This genus has broad curved bands across tergite 3 and 4 which sometimes touch and other times are separate.

This genus is similar to *Dasysyrphus* but *Lapposyrphus* displays distinctive bare eyes. Additionally, the R4 + 5 vein appear dipped or bent on *Lapposyrphus* wing can help distinguish from *Eupeodes*. The wings are also densely covered with tiny fine hairs on the top 1/3 of the wing (Miranda et al., 2013, p 92). The species *L. lapponicus* can be differentiated from other species by the yellow line along the margin of tergite 5 (Hauser, 2014).



Figure 16. *L. lapponicus* displaying bare eyes and distinctive yellow line along tergite 5. From bugguide.net user iNaturalist/ Odophile 2010.

### **Local plants where you could find *Lapposyrphus***

The most visited plant by this genus was *Arctostaphylos* sp. with three occurrences. Other plants that were recorded with only one visit included: *Althus* sp., *Ericameria* sp., *Pinus* sp., and *Quercus* sp.

## Scaeva

### Description and Identification Features

This genus is visually similar to other genera like *Eupeodes*. *Scaeva* is generally a bigger size than *Eupeodes* with the former's body size ranging from 11-15.7 mm. *S. pyrastris* is often confused with *E. volucris*. *Scaeva* is differentiated by the dense white hairs on the eyes that resemble a halo (Miranda et al., 2013). *Scaeva* displays sexual dimorphism in their antennae where the female frons are light yellow and narrow while the frons in the male are swollen.

The abdominal markings are similar to other genera in the tribe but one way to tell them apart is the black with narrow, yellow to white, curved bands on tergites three and four (Miranda et al. 2013). These markings are usually uniform in width and unlike genera such as *Lapposyrphus* whose bands sometimes touch, the bands on this genus will never touch. The wings are bare and are actually glossy with very few microtrichia.



Figure 17. Male *S. pyrastris* with distinctive densely haired eyes and separate tergal bands. From Lynn Monroe 2009.

### Local plants where you could find Scaeva

The most visited flower for this genus was *Salvia Mellifera* or black sage which is a plant that tends to bloom starting in winter and spring. Other common plants visited by this genus include: *Lupinus sp.*, California yerba santa (*Eriodictyon californicum*), and coyote brush (*Baccharis pilularis*).

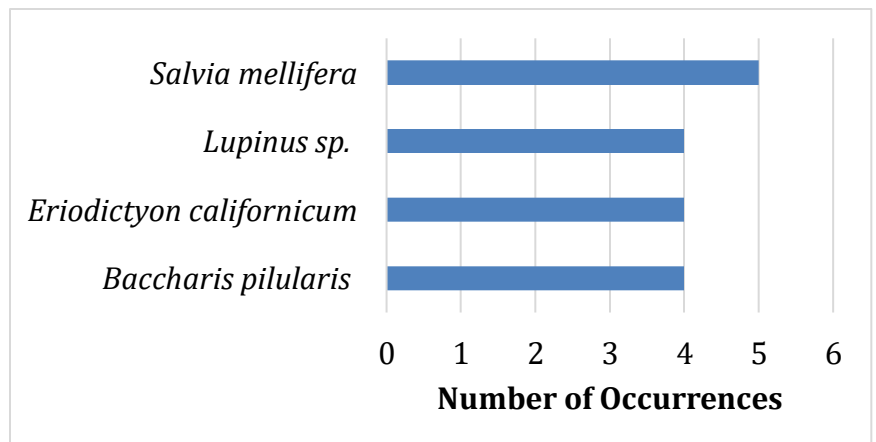


Figure 18. Plant species most visited by *Scaeva* species from 1991-1999 in Santa Cruz County.



## *Sphaerophoria*

### Description and Identification Features

This genus is distinctive because of its elongated abdomen and the bold yellow markings along it. The species *S. contigua* and *S. sulphuripes* are visually similar but could be distinguished by taking a really close look at the thorax. If there is a yellow spot on the anepimeron connected to the katepimeron then it is probably *S. contigua* and if there is no yellow spot between these parts then it is possibly *S. sulphuripes* (Balaban et al., 2018b.).

Male *Sphaerophoria* genitalia is usually large, globose, and parallel to the abdomen (Fig. 23a) (Miranda et al., 2013). The females in this genus (Fig. 23b) resemble species in *Toxomerus* but they lack triangular notches on the eye and distinct abdominal patterns. *Sphaerophoria* can also be characterized by the reduced to no hair under the scutellum and the rectangular 4th abdominal tergite (Miranda et al., 2013).

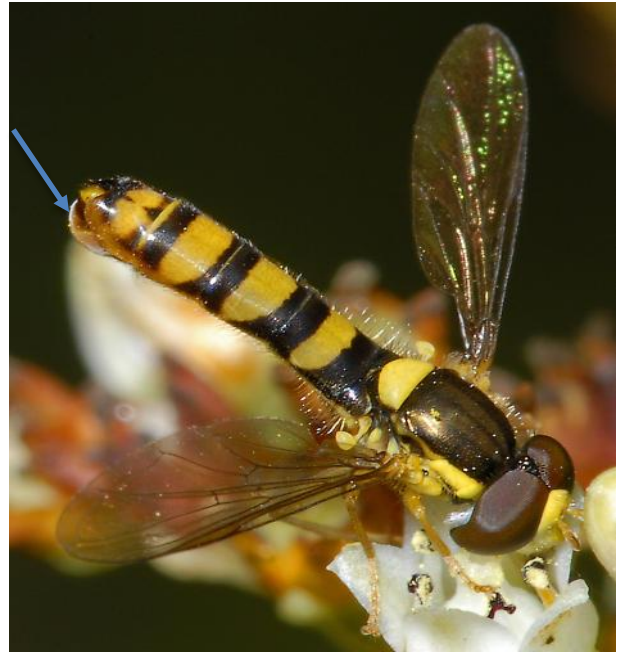


Figure 19a. Male *S. contigua* displaying thin and straight abdomen with globose genitalia. From Gary Mc Donald 2010.



Figure 23b. Female *S. contigua* displaying a darker color morph and broader abdomen. From University of California Santa Cruz.

## ***Sphaerophoria* (continued)**

### **Local plants where you could find *Sphaerophoria***

The specimen that were collected off a plant appeared to prefer yellow and white flowers. The most visited flower was coyote brush (*Baccharis pilularis*), followed by the flower tidy tips (*Layia platyglossa*). Other commonly visited plants in the Santa Cruz county included: telegraph weed (*Heterotheca grandiflora*), hairy gumweed (*Grindelia hirsutula*), and *Ericameria*

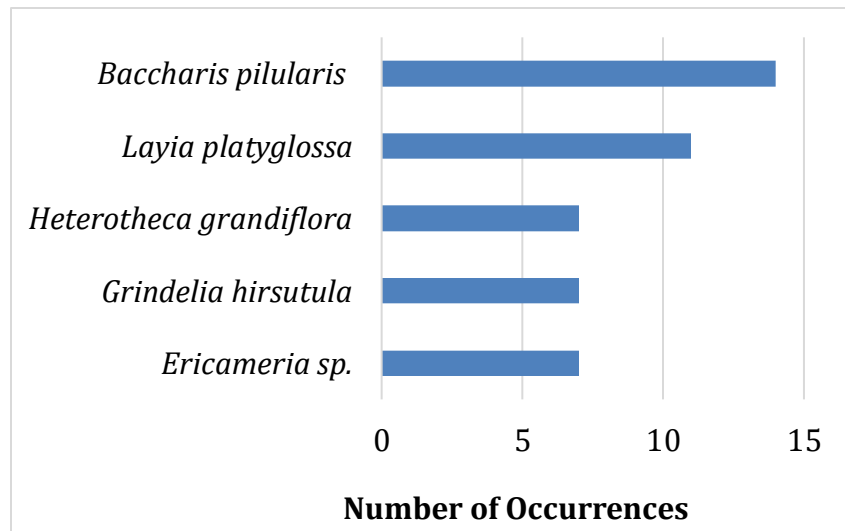


Figure 20. Plant species most visited by *Sphaerophoria* species from 1991-1999 in Santa Cruz County.

sp.

## ***Eupeodes*:**

### **Description and Identification Features**

This genus can be confused with other members of its tribe, Syrphini. The size of *Eupeodes* ranges from 6.3-8.9 mm. Their feet and tibia are red/orange, wings have small irregularly scattered hair, and the eyes are almost hairless (Balaban et al., 2018c). A distinct characteristic from a similar genus like *Syrphus* is the black margined abdomen (Fig. 25b) (Balaban et al., 2018c).

*Eupeodes* has two very similar species *E. volucris* and *E. fumipennis*. The two can be differentiated by *E. volucris*' scutellum which has a yellow margin at the top with mostly short white hair (Balaban et al., 2018c). Individual *E. fumipennis* species are highly variable, some varieties have abdominal markings that meet in the center while others have single yellow bands across each tergite (Miranda et al., 2013). *E. volucris* however, shows no constriction between the two yellow bands.



Figure 21a. *E. volucris*. shows no constriction between yellow bands. From Gary McDonald 2008.



Figure 25b. Male *E. fumipennis* displaying strongly margined abdomen. From Gary McDonald, 2010

### **Local plants where you could find *Eupeodes***

The specimen collected from flowers mostly visited *Arctostaphylos sp.* and most occurrences on Manzanita. Other common plants were coyote brush and Monterey spineflower. This pattern is interesting because many other genera, showed their preferred plant was coyote brush.

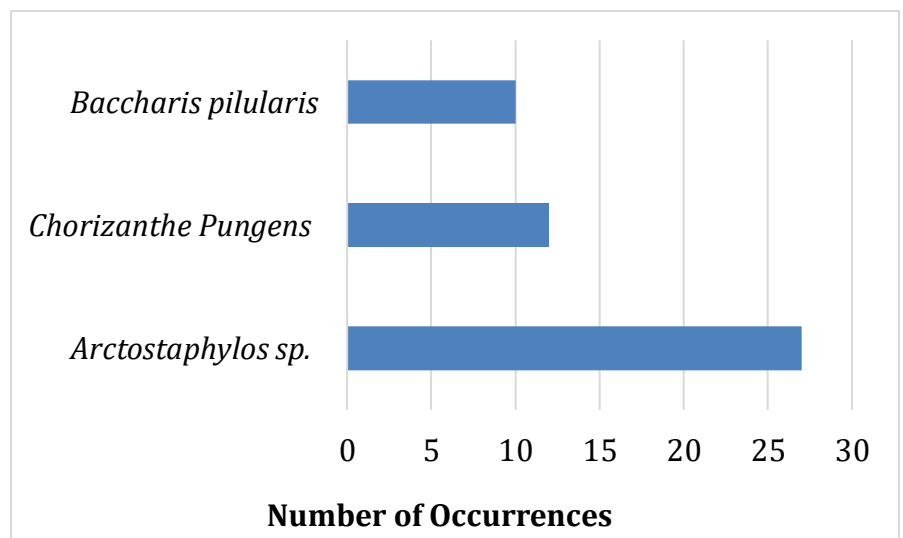


Figure 22. Plant species most visited by *Eupeodes* species from 1991-1999 in Santa Cruz County.

Tribe: *Toxomerini*

## *Toxomerus*

### Description and Identification Features

The species in *Toxomerus* are very small in size and are also quite common. The third, fourth, and fifth tergites usually have a pair of black stripes running down the middle of abdomen that may extend to the lateral sides on some species and for other species it may be mostly yellow with faded black stripes in the middle (Miranda et al., 2013). One very distinct feature that differentiates them from other genera is the triangular notches around their eyes.

*T. marginatus* and *T. occidentalis* are very similar but one sure way of differentiating them is the former has a margin of uninterrupted yellow around the abdomen (Fig. 27a) whereas the abdominal margin for *T. occidentalis* is interrupted yellow and black (Miranda et al., 2013). The scutellum on *T. occidentalis* is black with a yellow margin and the female specimen (Fig. 27b) has a broad abdomen and extended ovipositor.

### Local plants where you could find *Toxomerus*

This genus highly preferred coyote brush flowers, with more than 70 occurrences. Other highly visited plants include the California buttercup (*Ranunculus californicus*) and golden bush (*Ericameria* sp.).



Figure 23a. *T. marginatus*, displaying uninterrupted yellow abdominal margin. From Even Dankowicz 2005.



Figure 27b. Female *T. occidentalis* displaying broad abdomen and extended ovipositor. From Gary McDonald, 2008

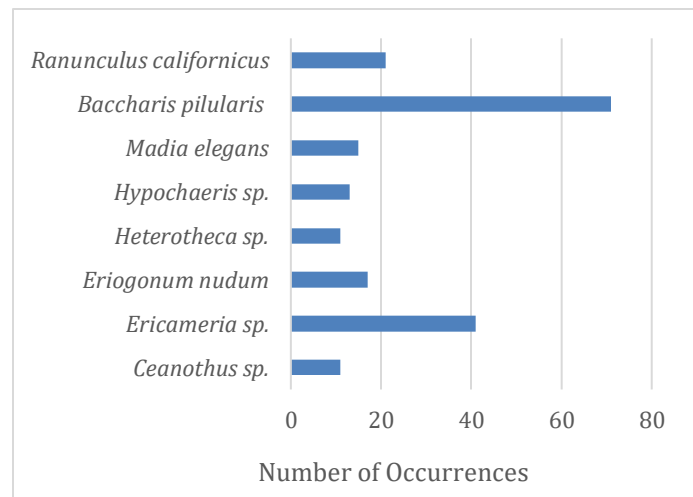


Figure 24. Plant species most visited by *Toxomerus* species from 1991-1999 in Santa Cruz County.

## Syrphidae Occurrences in Santa Cruz County by Month (1991-1999)

### *Eristalis*

In RMIC *Eristalis* is the most abundant and represented genus with over 750 occurrences from 1991-1999. The most abundant species include: *E. tenax*, *E. hirta*, *E. arborustrum*. This genus has a similar distribution to other abundant genera like *Eupeodes* and *Toxomerus*. According to RMIC data, species in *Eristalis* seem to occur year-round but with very few occurrences in

January and December, an increase in May, and the most abundant in August, September, and October. This data can suggest that *Eristalis* species found in this county may prefer the warmer months in late summer and early fall.

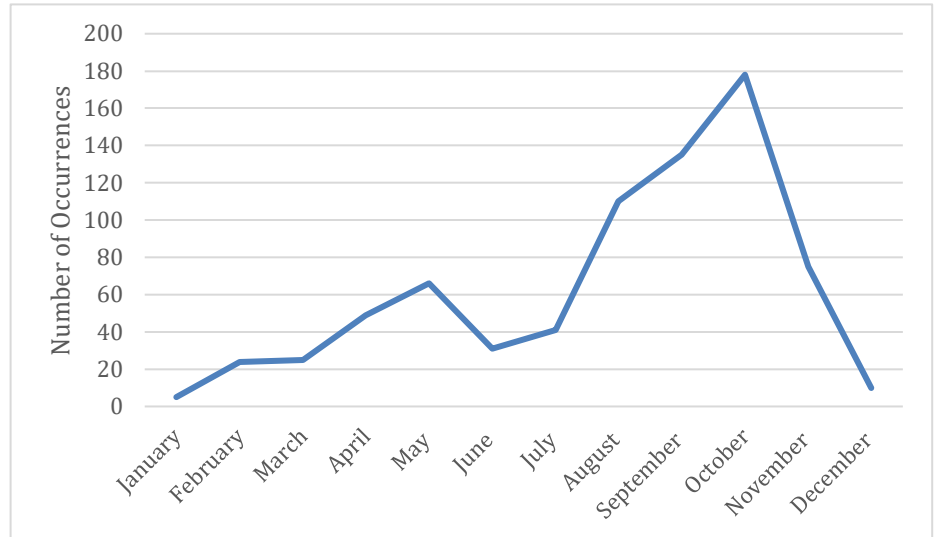


Figure 25. Monthly distribution of *Eristalis* from 1991-1999 in Santa Cruz County.

### *Merodon*

In the RMIC, *Merodon* occurred 26 times throughout the 8 years. They were most abundant March to June, which are the bright and beautiful spring months following the winter rains in Santa Cruz.

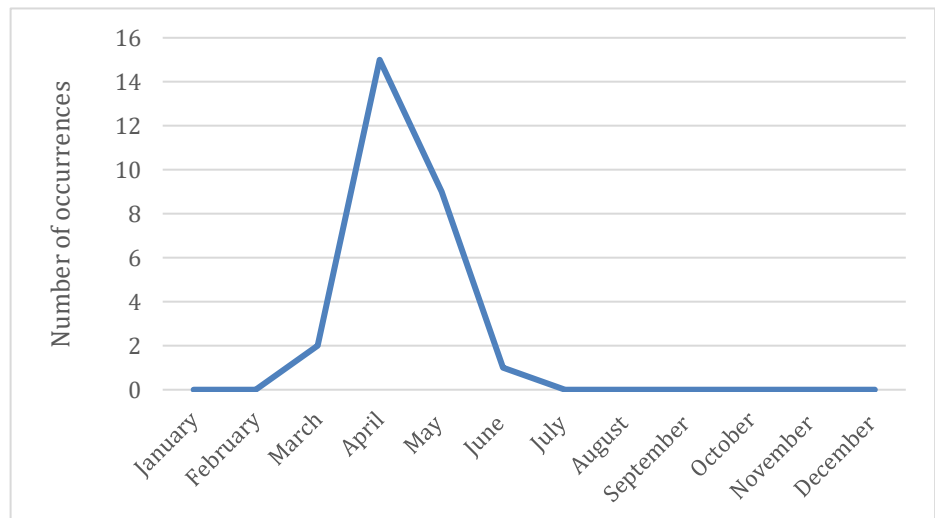


Figure 26. Monthly distribution of *Merodon* from 1991-1999 in Santa Cruz County

### ***Sphecomyia***

In the RMIC this species was only collected on three occasions between 1991-1999. Although we cannot necessarily find conclusive patterns from this data, it is important to note the time of year when the specimen were collected. There were two occurrences in February which is generally

a chillier time of the year and one specimen was collected in April which is the time of year where we start to see the sun again. This genus may be more cold hardy than other genera that do not occur during this time of year.

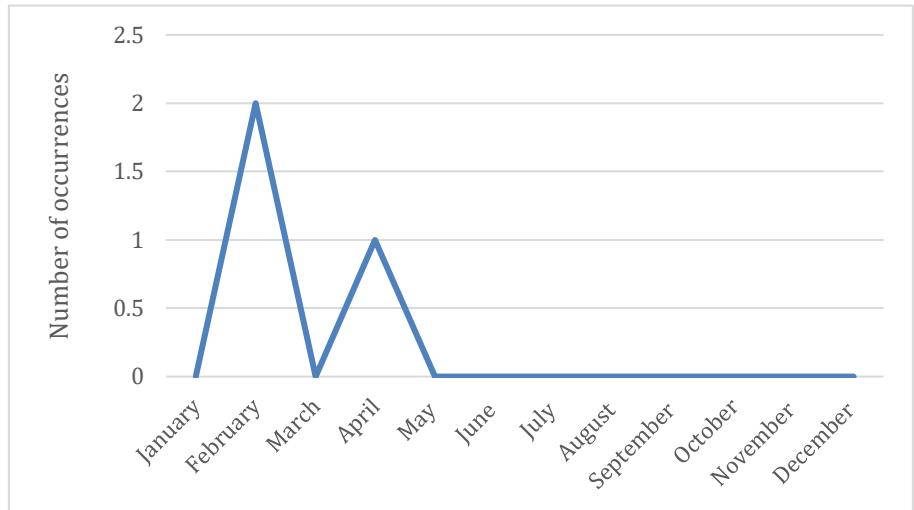


Figure 27. Monthly distribution of *Sphecomyia* from 1991-1999 in Santa Cruz County

### ***Spilomyia***

In the RMIC *Spilomyia* was collected 25 times throughout this eight-year period from 1991-1999. Most of these occurred during Santa Cruz's warmer months towards the end of July and the entirety of August and September. The numbers decline in October which is around the time temperatures start to drop.

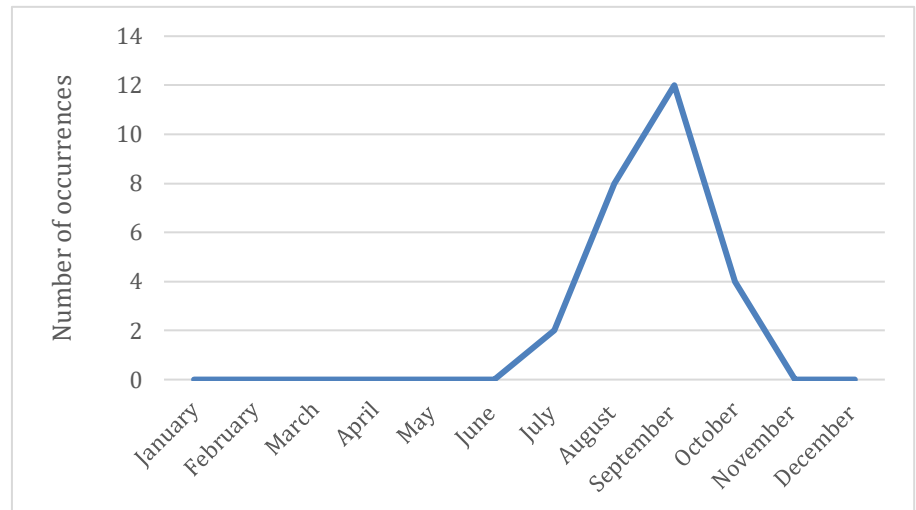


Figure 28. Monthly distribution of *Spilomyia* from 1991-1999 in Santa Cruz County

### ***Copestylum***

In the RMIC data we see six occurrences throughout the eight years of the collection. One happened in September, four in October, and one in November. The highest abundance in October can suggest a preference towards this time of the year.

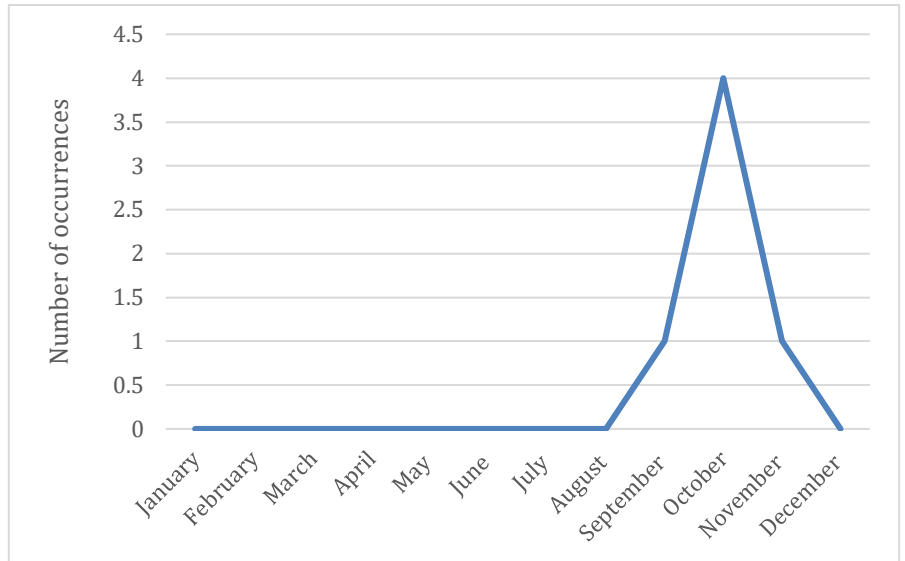


Figure 29. Monthly distribution of *Copestylum* from 1991-1999 in Santa Cruz County

### ***Volucella***

The RMIC data represents over eight years of collecting, but there is only one record of a *Volucella* species. This occurred in March (1995) which is a time of year where abundant genera like *Eristalis* and *Eupeodes* are not as plentiful.

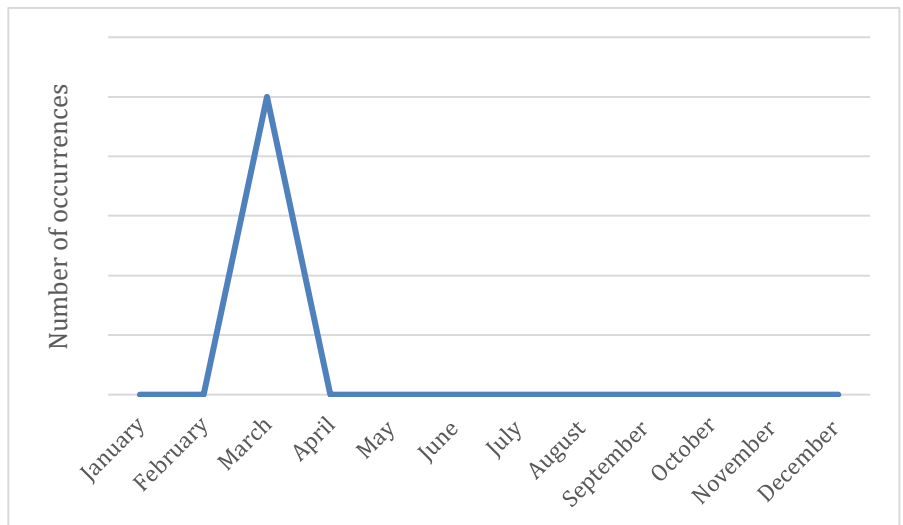


Figure 30. Monthly distribution of *Volucella* from 1991-1999 in Santa Cruz County

## Syritta

In the RMIC *Syritta* represents 112 occurrences throughout the eight years. The most abundance is concentrated from July to October with the highest frequencies in August and September. These are generally the warmest months of the year in the Santa Cruz area.

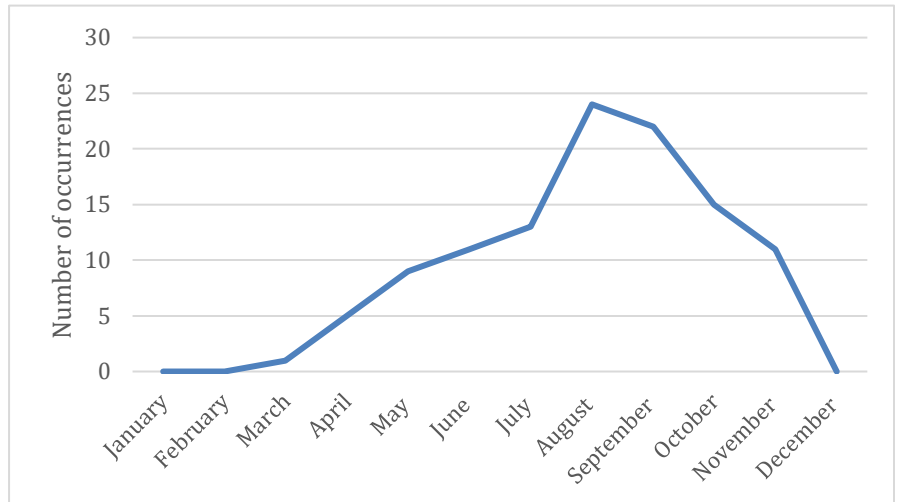


Figure 31. Monthly distribution of *Syritta* from 1991-1999 in Santa Cruz County

## Allograpta

RMIC represents ~175 occurrences of *Allograpta* from 1991-1999. The most abundant species included: *A. obliqua* and *A. exotica*. After the peak abundance in February, there was a strong decline until the exponential growth in July. The longest period with high frequencies begins in September and carries on through November which is a trend seen in other genera as well.

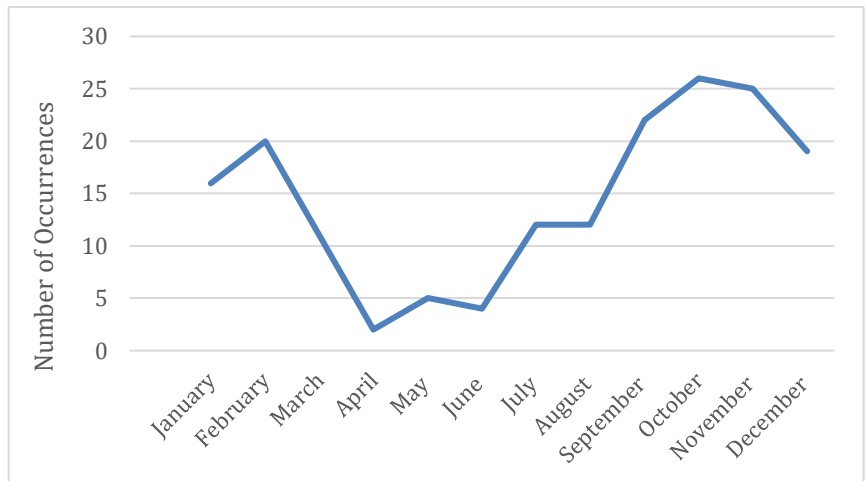


Figure 32. Monthly distribution of *Allograpta* from 1991-1999 in Santa Cruz County



## ***Syrphus***

RMIC represents 182 occurrences of the genus *Syrphus* and mostly the species *S. ribesii* and *S. opinator*. The 1991-1999 monthly distribution graph displays an interesting pattern as it peaks in March and November. The high abundance during October, November, December could suggest they prefer lower temperatures.

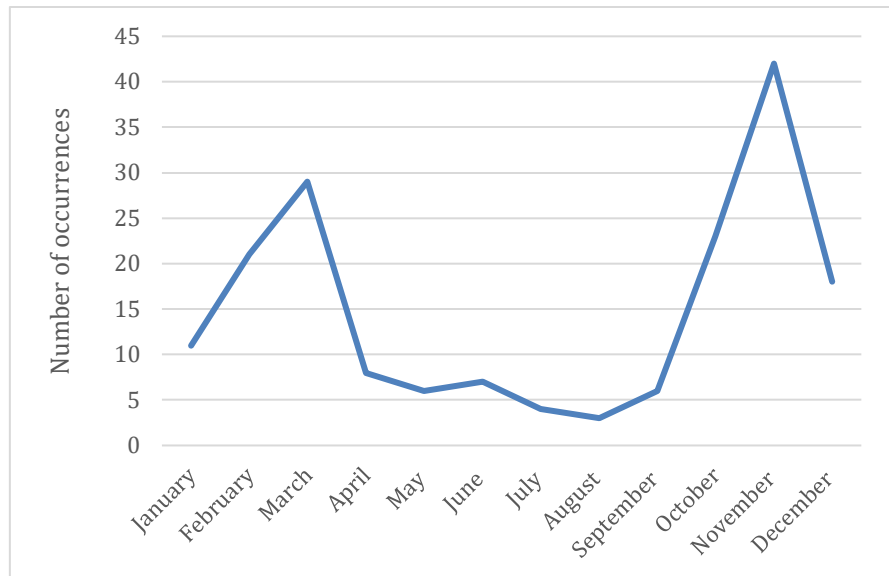


Figure 33. Monthly distribution of *Syrphus* from 1991-1999 in Santa Cruz County

## ***Dasysyrphus***

Though there are only six occurrences of this genus in the RMIC, there is an interesting pattern in the months when these specimens were collected. Two occurrences in April of 1991 and one occurrence in April of 1992 and 1993. Then, in 1995 and 1996 there was one specimen recorded in May of both years. Thus, a lack of abundance does not necessitate a lack of presence, though there were not several flies collected, their presence was noted during the peak of spring blooms.

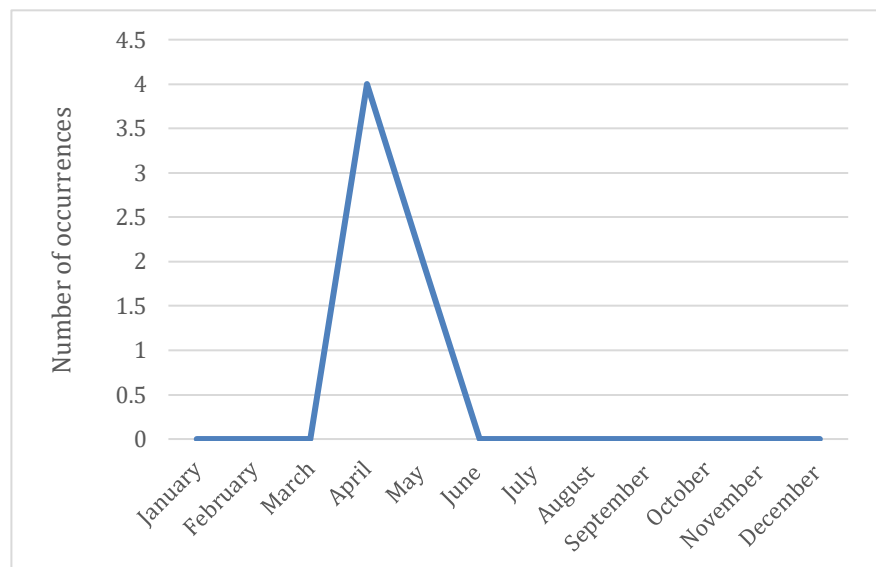


Figure 34. Monthly distribution of *Dasysyrphus* from 1991-1999 in Santa Cruz County

### **Lapposyrphus**

RMIC represents 14 *Lapposyrphus* occurrences. The unusual pattern in the graph is due to the lack of specimen collected in March. There were three collected in January, February, and April. Then, July through October there is a lack of occurrences. This might suggest that *Lapposyrphus* tend to emerge in the earlier half of the year.

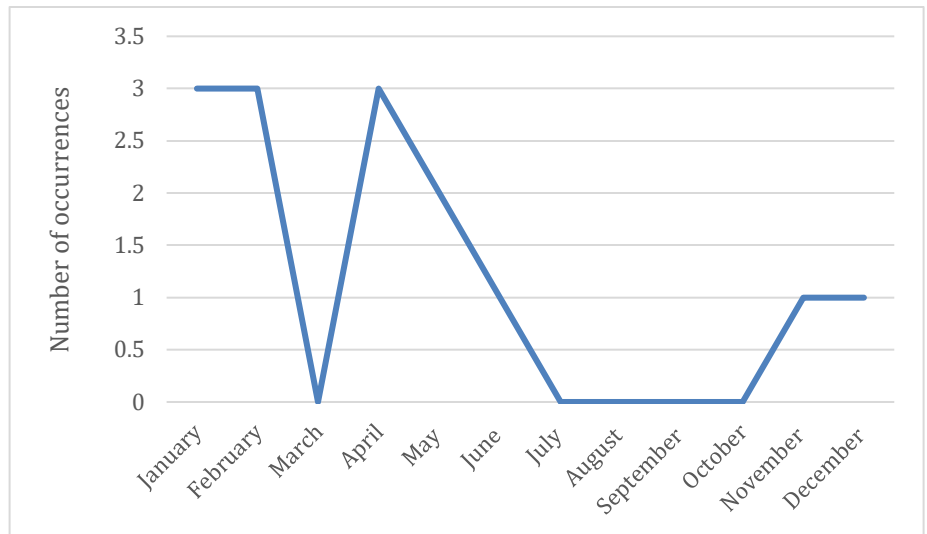


Figure 35. Monthly distribution of *Lapposyrphus* from 1991-1999 in Santa Cruz County

### **Scaeva**

RMIC represents at least one occurrence for each month throughout eight years. Occurrences begin in January and carry on through December. Peak abundance occurred in April and May. After June, *Scaeva* is much less present and clearly shows a drastic decline in numbers.

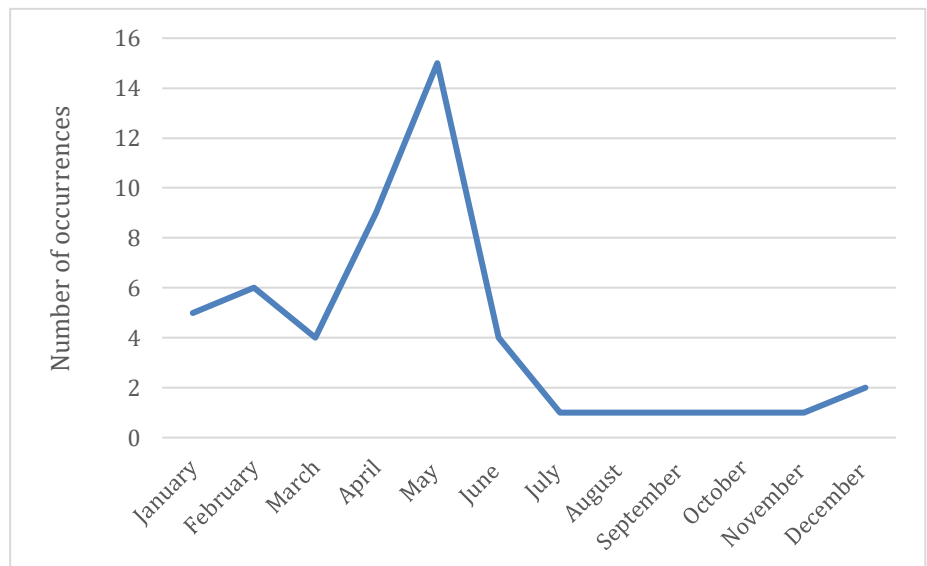


Figure 36. Monthly distribution of *Scaeva* from 1991-1999 in Santa Cruz County

## ***Sphaerophoria***

In the RMIC, *Sphaerophoria* represents a higher abundance than other members of the Syrphini tribe. The graph displays an interesting bell curve shape. This shows there are few to no occurrences in the beginning and ending months of the year, which generally have the lowest temperatures. There is a greater abundance for the months in the middle. March through October hosted the most occurrences with the peak abundance in June.

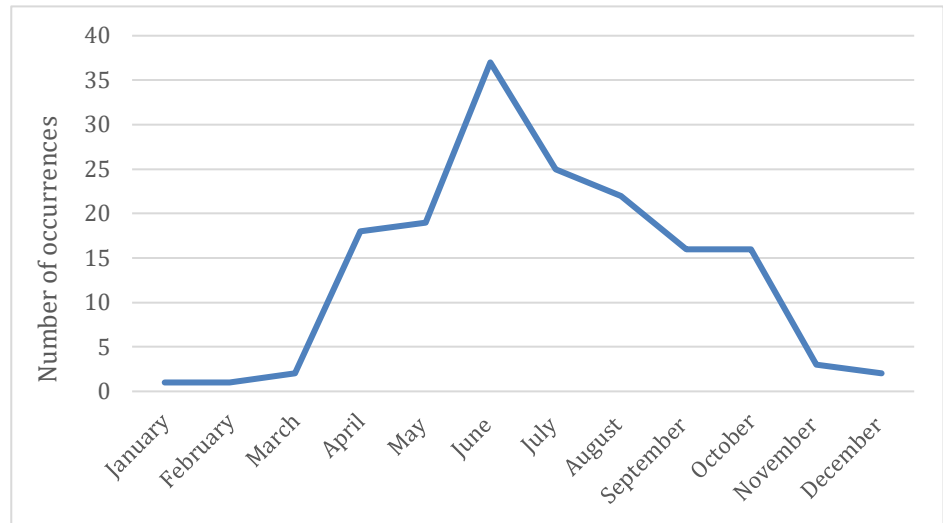


Figure 37. Monthly distribution of *Sphaerophoria* from 1991-1999 in Santa Cruz County

## ***Eupeodes***

*Eupeodes* is widely represented in RMIC, with over 300 occurrences throughout the eight-year sample period. Unlike other highly abundant genera in RMIC, which seem to prefer August- October, *Eupeodes* is not as abundant during this time. Instead, this genus seems to prefer January- July with a peak in May. There is a strong decrease in abundance from July to September and then the numbers pick up in November and December.

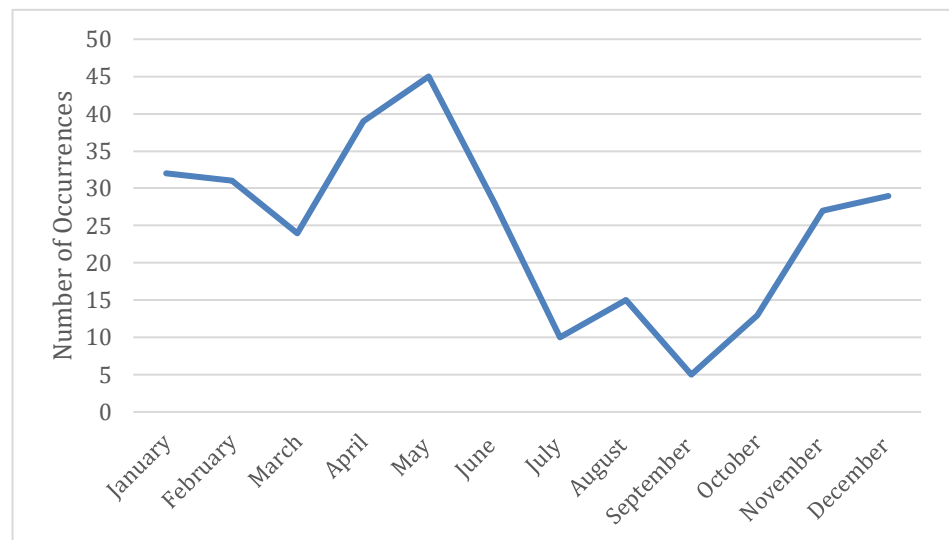


Figure 38. Monthly distribution of *Eupeodes* from 1991-1999 in Santa Cruz County

### ***Toxomerus***

*Toxomerus*, the second most abundant genus in RMIC represents over 430 occurrences. This genus is not very present in December and January but has a steady population throughout February and August. Similar to the most abundant genus, *Eristalis*, *Toxomerus* also has a peak abundance in October.

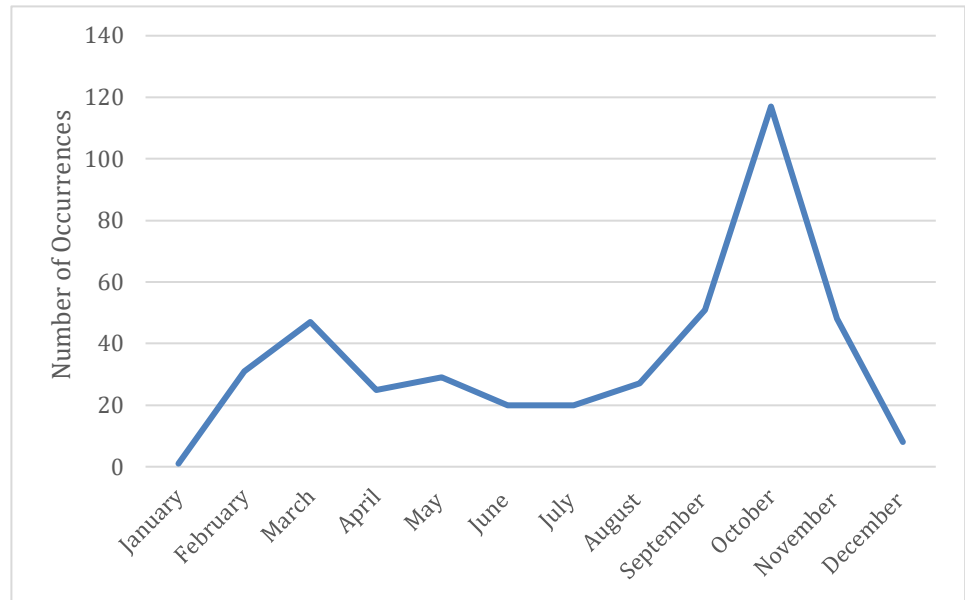


Figure 39. Monthly distribution of *Toxomerus* from 1991-1999 in Santa Cruz County

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