

**FORENSIC ENTOMOLOGY INVESTIGATIONS
REPORT OF DIAGNOSTIC LABORATORY EXAMINATION**

Name: Caylee Anthony -- Missing Person

Case #: 08-069208; FEI #:1187 (A)

Sex: Female

Age: 2

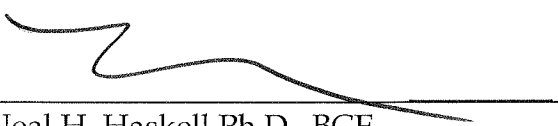
Date: August 28, 2008.

Requesting Agency: ASL/CSI Michael Vincent, Orange County Sheriff's Office, 2500 West Colonial Drive, Orlando, FL 32804, (407) 254-7122, ext. 70680.

Participating Entomologist: Dr. Neal H. Haskell

SUMMARY OF CONCLUSIONS

The presence of large numbers of larvae, puparia and some adults of Diptera: Phoridae; *Megaselia scalaris* a species of scuttle fly/coffin fly recovered from the trunk of the Pontiac Sunbird and from inside the white plastic trash bag with blue handles indicates the presences of sufficient decompositional material to attract significant numbers of this species. The presence of a leg from Diptera: Calliphoridae (blow fly) supports this finding. The phorid flies are attracted to remains which have passed into more advanced decomposition than when the Calliphoridae, the first insect group attracted to decomposition are known to arrive. Due to the hot temperatures prevailing over the period from June 16, 2008 through July 31, 2008 decomposition would have progressed very quickly where 4 or more days could be sufficient for decomposition to be exhibiting advanced purging of fluids with tissue breakdown. The car was found abandoned on June 27, 2008 at an Amscot store and impounded on June 30, 2008. Thus, any decomposing carrion would have been most likely removed between June 20 and June 27, 2008.



Neal H. Haskell Ph.D., BCE

Date 9/22/08

Forensic Entomology Investigations; Dr. Neal H. Haskell, 425 Kannal Ave. Rensselaer, Indiana 47978
Phones: (219) 866-7824, (219) 866-3460

10453

Name: **Caylee Anthony -- Missing person**

Investigating Officers: ASL/CSI Michael Vincent, Sgt. John Allen, Detective Corporal Yurimelich, Orange County Sheriff's Office and Special Agent Nick Savage from the FBI.

Collected by: Michael Vincent

Delivered to Haskell Laboratory by: Federal Express #861909041256 on September 10, 2008 and Federal Express #861909041212 on October 8, 2008.

SAMPLES SUBMITTED:

Sample #1 - 8/28/08 (1100) - Preserved larvae (ETOH) from trash bag in trunk of car. Rec. 9/10/08

Sample #2 - 8/28/08 (1100) - Puparia (dry) from trash bag in vehicle. Rec. 9/10/08

Sample #3 -- 8/28/08 - From sealed evidence box, Rec. 10/8/08; processed 10/11/08 to 10/17/08 and divided into the following samples:

Sample #1a - 8/28/08 - Insects and insect parts from trash bag in trunk of car.

Sample #2a - 8/28/08 - From trash bag in trunk of car.

Sample #3a - 8/28/08 - Small botanical from trash bag in trunk of car.

Sample #4a - 8/28/08 - Phorid puparia (eclosed and unclosed) - from trash bag in trunk of car. Into ETOH 10/12/08

Sample #5a - 8/28/08 - From off of paper towels from trash bag in Trunk of car. Examination of the paper towels: The paper towels were gently straightened out from their wadded condition and then specimens shaken from each towel into a white porcelain pan. Examination on 10/17/08. Insect evidence to Sample # 6a. Additional hair and plant material to Sample # 6b.

Sample #6a - 8/28/08 - Many phorid puparia - from off of paper towels from trash bag in trunk of car.

Sample #6b - 8/28/08 -- Plant material and small hairs - from off of paper towels from trash bag in trunk of car.

Hairs

Plant material

ADDITIONAL INFORMATION

- A. Orange County Sheriff's Office Property Form.
- B. Climatological data from Orlando, Florida June 16, 2008 to July 31, 2008

CASE SCENARIO

A white trash bag with blue handles containing paper towels and miscellaneous items was removed from the trunk of a 1998 white Pontiac Sunfire (owned by the mother of the missing child) on July 16, 2008. I (Dr. Neal Haskell, a forensic entomologist) was contacted in September 2008 and asked to evaluate entomological evidence from the trunk of the car and discovered in the plastic trash bag from the trunk of the car.

BACKGROUND AND METHODS

CLIMATOLOGICAL DATA

NATIONAL WEATHER SERVICE STATION DATA (Orlando, FL)

Because the growth of all biological organisms depend on time and energy, degree days can be used to indicate the development time for organisms that can't regulate their body temperature. Forensically, degree days are most often used to determine the development time of calliphorids (blow flies) and other insects. Also, decomposition involves the breakdown of cells by enzymes (called autolysis) and the consumption of tissues by bacteria and fungi (called putrifaction), and both of these processes are temperature dependent (within limits, higher temperatures lead to faster decomposition). Here, the degree day totals provide an indication of potential insect development and of the potential rate of decomposition (Megyesi, et. al. 2005).

Temperature data, the degree day (DD) and accumulated degree day (ADD) are found in Table 1. Calculations on a base temperature of 10° C (DD-B10), and daily temperatures from the national weather service station data were from Orlando, Florida. There is a likely increase in temperature due to solar radiation influence when the car was not shaded during daylight hours. Decomposition is influenced directly by temperature with Table 1 based upon ambient temperatures but due to this solar radiation influence higher temperatures could be expected in the trunk of

the automobile which would provide increases in the degree days which drive the breakdown of the remains while in the car trunk.

The range of time in question is from June 16, 2008, when the victim was last known alive, through June 27, 2008, when the automobile was found abandoned and then placed into impoundment on June 30, 2008.

RESULTS OF EXAMINATION

Sample #1 - 8/28/08 (1100) - Preserved larvae from trash bag in trunk of car (ETOH).

(6) -- larvae (3.5-7.0 mm) -- Diptera: Phoridae

Sample #2 - 8/28/08 (1100) - Puparia (dry) from trash bag in vehicle.

(ca.30) -- puparia (3.5-7.0 mm) -- Diptera: Phoridae (into ETOH 9/10/08)

Sample #3 -- 8/28/08 - From sealed evidence box, processed 10/11/08 and divided into the following samples:

Sample #1a - 8/28/08 - Insects and insect parts from trash bag in trunk of car.

(ca. 15) -- adults (3.5 mm) -- Diptera: Phoridae;

Megaselia scalaris; sent to B. Brown for species confirmation (10/21/08). Received back at FEI lab 10/28/08, Fed Ex.

(ca. 5) -- puparia (3.5 mm) -- Diptera: Phoridae

Sample #2a - 8/28/08 - From trash bag in trunk of car.

Hairs

Large botanical

These items returned to Michael Vincent 10/22/08 Fed. Ex.

Sample #3a - 8/28/08 - Small botanicals from trash bag in trunk of car.

Small Botanical

These items returned to Michael Vincent 10/22/08 Fed. Ex.

Sample #4a - 8/28/08 - Phorid puparia (eclosed and uneclosed) - from trash bag in trunk of car. Specimens into ETOH 10/12/08

(ca. 300+) -- puparia (3.0-4.0 mm) -- Diptera: Phoridae mostly eclosed.

(1) -- puparium (3.5 mm) -- Diptera: Phoridae,
2nd species uneclosed.

Sample #5a – 8/28/08 – From off of paper towels from trash bag in Trunk of car. Examination of the paper towels: The paper towels were gently straightened out from their wadded condition and then specimens shaken from each towel into a white porcelain pan. Examination on 10/17/08. Insect evidence to Sample # 6a. Additional hair and plant material to Sample # 6b.

2 hairs : 1 -- longer and blondish/brownish
 1 -- short curved and dark -- appears to have what looks like a root

These items returned to Michael Vincent 10/22/08 Fed. Ex.

Sample #6a – 8/28/08 – Many phorid puparia – from off of paper towels from trash bag in trunk of car.
 (ca. 100+) -- puparia (3.0-4.0 mm) -- Diptera: Phoridae uneclosed and eclosed.
 (1) -- adult (2.0 mm) -- Diptera: Phoridae w/o abdomen
 (1) -- leg (6.0 mm) -- Diptera: Calliphoridae into minutia vial

Sample #6b – 8/28/08 -- Plant material and small hairs – from off of paper towels from trash bag in trunk of car.

Hairs

Plant material

These items returned to Michael Vincent 10/22/08 Fed. Ex.

* Initial family level identification was conducted by N. Haskell Ph.D., BCE. Specific specimen species identification was finalized by Dr. Brian Brown of the Natural History Museum of Los Angeles, Los Angeles, California.

References

Megyesi, M., S. Nawrocki, N. Haskell. 2005. "Using accumulated degree-days to estimate the postmortem interval from decomposing human remains." J Forensic Sci, No. 3, 50:618-626.

DISCUSSION

Michael Vincent indicated to me that uneclosed and eclosed (hatched) puparia and adult flies were seen in the mother's car trunk during initial entry into the trunk of the car July 16, 2008, and this discovery led to additional searches for insect

evidence. Subsequent insect evidence recovery on August 28, 2008 prompted additional examination of items of physical evidence recovered from the car trunk with Vincent recognizing insect larvae and puparia.

Two vials of specimens were sent for initial evaluation on September 9, 2008. These vials contained only larvae and puparia from the phorid fly family, Phoridae, which is a common group of flies known to colonize decomposing animal carrion and other organic material. If possible, species identification should be obtained for further confirmation of the species preference for animal carrion. With this fly family, it is difficult to render species level identification without having adult specimens of the species available to identify.

Once initial family level identification was complete, Vincent was again contacted to ascertain if adults of the specimens were available. Another search of the car trunk turned up negative results for phorid adults. However, it was Vincent who noted that he had seen hundreds of the larvae and puparia in the trash bag which had been sealed as evidence back in August. This evidence had been secured in tightly wrapped (sealed) packaging and then placed into the evidence locker of the Orange County Sheriff's crime lab. Growth and development of some of the specimens would continue while in the secured box so examination of this physical evidence was undertaken.

The box of evidence ((white plastic bag with blue handles and additional paper toweling (several sheets)) was received at the Forensic Entomological Diagnostic Laboratory of Dr. Neal H. Haskell, Rensselaer, Indiana on October 8, 2008. The plastic bag was searched for adult phorid specimens and successful recovery was made on October 12, 2008 with approximately 15 adult specimens being recovered. These adults were then shipped Fed Ex to Dr. Brian Brown, a phorid fly identification expert for species level determination. Dr. Brown identified the adult specimens as Diptera: Phoridae; *Megaselia scalaris*, a very common species of phorid which comes to animal carrion. It is one of the most common to appear on decomposed tissues in human cases as seen by numerous accounts of its presence in human case studies in the literature. It should be noted that this species can also be found on decaying organic matter from other sources.

When this family is found on decomposing animal carrion, their presence indicates that decomposition is well advanced. Phorid flies, including *Megaselia scalaris*, have a preference for attractant compounds associated with carrion of a week or two, to months, or even years old. One species of this group is known as the coffin fly, because of its ability to find buried remains. Coffin fly larvae may migrate down to as much as six feet underground and access bodies, even if enclosed in a wooden coffin where it will enter the coffin and continue to produce generation after generation as long as the moisture content is high enough. This group is also responsible for colonizing bodies in mausoleums causing a major nuisance if high enough populations are produced. As indicated by this behavior, the coffin fly group is very tenacious at accessing bodies in enclosed and tight confinement. Unlike other carrion groups which have trouble penetrating bodies enclosed by barriers, this fly is

very small (gnat like) and can gain access through the tiniest openings. Thus, a decomposing body in a car trunk is readily accessible to these species.

Since the majority of these specimens were recovered from paper toweling in the plastic garbage bag in the trunk of the car, it is likely that in addition to the decomposition fluids on the carpeting of the trunk of the car, an additional source for attracting these flies would have been fluids on the paper towels themselves. Given the association of towels with the car, it seems most likely that the paper toweling was used in an attempt to clean the decompositional fluids purged from the remains in the trunk of the car during very hot temperatures in mid June. From June 17 to June 20 temperature maximums were over 90°F with trunk temperature well in excess of that. This would lead to body fluid purging in a very short period of time of no more than 3 or 4 days from the time death occurred. The trunk of the car would exclude many of the early occurring carrion insects for an initial period and unless cleaned during darkness, blow flies could access once the car trunk was opened. This seems a likely source of the blow fly leg found in conjunction with the paper toweling in Sample # 6a.

Given (1) the time line when Caylee Anthony was last seen (June 16, 2008), (2) the impounding of the car on June 30, 2008, and (3) the abandonment of the car at Amscot on the 27th of June 2008, it is likely that remains were removed from the car between June 19 and 27. This interpretation is supported by the degree day accumulation needed to initiate purging of fluids (35 to 40 ADDs B10) with hot temperatures driving the decomposition. This 35 to 40 ADD was achieved on June 19, and decompositional fluids (including purge fluid), would have been present thereafter. In addition, I traveled to the Orange County Florida crime lab to inspect the car (specifically the car trunk) in mid-December 2008. Even after nearly 6 months of time passing and with the trunk carpet liner removed, strong decompositional odor was still present.

The presence of large numbers of phorids implies that the decomposing tissue in the trunk was accessible (not in a sealed container). If the decomposing tissue were a human body, given the high temperatures it would likely have proceeded to the bloat stage during this interval (June 19 through 27), and considerable loss of fluids would have resulted. Because evidence of large amounts of decompositional grease (as would be associated with post-bloat stage decomposition) was not observed in the trunk, the most likely interpretation is that the body was removed after purging occurred but before decomposition proceeded to post-bloat. These conditions imply that remains were removed earlier in this earlier interval (June 19-22) rather than later (June 23-27).

Therefore, the presence of large numbers of larvae, puparia and some adults of Diptera: Phoridae; *Megaselia scalaris* a species of scuttle fly/coffin fly recovered from the trunk of the Pontiac Sunbird and from inside the white plastic trash bag with blue handles indicates the presences of sufficient decompositional material to attract significant numbers of this species. The presence of a leg from Diptera: Calliphoridae (blow fly) supports this finding. The phorid flies are attracted to remains which have

passed into more advanced decomposition than when the Calliphoridae, the first insect group attracted to decomposition are known to arrive. Due to the hot temperatures prevailing over the period from June 16, 2008 through July 31, 2008 decomposition would have progressed very quickly where 4 or more days could be sufficient for decomposition to be exhibiting advanced purging of fluids with tissue breakdown. The car was found abandoned on June 27, 2008 at an Amscot store and impounded on June 30, 2008. Thus, any decomposing carrion would have most likely been removed between June 20 and June 27, 2008.

Peer Review of Findings

This report was peer reviewed by board certified forensic entomologists Dr. Leon G. Higley, Professor of Entomology and Forensic Science, Univ. of Nebraska-Lincoln, D-ABFE and by Dr. Ralph E. Williams, Professor of Entomology, Purdue Univ., D-ABFE. Their peer reviews were for the confirmation of standard forensic entomology protocols, procedures, and analytical methods recognized by the forensic entomology community. This peer review process of forensic science reports was recommended by the National Academy of Science during their evaluations of forensic science practices employed by the forensic science community in court proceedings. Additionally, Drs. Higley and Williams were present in the laboratory during sample preparation and initial insect identifications to assist with evidence handling, specimen curation, and record keeping.

Cayley Anthony
08-06920: FEI 1187

Daily Max/Min Temperatures from June 16, 2008 to July 31, 2008
NWS Station Orlando, Florida

Date	Temperatures		Daily Mean °F	Temperatures		DD-B10	ADD-B10	
	Max °F	Min °F		Max °C	Min °C			
6/16/08	90	73	81.5	32.2	22.8	17.5	17.5	last seen 1300
6/17/08	91	73	82.0	32.8	22.8	17.8	35.3	Tony
6/18/08	91	72	81.5	32.8	22.2	17.5	52.8	Tony car shovel
6/19/08	91	72	81.5	32.8	22.2	17.5	70.3	boy friend no phone act.
6/20/08	93	73	83.0	33.9	22.8	18.3	88.6	out of gas boy f. rt side trunk open
6/21/08	86	71	78.5	30.0	21.7	15.8	104.5	
6/22/08	86	72	79.0	30.0	22.2	16.1	120.6	
6/23/08	91	71	81.0	32.8	21.7	17.2	137.8	dad abt gas cans
6/24/08	91	73	82.0	32.8	22.8	17.8	155.6	
6/25/08	91	73	82.0	32.8	22.8	17.8	173.4	
6/26/08	89	71	80.0	31.7	21.7	16.7	190.0	
6/27/08	91	73	82.0	32.8	22.8	17.8	207.8	text abt hitting anim car at Amscot
6/28/08	93	73	83.0	33.9	22.8	18.3	226.1	car at Amscot
6/29/08	93	72	82.5	33.9	22.2	18.1	244.2	car at Amscot
6/30/08	91	73	82.0	32.8	22.8	17.8	262.0	car towed
7/1/08	99	71	85.0	37.2	21.7	19.4	281.4	
7/2/08	89	71	80.0	31.7	21.7	16.7	298.1	
7/3/08	89	73	81.0	31.7	22.8	17.2	315.3	
7/4/08	89	73	81.0	31.7	22.8	17.2	332.5	
7/5/08	91	73	82.0	32.8	22.8	17.8	350.3	
7/6/08	91	73	82.0	32.8	22.8	17.8	368.1	
7/7/08	89	73	81.0	31.7	22.8	17.2	385.3	
7/8/08	90	73	81.5	32.2	22.8	17.5	402.8	
7/9/08	90	73	81.5	32.2	22.8	17.5	420.3	
7/10/08	93	75	84.0	33.9	23.9	18.9	439.2	
7/11/08	93	73	83.0	33.9	22.8	18.3	457.6	
7/12/08	89	75	82.0	31.7	23.9	17.8	475.3	
7/13/08	84	73	78.5	28.9	22.8	15.8	491.2	
7/14/08	91	73	82.0	32.8	22.8	17.8	509.0	
7/15/08	88	75	81.5	31.1	23.9	17.5	526.5	Dad 911 trashbags to dumpster
7/16/08	84	75	79.5	28.9	23.9	16.4	542.8	Bags out evid. 2300
7/17/08	88	73	80.5	31.1	22.8	16.9	559.8	Cad dogs hit on trunk
7/18/08	91	75	83.0	32.8	23.9	18.3	578.1	
7/19/08	93	75	84.0	33.9	23.9	18.9	597.0	
7/20/08	95	75	85.0	35.0	23.9	19.4	616.5	
7/21/08	96	78	87.0	35.6	25.6	20.6	637.0	
7/22/08	91	75	83.0	32.8	23.9	18.3	655.4	
7/23/08	90	73	81.5	32.2	22.8	17.5	672.9	
7/24/08	91	73	82.0	32.8	22.8	17.8	690.6	
7/25/08	91	75	83.0	32.8	23.9	18.3	709.0	carpet out sent to Arpad
7/26/08	91	75	83.0	32.8	23.9	18.3	727.3	
7/27/08	91	73	82.0	32.8	22.8	17.8	745.1	

FL, Orange T1a Assend 12-11-08 9-24-09

7/28/08	91	75	83.0	32.8	23.9	18.3	763.4
7/29/08	91	77	84.0	32.8	25.0	18.9	782.3
7/30/08	88	77	82.5	31.1	25.0	18.1	800.4
7/31/08	88	75	81.5	31.1	23.9	17.5	817.9

**FORENSIC ENTOMOLOGY INVESTIGATIONS
REPORT OF DIAGNOSTIC LABORATORY EXAMINATION**

Name: Caylee Anthony

Case #: 08-069208; FEI #:1187 (B)

Sex: Female

Age: 2

Date: December 11, 2008

Requesting Agency: ASL/CSI Michael Vincent, Orange County Sheriff's Office, 2500 West Colonial Drive, Orlando, FL 32804, (407) 254-7122, ext. 70680.

Participating Entomologist: Dr. Neal H. Haskell

RECEIVED
2009 OCT -6 PM 2:45
STATE ATTORNEY
NINTH JUDICIAL CIRCUIT

SUMMARY OF CONCLUSIONS

Based upon insect development of the presence of eclosed (hatched) puparia of Diptera: Calliphoridae; *Chrysomya rufifacies*; Diptera: Calliphoridae; *Chrysomya megacephala* (likely); Diptera: Sarcophagidae ; Diptera: Muscidae; *Ophyra* sp.; Diptera: Muscidae; *Fannia* sp.; Diptera: Phoridae; *Megaselia scalaris*; and Diptera: Stratiomyidae; *Hermetia illucens* recovered either from the remains at autopsy or from the scene where the remains were deposited is consistent for death and insect colonization occurring in the later portion of June 2008 and into July 2008.



Neal H. Haskell Ph.D., BCE

Date

9/22/09

Forensic Entomology Investigations; Dr. Neal H. Haskell, 425 Kannal Ave. Rensselaer, Indiana 47978
Phones: (219) 866-7824, (219) 866-3460

10463

Name: **Caylee Anthony**

Investigating Officers: ASL/CSI Michael Vincent, Sgt. John Allen, Detective Corporal Yuri Melich , , Orange County Sheriff's Office and Special Agent Nick Savage from the FBI.

Collected by: Authorized crime scene investigators and Dr. Neal Haskell.

Delivered to Laboratory by: N. Haskell, December 19, 2008, Federal Express #861909040834 on January 15, 2009, and Federal Express #861909040904 on March 3, 2009.

SAMPLES SUBMITTED:

- Sample #6 (1400) -- 12/17/08 -- from two plastic bags; laundry bag; blanket; clothing; general debris from clothing; morgue
- Sample #7 (1400) -- 12/17/08 -- from drying chamber; from body bag; morgue
- Sample #8 -12/11/08 - Live larvae from remains. autopsy
- Sample #9 - 12/11/08 - Pupal cases (dry) from bags; autopsy
(Sa#9 & #10 from same source).
- Sample #10 - 12/11/08 - Pupal cases (dry) from bags - autopsy
(Sa#9 & #10 from same source)..
- Sample #11 - 12/17/08 - Puparium, north of skull area -H-605019 from scene.
- Sample #12 - 12/18/08 - Coleoptera wing cover (elytra) - from scene.
- Sample #13 - 12/17/08 - Miscellaneous insects; labeled vial #1;
loc AR L5 12' 6" - bag 1735hrs -- from scene.
- Sample #14 - 12/17/08 - Miscellaneous insects; elytron; labeled vial #2;
loc MC L2 E of BL - bag 1735hrs -- from scene.
- Sample #15 - 12/17/08 - Miscellaneous insects labeled vial #3;
loc AR L5 9' 6" depth - bag 1735hrs -- from scene.
- Sample #16 -- 12/17/08 - Miscellaneous insects labeled vial #4;
loc AR L5 12' 6" depth - bag 1735hrs -- from scene.
- Sample #17 -- 12/17/08 - Miscellaneous insects labeled vial #5;
loc AR L5 13' 6" - bag 1735hrs -- from scene.
- Sample #18 - 12/17/08 -- Miscellaneous insects labeled vial #6;
loc JW L5 0/10- bag 1735hrs -- from scene.
- Sample #19 -- 12/17/08 -- Miscellaneous insects labeled vial #7;
loc CN L 12 30/40- bag 1735hrs -- from scene.
- Sample #20 -- 12/17/08 -- Miscellaneous insects labeled vial #8;
loc AR L5 8/ - bag 1735hrs -- from scene.
- Sample #21 -- 12/17/08 -- Miscellaneous insects labeled vial #9;
loc CN L8 40/50- bag 1735hrs -- from scene.
- Sample #22 -- 12/17/08 -- Miscellaneous insects labeled vial #10;
loc AR L4 8' - bag 1735hrs -- from scene.

- Sample #23 -- 12/17/08 -- Miscellaneous insects labeled vial #11;
 loc SM L5 base of tree - bag 1735hrs -- from scene.
- Sample #24 -- 12/17/08 -- Miscellaneous insects labeled vial #12;
 loc Re S4 - bag 1735hrs -- from scene.
- Sample #25 -- 12/17/08 -- Miscellaneous insects labeled vial #13;
 loc AR L5 12' Dep 6" - bag 1735hrs -- from scene.
- Sample #26 - 12/19/08 - Item #1 Qty 1 Miscellaneous bug in small sealed
 container; Lane 5 Tag No. J-60012 Melissa -- from scene.
- J-60052 Item #1 - 12/18/08 - Vial with bug. CN L 13 20'
- J-60052 Item #2 - 12/18/08 - Vial with bug. VR L7 14'
- J-60052 Item #3 - 12/18/08 - Vial with insects/casings. AR L5 15'
- J-60052 Item #4 - 12/18/08 - Vial with bug. AR L4 20'
- J-60052 Item #5 - 12/18/08 - Vial with bug. AB C5 E of BL 5' 0845
- J-60052 Item #6 -- 12/18/08 - Vial with bug. SM L4 E of BL 10' 1040
- J-60052 Item #7 -- 12/18/08 - Vial with bug. AB c12 E of BL 10/15
- J-60052 Item #8 -- 12/18/08 - Vial with bug. AR L3 23' 0919
- J-60052 Item #9 -- 12/18/08 - Vial with bug. AR L4 20' 1125
- J-60052 Item #10 -- 12/18/08 - Vial with bug. L4 10'
- J-60052 Item #11 -- 12/18/08 - Vial with bug. L5 50'
- J-60052 Item #12 - 12/18/08 - Envelope with bug (unknown). VR L12 10-15'
- J-60053 Item #3 - 12/18/08 - Possible bug casing. (L2 SM 10-15)
- J-60051 Item #14 - 12/16/08 - Insects/casings. (VR L5 45-50')
- J-60051 Item #15 - 12/16/08 - Insects/insect casings. (VR L1 L2)
- J-60022 Item #2 (vial 1) - 12/13/08 - Entomology items.
- J-60022 Item #2 (vial 2) - 12/13/08 - Entomology items.
- J-60054 Item #15 - 12/19/08 - Vial with bug. (AR L4 10')
- J-60032 Item #6 - 12/15/08 - Possible insect pupa. (RE 54)
- H-60511 Item #8 - 12/14/08 - Pupae. (VR L4)
- H-60518 Item #2 - 12//11/08 - Vial of sus. Entomology evidence from off of above
 alt#1 Disney Bag.
- H-60518 Item #6 - 12/11/08 - Vial of entomology evidence from alt#5 with pupae
 beneath.

ADDITIONAL INFORMATION:

- A. Orange County Sheriff's Office Property Forms.
- B. Orange County Sheriff's Office Forensic Section Report of Crime Scene Investigation.
- C. Orange County Sheriff's Office Supplemental Report.

CASE SCENARIO

The skeletal remains of a female were discovered in a wooded area on the 8900 block of Suburban Drive in Orlando, Florida on December 11, 2008 at approximately 1125 hours. Suburban Drive extended in an east/west direction and was located at the north end of Hopespring Drive.

The scene was located in a wooded area along the south side of Suburban Drive, east of the intersection of Hopespring Drive/Suburban Drive. The area was dense with trees, vines, and vegetation that were present along the west and east sides of a path that curved southwest and down into the wooded area. A rotting log was observed along the west side of the path, partially covered with vegetation. Directly west of the northwest corner area of the log was a human skull. The skull was upright on the ground, partially hidden by vegetation, with the front facing northwest towards hanging vines. The back of the skull faced southeast. Lying on the ground directly to the north/northwest of the skull was a black plastic garbage bag that appeared to be open in some way. Vegetation was present on the bag. Several bones were observed to be to the south of the approximate center of the bag, north of the front of the skull. On top of the black plastic garbage bag, at the northwest corner, was an off-white canvas bag. Lying on the ground to the west of the southwest corner of the black plastic bag was what appeared to be a human bone. Additional bones were located to the west of the black plastic bag and appeared to have possibly fallen out of the bag.

The skull was removed from the scene by Orange County Chief Medicolegal Investigator Steven Hanson at approximately 1428 hours. Once the skull had been removed, it was noted that it had been lying on small pieces of root on the ground.

Dr. Neal Haskell, a forensic entomologist, was contacted to evaluate the entomological evidence of a child's remains.

BACKGROUND AND METHODS

CLIMATOLOGICAL DATA

NATIONAL WEATHER SERVICE STATION DATA (Orlando, FL)

Because the growth of all biological organisms depend on time and energy, degree days can be used to indicate the development time for organisms that can't regulate their body temperature. Forensically, degree days are most often used to determine the development time of calliphorids (blow flies) and other insects. Also, decomposition involves the breakdown of cells by enzymes (called autolysis) and the consumption of tissues by bacteria and fungi (called putrefaction), and both of these processes are temperature dependent (within limits, higher temperatures lead to faster decomposition).

Temperature data, with the degree day (DD) and accumulated degree day (ADD) calculations on a base temperature of 10° C (DD-B10) are found in Table 3. The degree day values represent a measures of energy available for growth (specifically, energy above a minimum temperature) over 24 hours. Large groups of 3rd stage maggots (a maggot mass) can at certain points generate sufficient metabolic heat to exceed ambient temperates. However, I did not include this "maggot mass temperature" in calculations because inclusion would imply a level of knowledge (regarding if, when, and how long a mass was present) that is not supported by the available evidence. As a practical matter, any influence of maggot mass temperatures likely would be less than the underlying variability associated with microclimatic factors.

Table 2 presents growth and development data of several forensically important species recovered from this case. It should be noted that degree day accumulations for all the insects of forensic importance exceed the requirements to go from egg to adult, and this conclusion is supported by the recovery of eclosed puparia (the cases left after adults have emerged). The only exception is the recovery of three Stratiomyidae larvae. Degree day calculations show sufficient time for development to the adult stage, however, it is likely that these three living larvae would be from eggs laid after initial colonization, and the larvae were likely feeding upon remaining decompositional material in the soil. If these larvae represented initial colonizers, we would expect to see additional live insects, including those of other species. Moreover, the large number of fully eclosed puparia support the interpretation that the Stratiomyid larvae were from secondary colonization..

RESULTS OF EXAMINATION

Sample #6 (1400) -- 12/17/08 -- from two plastic bags; laundry bag; blanket; clothing; general debris from clothing; morgue
 (20) -- eclosed puparia (10.5-20.8mm); Diptera: Stratiomyidae; *Hermetia illucens*.
 (3) -- eclosed puparia (3.6-6.0mm); Diptera: Muscidae; *Ophyra* sp.
 (1) -- larva (8.5mm); Diptera: Stratiomyidae; *Hermetia illucens*.
 (5) -- isopods (ca. 6.0mm); Isopoda
 (1) -- eclosed puparia (11.5mm); Diptera: Sarcophagidae
 (2) -- eclosed puparia (4.0-4.8mm); Diptera: Phoridae; *Megaselia scalaris*
 (1) -- immature (3.6-5.3mm); Dermaptera
 (2) -- eclosed puparia (ca. 9.0mm); Diptera: Calliphoridae;
Chrysomya rufifaces
 Piece of material and 2 strands of hair

Sample #7 (1400) -- 12/17/08 -- from drying chamber; from body bag; morgue
 (2) -- eclosed puparia (3.6-5.3mm); Diptera: Muscidae; *Ophyra* sp.
 (3) -- unclosed puparia (ca.6.0mm); Diptera: Muscidae; *Ophyra* sp.

- (2) -- uneclosed puparia (9.0 - 10.0mm); Diptera: Calliphoridae;
Chrysomya rufifaces
- (1) -- eclosed puparium (8.0mm); Diptera: Calliphoridae;
Chrysomya rufifaces
- (3) -- isopods (5.2- 6.0mm); Isopoda
- (1) -- front ½ puparium (6.5mm); Diptera: Stratiomyidae;
- (1) -- rear end (6.0mm); Dermaptera
- (1) -- eclosed puparium (4.5mm); Diptera: Phoridae;
likely *Megaselia scalaris*
- (11) -- eclosed puparia (10.5-15.1mm); Diptera: Stratiomyidae;
Hermetia illucens.

Sample #8 -12/11/08 - Live larvae from remains. autopsy

- (1) -- larva (16.0mm); Diptera: Sarcophagidae .

Sample #9 - 12/11/08 - Pupal cases (dry) from bags; autopsy

(Sa#9 & #10 from same source).

- (4) -- thorax (ca.4.5-5.0mm); Diptera: Calliphoridae
- (1) -- eclosed puparia (5.3 mm); Diptera: Muscidae; *Ophyra* sp.
- (1) -- puparium (ca.4.6mm); Diptera: Muscidae; *Fannia* sp.
- (ca.64) -- eclosed puparia (7.0-9.0mm); Diptera: Calliphoridae;
Chrysomya rufifaces
- (26) -- eclosed puparia (10.5-21.0mm); Diptera: Stratiomyidae;
Hermetia illucens.
- (1) -- rear portion (9.0mm); Coleoptera
- (3) -- broken puparia (4.0-6.0mm); Diptera: Sarcophagidae
- (1) -- crustacean (3.0mm); Crustacean
- (2) -- isopods (3.0-4.5mm); Isopoda

Sample #10 - 12/11/08 - Pupal cases (dry) from bags - autopsy

(Sa#9 & #10 from same source).

- (2) -- eclosed puparia (7.5-8.5mm); Diptera: Calliphoridae;
Chrysomya rufifaces
- (1) -- uneclosed puparium (4.3 mm); Diptera: Muscidae; *Ophyra* sp.
- (1) -- eclosed puparia (5.0 mm); Diptera: Muscidae; *Ophyra* sp.
- (10) -- eclosed puparia (12.0-20.0mm); Diptera: Stratiomyidae;
Hermetia illucens.

Sample #11 - 12/17/08 - Puparium, north of skull area -H-605019 from scene.

- (1) -- eclosed puparia (13.6mm); Diptera: Stratiomyidae;
Hermetia illucens.

Sample #12 - 12/18/08 - Coleoptera wing cover (elytra) - from scene.

(1) -- elytra (3.6mm); Coleoptera

Sample #13 - 12/17/08 - Miscellaneous insects; labeled vial #1;
loc AR L5 12' 6" - bag 1735hrs -- from scene.

(2) -- (5.0mm) Arachnida

Sample #14 - 12/17/08 - Miscellaneous insects; elytron; labeled vial #2;
loc MC L2 E of BL - bag 1735hrs -- from scene.

(1) -- elytra (10.0mm); Coleoptera

Sample #15 - 12/17/08 - Miscellaneous insects labeled vial #3;
loc AR L5 9' 6" depth - bag 1735hrs -- from scene..

(1) -- (6.0mm) Arachnida

Sample #16 -- 12/17/08 - Miscellaneous insects labeled vial #4;
loc AR L5 12' 6" depth - bag 1735hrs -- from scene.

(1) -- adult (19.0mm); Coleoptera: Hydrophilidae;

(1) -- nymph (13.0mm); Blattaria

Sample #17 -- 12/17/08 - Miscellaneous insects labeled vial #5;
loc AR L5 13' 6" - bag 1735hrs -- from scene.

(1) -- pupa (10.8mm); Hymenoptera:

(1) -- small beetle (4.0mm); Coleoptera

(6) -- eclosed puparia (15.5-20.0mm); Diptera: Stratiomyidae;
Hermetia illucens.

(2) -- larvae (8.0-14.0mm); Diptera: Stratiomyidae;
Hermetia illucens.

Sample #18 - 12/17/08 -- Miscellaneous insects labeled vial #6;
loc JW L5 0/10- bag 1735hrs -- from scene.

(1) -- millipede (20.0mm); Diplopoda;

Sample #19 -- 12/17/08 -- Miscellaneous insects labeled vial #7;
loc CN L 12 30/40- bag 1735hrs -- from scene.

(1) -- adult (19.0mm); Blattaria: *Periplaneta fuliginosa*

Sample #20 -- 12/17/08 -- Miscellaneous insects labeled vial #8;
loc AR L5 8/ - bag 1735hrs -- from scene.

(1) -- isopod (7.0mm); Isopoda

(2) -- crustacean (3.3-5.0mm); Crustacean

(1) -- adult (5.3mm); Hemiptera

- Sample #21 -- 12/17/08 -- Miscellaneous insects labeled vial #9;
loc CN L8 40/50- bag 1735hrs -- from scene.
(1) -- abdomen (17.0mm); Arachnida
- Sample #22 -- 12/17/08 -- Miscellaneous insects labeled vial #10;
loc AR L4 8' - bag 1735hrs -- from scene.
(1) -- larva (ca. 30.0mm); Coleoptera: Scarabidae
- Sample #23 -- 12/17/08 -- Miscellaneous insects labeled vial #11;
loc SM L5 base of tree - bag 1735hrs -- from scene.
(1) -- adult (10.0mm); Arachnida
- Sample #24 -- 12/17/08 -- Miscellaneous insects labeled vial #12;
loc Re S4 - bag 1735hrs -- from scene.
(2) -- egg purse (14.0-17.0mm); Blattaria
(2) -- pupae (10.7-11.8mm); Hymenoptera
(1) -- adult parts (7.0mm); Hemiptera: Pentatomidae wings, scutellum
(1) -- crustacean (ca. 6.0mm); Crustacean
(several) -- parts -- Insecta
- Sample #25 -- 12/17/08 -- Miscellaneous insects labeled vial #13;
loc AR L5 12' Dep 6" - bag 1735hrs -- from scene.
(2) -- mature larva (14.0-16.0mm); Diptera: Stratiomyidae;
Hermetia illucens. (live)
(1) -- pupa (11.2mm); Hymenoptera (live)
- Sample #26 - 12/19/08 - Item #1 Qty 1 Miscellaneous bug in small sealed
container; Lane 5 Tag No. J-60012 Melissa -- from scene.
(1) -- partial adult (4.2mm); Coleoptera: Carabidae (metallic green)
(many) -- small curved hairs (0.8-1.5mm)
(2) -- legs (ca. 1.0mm); Insecta
(1) -- loose femur (ca. 1.2mm); Insecta
- J-60052 Item #1 - 12/18/08 - Vial with bug. CN L 13 20'
(1) -- Chilopoda
- J-60052 Item #2 - 12/18/08 - Vial with bug. VR L7 14'
(1) -- Diplopoda
- J-60052 Item #3 - 12/18/08 - Vial with insects/casings. AR L5 15'
(1) -- adult; Diptera: Stratiomyidae; *Hermetia illucens*.
(4) -- eclosed puparia; Diptera: Stratiomyidae; *Hermetia illucens*.
(2) -- unclosed puparia; Diptera: Stratiomyidae; *Hermetia illucens*

- J-60052 Item #4 - 12/18/08 - Vial with bug. AR L4 20'
 (1) -- adult; Diptera: Stratiomyidae; *Hermetia illucens*.
 (1) -- eclosed puparia; Diptera: Stratiomyidae; *Hermetia illucens*.
- J-60052 Item #5 - 12/18/08 - Vial with bug. AB C5 E of BL 5' 0845
 (1) -- adult -- Isopoda
- J-60052 Item #6 -- 12/18/08 - Vial with bug. SM L4 E of BL 10' 1040
 (1) -- larva -- Diptera: Nemastocera
- J-60052 Item #7 -- 12/18/08 - Vial with bug. AB c12 E of BL 10/15
 (1) -- adult -- Arachnida
- J-60052 Item #8 -- 12/18/08 - Vial with bug. AR L3 23' 0919
 (1) -- adult -- Arachnida (with egg sac)
- J-60052 Item #9 -- 12/18/08 - Vial with bug. AR L4 20' 1125
 (1) -- adult -- Gastropoda (snail)
 (1) -- larva -- Coleoptera: Scarabaeidae
- J-60052 Item #10 -- 12/18/08 - Vial with bug. L4 10'
 (1) -- nymph -- Homoptera: Cicadidae
- J-60052 Item #11 -- 12/18/08 - Vial with bug. L5 50'
 (1) -- adult -- Crustacea
- J-60052 Item #12 - 12/18/08 - Envelope with bug (unknown). VR L12 10-15'
 (1) -- adult -- Hemiptera: Belostomatidae
- J-60053 Item #3 - 12/18/08 - Possible bug casing. (L2 SM 10-15)
 (1) -- elytra -- Coleoptera
- J-60051 Item #14 - 12/16/08 - Insects/casings. (VR L5 45-50')
 (1) -- adult -- Hemiptera:
 (1) -- adult -- Coleoptera: Scarabaeidae
- J-60051 Item #15 - 12/16/08 - Insects/insect casings. (VR L1 L2)
 (3) -- empty pupa -- Hymenoptera
 (1) -- empty ootheca -- Blattaria
 (1) -- adult -- Hemiptera (squashed)
 (1) -- broken puparium; Diptera: Stratiomyidae; *Hermetia illucens*.

- J-60054 Item #15 - 12/19/08 - Vial with bug. (AR L4 10')
 (1) -- broken puparium; Diptera: Stratiomyidae; *Hermetia illucens*.
- J-60032 Item #6 - 12/15/08 - Possible insect pupa. (RE 54)
 (1) -- puparium (1.8mm); Diptera:
- J-60022 Item #2 (vial 1) - 12/13/08 - Entomology items.
 (3) -- broken puparium; 1 eclosed, 1 uneclosed; Diptera: Stratiomyidae;
Hermetia illucens.
- J-60022 Item #2 (vial 2) - 12/13/08 - Entomology items.
 (1) -- partial puparia; Diptera: Stratiomyidae; *Hermetia illucens*.
 (1) -- larva (13.0mm); Insecta (squashed)
 -- adult parts; Coleoptera debris, elytra, sternal plates, pronotum
- H-60511 Item #8 - 12/14/08 - Pupae. (VR L4)
 No Specimens Found
- H-60518 Item #2 - 12/ /11/08 - Vial of sus. Entomology evidence from off of
 above alt#1 Disney Bag.
 (1) -- adult; Isopoda
 (1) -- adult; Arachnida (fragmented)
 (1) -- puparium (5.5mm); Diptera (fragmented)
 (1) -- puparium (6.0mm) fragmented; Diptera: Calliphoridae;
Chrysomya megacephala (likely)
 (1) -- adult; Diptera: Stratiomyidae; *Ptecticus* sp.
 (4) -- eclosed puparia; Diptera: Stratiomyidae; *Hermetia illucens*
- H-60518 Item #6 - 12/11/08 - Vial of entomology evidence from alt#5 with
 pupae beneath.
 (1) -- uneclosed puparium; Diptera: Calliphoridae;
Chrysomya megacephala (likely)
 (2) -- eclosed puparium; Diptera: Calliphoridae;
Chrysomya megacephala (likely)

* Identification was conducted by N. Haskell Ph.D., BCE, DABFE; R.E. Williams, Ph.D. DABFE,
 L.G. Higley, Ph.D. DABFE.

DISCUSSION

The following insect taxa recovered from the remains and areas of the scene are forensically important insect groups/species and are known to be associated with decomposing carrion. These include:

Diptera: Stratiomyidae; *Hermetia illucens*.

(1) -- adult

(1) -- adult

(20) -- eclosed puparia (10.5-20.8mm);

(11) -- eclosed puparia (10.5-15.1mm)

(26) -- eclosed puparia (10.5-21.0mm)

(10) -- eclosed puparia (12.0-20.0mm)

(1) -- eclosed puparia (13.6mm)

(6) -- eclosed puparia (15.5-20.0mm)

(4) -- eclosed puparia

(1) -- eclosed puparia

(4) -- eclosed puparia;

(1) -- broken puparium

(3) -- broken puparium

(1) -- partial puparia

(1) -- front ½ puparium (6.5mm)

(2) -- uneclosed puparia

(1) -- larva (8.5mm)

(2) -- larvae (8.0-14.0mm)

(1) -- larva (22.0mm)

(2) -- mature larva (14.0-16.0mm)

(2) -- mature larva (14.0-16.0mm); Diptera: Stratiomyidae;
Hermetia illucens. (live)

(1) -- larva (22.0mm); Diptera: Stratiomyidae;
Hermetia illucens. (live)

(1) -- adult; Diptera: Stratiomyidae; *Ptecticus* sp a second species

Diptera: Calliphoridae

(4) -- thorax (ca.4.5-5.0mm); Diptera: Calliphoridae

Diptera: Calliphoridae; *Chrysomya rufifaces*

(2) -- eclosed puparia (ca. 9.0mm);
 (2) -- unclosed puparia (9.0 - 10.0mm);
 (1) -- eclosed puparium (8.0mm);
 (ca.64) -- eclosed puparia (7.0-9.0mm);
 (2) -- eclosed puparia (7.5-8.5mm);

Diptera: Calliphoridae; *Chrysomya megacephala* (likely)

(1) -- puparium (6.0mm) fragmented;
 (2) -- eclosed puparium; Diptera
 (1) -- unclosed puparium; Diptera:

Diptera: Phoridae; *Megaselia scalaris*

(2) -- eclosed puparia (4.0-4.8mm); Diptera: Phoridae; *Megaselia scalaris*
 (1) -- eclosed puparium (4.5mm); Diptera: Phoridae;
 likely *Megaselia scalaris*

Diptera: Muscidae; *Ophyra* sp.

(3) -- eclosed puparia (3.6-6.0mm); .
 (2) -- eclosed puparia (3.6-5.3mm); .
 (1) -- eclosed puparia (5.0 mm);
 (1) -- eclosed puparia (5.3 mm);
 (1) -- unclosed puparium (4.3 mm);
 (3) -- unclosed puparia (ca.6.0mm);

Diptera: Muscidae; *Fannia* sp.

(1) -- puparium (ca.4.6mm);

Diptera: Sarcophagidae

(1) -- eclosed puparia (11.5mm);
 (3) -- broken puparia (4.0-6.0mm); Diptera: Sarcophagidae
 (1) -- larva (16.0mm); Diptera: Sarcophagidae

Isopoda

(5) -- isopods (ca. 6.0mm);
 (3) -- isopods (5.2- 6.0mm);
 (2) -- isopods (3.0-4.5mm);
 (1) -- isopod (7.0mm);
 (1) -- adult --

(1) -- adult;

The presence of eclosed (hatched) puparia of Diptera: Calliphoridae; *Chrysomya rufifaces*; Diptera: Calliphoridae; *Chrysomya megacephala* (likely); Diptera: Sarcophagidae ; Diptera: Muscidae; *Ophyra* sp.; Diptera: Muscidae; *Fannia* sp.; Diptera: Phoridae; *Megaselia scalaris*; and Diptera: Stratiomyidae; *Hermetia illucens* recovered either from the remains at autopsy or from the scene where the remains were deposited is consistent with earlier colonization (and not from an October - December colonization date). The recovery of fewer than 100 calliphorid specimens, despite an extensive search, suggests that a lower population of these initial insect colonizers occurred (initial colonizers are the first species to find and use a freshly dead body). Given that weather was favorable and would not prevent initial colonization, some other factor must have delayed access of these colonizers to the body. The recovery of some body parts within a plastic bag, might suggest that the entire body was wholly or partially within the bag initially. Similarly, if eggs or larvae had been manually washed off or if submersion of the remains had occurred during an early portion of the period at the recovery site, initial blow fly colonization could be delayed, but this likely would not result in reduced numbers as seen here.

In a separate report I discussed entomological evidence associated with a trash bag and trunk of a 1998 white Pontiac Sunfire (owned by the mother of the missing child) on July 16, 2008. The observation of reduced numbers of initial colonizers is consistent with the suggestion that the body was initially stored in a location that excluded initial colonizers. Specifically, the colonization pattern observed could be caused by the remains initially being in a car trunk which could exclude blow flies for a few days. Once the remains were finally exposed the calliphorids would have been less likely to conduct extensive colonization due to the change in the biochemical composition of the remains, thus the remains would have been attractive to insects which prefer older decomposing remains. These taxa would include: Sarcophagidae; Muscidae; *Ophyra* sp.; Muscidae; *Fannia* sp.; Phoridae; *Megaselia scalaris*; and

Stratiomyidae; *Hermetia illucens*. The phorids would have been there from the earlier colonization of the remains while in the trunk. Thus, evidence from the remains is consistent with the body having initially been stored in the trunk of a car and deposited after some decomposition had occurred.

There were three specimens of *H. illucens* found as live specimens from in close proximity to the bag in which the remains were discovered in at the scene. This is likely a result of additional generations of the species continuing to live in the soil containing decomposition material from the body.

It is seen in Table 2 that for all of these forensically important species, the degree day requirements are met in relatively shorter periods of time than what has passed in this case if death and decomposition occurred during June and into July. These taxa would include: Sarcophagidae (347 to 266 ADD-B10 ; Muscidae; *Ophyra* sp. (*Hydrotea* 216 ADD-B10); Muscidae; *Fannia* sp. (338 ADD-B10)); Phoridae; *Megaselia scalaris* (367 ADD-B10 @ 26-28° C); and Stratiomyidae; *Hermetia illucens* (720 ADD-B10).

Given the above discussion, evidence recovered regarding species and growth and development for the species and all species going completely through their initial growth cycles based upon an initial colonization of the remains, this evidence remain consistent for death and insect colonization occurring in the later portion of June 2008 and into July 2008.

Therefore, based upon insect development of the presence of eclosed (hatched) puparia of Diptera: Calliphoridae; *Chrysomya rufifacies*; Diptera: Calliphoridae; *Chrysomya megacephala* (likely); Diptera: Sarcophagidae ; Diptera: Muscidae; *Ophyra* sp.; Diptera: Muscidae; *Fannia* sp.; Diptera: Phoridae; *Megaselia scalaris*; and Diptera: Stratiomyidae; *Hermetia illucens* recovered either from the remains at autopsy or from the scene where the remains were deposited is consistent for death and insect colonization occurring in the later portion of June 2008 and into July 2008.

Table 2

Anthony: Cs# 08-06920; FEI 1187 (B)

Fannia canicularis

Constant temperature rearing 26.7°C

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Eggs	30	30	501.0	501.0	20.9	20.9
larva	216	246	3607.2	4108.2	150.3	171.2
pupa	240	486	4008.0	8116.2	167.0	338.2
Total	486				338.2	

Hydrotaea

Mean temperature 16°C

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
egg and larva	864	864	5184.0	5184.0	216.0	216.0
Total	864				216.0	

Muscina assimilis

16.6°C 32 days at base 10

6.6 per hour 5068 Total ADH

at 46% for mature 3rd instar = 2332

Nuorteva Case study 18 Smith

For *Muscina stabulans* 16 to 18 °C

28 days at a base 10

Total ADH 4032 (16°C) to 5376 (18°C)

at 46% for mature 3rd instar

1855 to 2473

Lower Temperature Threshold 10°C

Hermitia illucens

Constant temperature rearing 27.8°C (May 1961)

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Mature Larva	744	744	13243.2	13243.2	551.8	551.8
Pupa	228	972	4058.4	17301.6	169.1	720.9
Total	972				720.9	

Hermitia illucens

Constant temperature rearing 29.3°C (Tingle)

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Total to Adult	912	912	17601.6	17601.6	733.4	733.4
Total	912				733.4	

Table 2

Anthony: Cs# 08-06920; FEI 1187 (B)

Hermitia illucens

Constant temperature rearing 24.0°C (Booth and Shepard)

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Eggs	103	103	1442.0	1442.0	60.1	60.1
Total	103				60.1	

C. rufifacies

Constant temperature rearing 26.7°C

Stage	Eggs	1st	2nd	3rd	Mig 3rd	Pupa	Total
Time (hrs)	14	18	24		78	82	82
DD-B10	9.7	12.5	16.7		54.3	57.6	150.8
ADD-B10	9.7	22.3	39.0		93.2	150.8	150.8
DH-B10	232.8	300	400.8		1,303.2	1,382.4	3619.2
ADH-B10	232.8	532.8	933.6		2,236.8	3,619.2	3619.2

Chrysomyia megacephala

Constant Temperature (27.0°C)

Stages	Time (hrs) mean	Time (hrs) Mean	Range	Range	Range
		ADD-B10	Time (hrs)	ADH-B10	ADD-B10
Eggs	13	009.2	16 - 14	204 - 238	8.5 - 10.0
1st Instar	22	015.6	16 - 28	272 to 476	11.3 - 19.8
2nd Instar	48	034.0	28 - 60	476 to 1020	19.8 - 42.5
3rd instar	62	043.9	48 - 84	816 to 1428	34 - 59.5
Prepupa	106	075.1	84 - 120	1428 to 2040	59.5 - 85
Pupa	198	140.3	120 - 216	1428 to 3672	85 - 153
Adults	222	157.3	210 - 234	3570 to 3974	148.8 - 165.8

Sarcophaga bullata

Constant temperature rearing 26.7°C

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Eggs						
1st Instar	26	26	434.2	434.2	18.1	18.1
2nd Instar	18	44	300.6	734.8	12.5	30.6
3rd Instar	54	98	901.8	1636.6	37.6	68.2
Prepupa	112	210	1870.4	3507.0	77.9	146.1
Pupa	288	498	4809.6	8316.6	200.4	346.5
Total	498				346.5	

Sarcophaga shermani

Constant temperature rearing 26.7°C

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
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Table 2

Anthony: Cs# 08-06920; FEI 1187 (B)

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Eggs						
1st Instar	22	22	367.4	367.4	15.3	15.3
2nd Instar	16	38	267.2	634.6	11.1	26.4
3rd Instar	48	86	801.6	1436.2	33.4	59.8
Prepupa	104	190	1736.8	3173.0	72.4	132.2
Pupa	192	382	3206.4	6379.4	133.6	265.8
Total	382				265.8	

Sarcophaga cooleyi

Constant temperature rearing 26.7°C

Stages	Time(hrs)	Σ (hrs)	DH-B10	ADH-B10	DD-B10	ADD-B10
Eggs						
1st Instar	24	24	400.8	400.8	16.7	16.7
2nd Instar	18	42	300.6	701.4	12.5	29.2
3rd Instar	48	90	801.6	1503.0	33.4	62.6
Prepupa	96	186	1603.2	3106.2	66.8	129.4
Pupa	216	402	3607.2	6713.4	150.3	279.7
Total	402				279.7	

Table 1 Summary of data on the duration of development of *Megaselia scalaris* in the literature

Reference	Sex	E C°	E-FL C°	E-PF C°	E-P C°	°C	Days
7	M + F	3-6	18-20	--	24-27	18-20	45-55
109	M + F	1.1	20	--	10.1-11.1	20.0	28.3-30.3
84	M + F	2	20.8	--	9.5	20.9	18.5
65	M + F	1.3	22	4.3	22	22.0	21.9
12	M	----				21-33	25.0
12	F	----				23-35	25.0
144	M	1	26-28	--	12-19	26-28	15-20
144	F	1	26-28	--	12-19	26-28	16-22
88	M	-----				28.0	18.0
88	F	-----				28.0	20.0

Abbreviations: E, egg; E-FL, egg + feeding-stage larva; E-PF, egg + feeding-stage larva + postfeeding-stage larva; C°, temperature range; M, males; F, females. E-P, egg + larva + pupa;

Cayley Anthony
08-06920: FEI 1187

Daily Max/Min Temperatures from December 12, 2008 to June 16, 2008
NWS Station Orlando, Florida

Date	Temperatures		Daily Mean °F	Temperatures		DD-B10	ADD-B10
	Max °F	Min °F		Max °C	Min °C		
12/12/08	64	51	57.5	17.8	10.6	4.2	4.2
12/11/08	73	60	66.5	22.8	15.6	9.2	13.4
12/10/08	81	64	72.5	27.2	17.8	12.5	25.9
12/9/08	78	59	68.5	25.6	15.0	10.3	36.1
12/8/08	73	46	59.5	22.8	7.8	5.3	41.4
12/7/08	64	46	55.0	17.8	7.8	2.8	44.2
12/6/08	75	59	67.0	23.9	15.0	9.4	53.7
12/5/08	75	51	63.0	23.9	10.6	7.2	60.9
12/4/08	72	55	63.5	22.2	12.8	7.5	68.4
12/3/08	68	43	55.5	20.0	6.1	3.1	71.4
12/2/08	61	46	53.5	16.1	7.8	1.9	73.4
12/1/08	66	55	60.5	18.9	12.8	5.8	79.2
11/30/08	78	60	69.0	25.6	15.6	10.6	89.8
11/29/08	77	52	64.5	25.0	11.1	8.1	97.8
11/28/08	75	48	61.5	23.9	8.9	6.4	104.2
11/27/08	69	46	57.5	20.6	7.8	4.2	108.4
11/26/08	68	48	58.0	20.0	8.9	4.4	112.8
11/25/08	71	55	63.0	21.7	12.8	7.2	120.1
11/24/08	73	53	63.0	22.8	11.7	7.2	127.3
11/23/08	70	46	58.0	21.1	7.8	4.4	131.7
11/22/08	66	43	54.5	18.9	6.1	2.5	134.2
11/21/08	68	48	58.0	20.0	8.9	4.4	138.7
11/20/08	68	44	56.0	20.0	6.7	3.3	142.0
11/19/08	61	39	50.0	16.1	3.9	0.0	142.0
11/18/08	66	46	56.0	18.9	7.8	3.3	145.3
11/17/08	64	44	54.0	17.8	6.7	2.2	147.6
11/16/08	62	48	55.0	16.7	8.9	2.8	150.3
11/15/08	82	62	72.0	27.8	16.7	12.2	162.6
11/14/08	86	71	78.5	30.0	21.7	15.8	178.4
11/13/08	84	69	76.5	28.9	20.6	14.7	193.1
11/12/08	82	66	74.0	27.8	18.9	13.3	206.5
11/11/08	79	57	68.0	26.1	13.9	10.0	216.5
11/10/08	75	54	64.5	23.9	12.2	8.1	224.5
11/9/08	75	54	64.5	23.9	12.2	8.1	232.6
11/8/08	79	61	70.0	26.1	16.1	11.1	243.7
11/7/08	79	62	70.5	26.1	16.7	11.4	255.1
11/6/08	78	57	67.5	25.6	13.9	9.7	264.8
11/5/08	68	61	64.5	20.0	16.1	8.1	272.9
11/4/08	68	63	65.5	20.0	17.2	8.6	281.5
11/3/08	80	62	71.0	26.7	16.7	11.7	293.1
11/2/08	75	64	69.5	23.9	17.8	10.8	304.0
11/1/08	78	62	70.0	25.6	16.7	11.1	315.1
10/31/08	77	62	69.5	25.0	16.7	10.8	325.9
10/30/08	73	48	60.5	22.8	8.9	5.8	331.8
10/29/08	64	43	53.5	17.8	6.1	1.9	333.7
10/28/08	64	46	55.0	17.8	7.8	2.8	336.5
10/27/08	79	57	68.0	26.1	13.9	10.0	346.5
10/26/08	79	60	69.5	26.1	15.6	10.8	357.3
10/25/08	82	70	76.0	27.8	21.1	14.4	371.8
10/24/08	80	69	74.5	26.7	20.6	13.6	385.4
10/23/08	82	71	76.5	27.8	21.7	14.7	400.1
10/22/08	81	64	72.5	27.2	17.8	12.5	412.6
10/21/08	82	64	73.0	27.8	17.8	12.8	425.4
10/20/08	81	64	72.5	27.2	17.8	12.5	437.9
10/19/08	78	60	69.0	25.6	15.6	10.6	448.4

Table 3

Anthony: Cs# 08-06920; FEI 1187

10/18/08	84	66	75.0	28.9	18.9	13.9	462.3
10/17/08	86	66	76.0	30.0	18.9	14.4	476.8
10/16/08	84	69	76.5	28.9	20.6	14.7	491.5
10/15/08	84	69	76.5	28.9	20.6	14.7	506.2
10/14/08	84	73	78.5	28.9	22.8	15.8	522.1
10/13/08	84	73	78.5	28.9	22.8	15.8	537.9
10/12/08	87	73	80.0	30.6	22.8	16.7	554.6
10/11/08	84	73	78.5	28.9	22.8	15.8	570.4
10/10/08	90	72	81.0	32.2	22.2	17.2	587.6
10/9/08	88	72	80.0	31.1	22.2	16.7	604.3
10/8/08	87	71	79.0	30.6	21.7	16.1	620.4
10/7/08	87	73	80.0	30.6	22.8	16.7	637.1
10/6/08	88	73	80.5	31.1	22.8	16.9	654.0
10/5/08	84	73	78.5	28.9	22.8	15.8	669.9
10/4/08	84	71	77.5	28.9	21.7	15.3	685.1
10/3/08	84	69	76.5	28.9	20.6	14.7	699.9
10/2/08	84	69	76.5	28.9	20.6	14.7	714.6
10/1/08	90	70	80.0	32.2	21.1	16.7	731.3
9/30/08	82	71	76.5	27.8	21.7	14.7	746.0
9/29/08	84	75	79.5	28.9	23.9	16.4	762.4
9/28/08	87	72	79.5	30.6	22.2	16.4	778.8
9/27/08	88	66	77.0	31.1	18.9	15.0	793.8
9/26/08	87	68	77.5	30.6	20.0	15.3	809.0
9/25/08	82	66	74.0	27.8	18.9	13.3	822.4
9/24/08	84	73	78.5	28.9	22.8	15.8	838.2
9/23/08	84	75	79.5	28.9	23.9	16.4	854.6
9/22/08	90	73	81.5	32.2	22.8	17.5	872.1
9/21/08	91	73	82.0	32.8	22.8	17.8	889.9
9/20/08	90	73	81.5	32.2	22.8	17.5	907.4
9/19/08	87	73	80.0	30.6	22.8	16.7	924.1
9/18/08	89	75	82.0	31.7	23.9	17.8	941.8
9/17/08	91	77	84.0	32.8	25.0	18.9	960.7
9/16/08	90	75	82.5	32.2	23.9	18.1	978.8
9/15/08	93	73	83.0	33.9	22.8	18.3	997.1
9/14/08	93	75	84.0	33.9	23.9	18.9	1,016.0
9/13/08	91	75	83.0	32.8	23.9	18.3	1,034.4
9/12/08	91	75	83.0	32.8	23.9	18.3	1,052.7
9/11/08	88	73	80.5	31.1	22.8	16.9	1,069.6
9/10/08	90	71	80.5	32.2	21.7	16.9	1,086.6
9/9/08	91	78	84.5	32.8	25.6	19.2	1,105.8
9/8/08	91	75	83.0	32.8	23.9	18.3	1,124.1
9/7/08	91	73	82.0	32.8	22.8	17.8	1,141.9
9/6/08	93	75	84.0	33.9	23.9	18.9	1,160.8
9/5/08	84	75	79.5	28.9	23.9	16.4	1,177.2
9/4/08	89	77	83.0	31.7	25.0	18.3	1,195.5
9/3/08	90	77	83.5	32.2	25.0	18.6	1,214.1
9/2/08	91	78	84.5	32.8	25.6	19.2	1,233.3
9/1/08	90	78	84.0	32.2	25.6	18.9	1,252.2
8/31/08	87	75	81.0	30.6	23.9	17.2	1,269.4
8/30/08	86	75	80.5	30.0	23.9	16.9	1,286.3
8/29/08	91	75	83.0	32.8	23.9	18.3	1,304.7
8/28/08	93	77	85.0	33.9	25.0	19.4	1,324.1
8/27/08	93	75	84.0	33.9	23.9	18.9	1,343.0
8/26/08	91	75	83.0	32.8	23.9	18.3	1,361.3
8/25/08	91	73	82.0	32.8	22.8	17.8	1,379.1
8/24/08	91	73	82.0	32.8	22.8	17.8	1,396.9
8/23/08	89	73	81.0	31.7	22.8	17.2	1,414.1
8/22/08	84	75	79.5	28.9	23.9	16.4	1,430.5
8/21/08	78	75	76.5	25.6	23.9	14.7	1,445.2
8/20/08	78	75	76.5	25.6	23.9	14.7	1,460.0
8/19/08	79	73	76.0	26.1	22.8	14.4	1,474.4
8/18/08	89	75	82.0	31.7	23.9	17.8	1,492.2
8/17/08	91	75	83.0	32.8	23.9	18.3	1,510.5
8/16/08	86	75	80.5	30.0	23.9	16.9	1,527.5
8/15/08	88	75	81.5	31.1	23.9	17.5	1,545.0

Table 3

Anthony: Cs# 08-06920; FEI 1187

8/14/08	81	73	77.0	27.2	22.8	15.0	1,560.0	
8/13/08	89	73	81.0	31.7	22.8	17.2	1,577.2	
8/12/08	90	75	82.5	32.2	23.9	18.1	1,595.3	
8/11/08	93	73	83.0	33.9	22.8	18.3	1,613.6	
8/10/08	91	75	83.0	32.8	23.9	18.3	1,631.9	
8/9/08	90	77	83.5	32.2	25.0	18.6	1,650.5	
8/8/08	90	75	82.5	32.2	23.9	18.1	1,668.6	
8/7/08	95	79	87.0	35.0	26.1	20.6	1,689.2	
8/6/08	95	78	86.5	35.0	25.6	20.3	1,709.4	
8/5/08	93	77	85.0	33.9	25.0	19.4	1,728.9	
8/4/08	93	77	85.0	33.9	25.0	19.4	1,748.3	
8/3/08	93	75	84.0	33.9	23.9	18.9	1,767.2	
8/2/08	90	75	82.5	32.2	23.9	18.1	1,785.3	
8/1/08	88	75	81.5	31.1	23.9	17.5	1,802.8	
7/31/08	88	75	81.5	31.1	23.9	17.5	1,820.3	
7/30/08	88	77	82.5	31.1	25.0	18.1	1,838.3	
7/29/08	91	77	84.0	32.8	25.0	18.9	1,857.2	
7/28/08	91	75	83.0	32.8	23.9	18.3	1,875.6	
7/27/08	91	73	82.0	32.8	22.8	17.8	1,893.4	
7/26/08	91	75	83.0	32.8	23.9	18.3	1,911.7	
7/25/08	91	75	83.0	32.8	23.9	18.3	1,930.0	
7/24/08	91	73	82.0	32.8	22.8	17.8	1,947.8	
7/23/08	90	73	81.5	32.2	22.8	17.5	1,965.3	
7/22/08	91	75	83.0	32.8	23.9	18.3	1,983.6	
7/21/08	96	78	87.0	35.6	25.6	20.6	2,004.2	
7/20/08	95	75	85.0	35.0	23.9	19.4	2,023.6	
7/19/08	93	75	84.0	33.9	23.9	18.9	2,042.5	
7/18/08	91	75	83.0	32.8	23.9	18.3	2,060.9	
7/17/08	88	73	80.5	31.1	22.8	16.9	2,077.8	
7/16/08	84	75	79.5	28.9	23.9	16.4	2,094.2	
7/15/08	88	75	81.5	31.1	23.9	17.5	2,111.7	
7/14/08	91	73	82.0	32.8	22.8	17.8	2,129.5	
7/13/08	84	73	78.5	28.9	22.8	15.8	2,145.3	
7/12/08	89	75	82.0	31.7	23.9	17.8	2,163.1	
7/11/08	93	73	83.0	33.9	22.8	18.3	2,181.4	
7/10/08	93	75	84.0	33.9	23.9	18.9	2,200.3	
7/9/08	90	73	81.5	32.2	22.8	17.5	2,217.8	
7/8/08	90	73	81.5	32.2	22.8	17.5	2,235.3	
7/7/08	89	73	81.0	31.7	22.8	17.2	2,252.6	
7/6/08	91	73	82.0	32.8	22.8	17.8	2,270.3	
7/5/08	91	73	82.0	32.8	22.8	17.8	2,288.1	
7/4/08	89	73	81.0	31.7	22.8	17.2	2,305.3	
7/3/08	89	73	81.0	31.7	22.8	17.2	2,322.6	
7/2/08	89	71	80.0	31.7	21.7	16.7	2,339.2	
7/1/08	99	71	85.0	37.2	21.7	19.4	2,358.7	
6/30/08	91	73	82.0	32.8	22.8	17.8	2,376.5	car towed
6/29/08	93	72	82.5	33.9	22.2	18.1	2,394.5	car at Amscot
6/28/08	93	73	83.0	33.9	22.8	18.3	2,412.9	car at Amscot
6/27/08	91	73	82.0	32.8	22.8	17.8	2,430.6	text abt hitting anim car at Amscot
6/26/08	89	71	80.0	31.7	21.7	16.7	2,447.3	
6/25/08	91	73	82.0	32.8	22.8	17.8	2,465.1	
6/24/08	91	73	82.0	32.8	22.8	17.8	2,482.9	
6/23/08	91	71	81.0	32.8	21.7	17.2	2,500.1	dad abt gas cans
6/22/08	86	72	79.0	30.0	22.2	16.1	2,516.2	
6/21/08	86	71	78.5	30.0	21.7	15.8	2,532.0	
6/20/08	93	73	83.0	33.9	22.8	18.3	2,550.4	out of gas boy f. rt side trunk open
6/19/08	91	72	81.5	32.8	22.2	17.5	2,567.9	boy fried no phone act.
6/18/08	91	72	81.5	32.8	22.2	17.5	2,585.4	Tony car shovel
6/17/08	91	73	82.0	32.8	22.8	17.8	2,603.2	Tony
6/16/08	90	73	81.5	32.2	22.8	17.5	2,620.7	last seen 1300