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Development of immature blowflies and their application to forensic science

Donnah Marie Day
University of Wollongong

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Development of immature blowflies and their application to forensic science

A thesis submitted by Donnah Marie Day for the degree of Masters of Science - Research at the University of Wollongong, NSW.

Supervisor: Dr James F. Wallman

School of Biological Sciences

January 2006

I, Donnah Marie Day, declare that the work recorded in this thesis is entirely my own effort, except where otherwise acknowledged. I also certify that this work is original and has not been previously submitted in any other course of study at this or any other institution.

Signature

Date

Student number

All nature is lovely and worthy of our reverent study.

Anonymous

ABSTRACT

Data on the development of immature blowflies and other carrion-breeding flies can assist with determination of the post-mortem interval and thus be used as a tool to help solve crime. The main focus of this research was to develop reliable data for growth at constant temperatures in larvae of *Calliphora augur*. Constant temperatures were chosen because fluctuating regimes can be location specific and may therefore have limited application. A number of other blowfly species were also studied, but only *C. augur* and *Lucilia cuprina* were used in planned experiments. Since *C. augur* is ovoviviparous, and therefore has a small clutch size, the fecund egg-laying species *Lucilia cuprina* was also cultured and used as a model for pilot experiments, in feasibility studies and to explore the broader applicability of results from trials with *C. augur*.

Some of the current ideas behind estimation of post-mortem interval using blowfly larvae have been expanded upon and prediction intervals for larvae of *C. augur* are presented. In forensic entomology, plots of this type usually present the variables differently than the strict mathematical method, where a known predictor (x) is used to estimate an unknown value of interest (y). In forensic entomology, these axes are often reversed. In my work, I have adopted a more classical mathematical method and present a way of estimating time as related to larval age (y) from the (known) somatic measurement of body length (x). Whilst this has been the main core of my work, some important practical difficulties of working in this field have also been given attention.

A way to salvage some damaged specimens has been discovered; measurement of body width at the junction of the 5th and 6th abdominal segments can be used as an alternative measurement to body length, and I present a means to convert from one measurement to the other. A paper on this topic has been published in *Forensic Science International*.

I have also explored the effect of freezing and thawing developmental media on larval growth in *Calliphora augur* and *Lucilia cuprina*, and it appears that there is no significant difference. The effect of different tissues from sheep on larval growth was also examined in the above two species, with growth on sheep's liver being slower than growth on sheep's brain or sheep's meat. A paper on this topic has been accepted by the *Journal of Forensic Sciences*.

The effect of preservative solutions on different larval stages of *C. augur*, and on the third instar larvae of *C. augur* and *L. cuprina*, was also examined. It was found that the larvae of each species reacted differently to the preservatives, as did the different instars within a

species. Ten per cent formalin and Kahle's solution effected the least change in larval body length, but when larvae were placed into preservatives alive only 10% formalin had no deleterious effect on both species. However, since 10% formalin can affect the analysis of larval DNA, it is not recommended. In fact, it appears that choosing an optimum preservative may be difficult until more work is done in this area.

While work in forensic entomology is far from straightforward, it is hoped that the decidedly practical nature of my studies will serve to equip forensic entomologists with more tools to help solve crime.

CONTENTS

	page
Chapter 1: Introduction	1
Chapter 2: Initial Observations	4
2.1 Initial trapping	4
2.2 Initial observations	4
2.2.1 <i>Calliphora stygia</i>	6
2.2.2 <i>Calliphora hilli hilli</i>	7
2.2.3 <i>Calliphora augur</i>	8
2.2.4 <i>Lucilia cuprina</i>	10
2.2.5 <i>Chrysomya rufifacies</i>	12
2.3 Species choice	13
2.3.1 <i>Calliphora augur</i>	13
2.3.2 <i>Lucilia cuprina</i>	16
2.4 Working cultures	18
Chapter 3: General Methods	19
3.1 Trapping	19
3.2 Materials and Equipment	20
3.2.1 <i>Culture establishment</i>	20
3.2.2 <i>Culture</i>	20
3.2.3 <i>Adult cages</i>	22
3.2.4 <i>Larval growth</i>	25
3.2.5 <i>Waste management</i>	25
3.2.6 <i>Temperature-controlled-cabinet</i>	27
3.3 Sample handling and preservation	27
3.3.1 <i>Sample handling</i>	27
3.3.2 <i>Mixing and storage of preservative solutions</i>	29
3.4 Measurement, data handling and statistics	29
3.4.1 <i>Larvae and pupae</i>	29
3.4.2 <i>Temperature</i>	31
3.4.3 <i>Humidity</i>	31
3.4.4 <i>Data handling and statistics</i>	31

Contents continued:

	page
Chapter 4: Pilot Experiments	32
4.1 Experiment A - Egg hatch and development in <i>Lucilia cuprina</i>	33
4.2 Experiment B - Average cohort size in <i>Calliphora augur</i>	35
4.3 Experiment C - Minimum larval density to induce elevated temperatures	35
4.4 Experiment D - Growth of <i>Calliphora augur</i> larvae on fresh substrate compared with frozen/thawed substrate	37
4.5 Experiment E - Larval growth on different tissue substrates	41
4.5.1 <i>Choice of substrates</i>	41
4.5.2 <i>Observed growth of <i>Lucilia cuprina</i> larvae on different tissue substrates</i>	41
4.5.3 <i>Measured growth of <i>Lucilia cuprina</i> larvae on different tissue substrates</i>	42
4.5.4 <i>Suitability of substrate types for capture of adult calliphorids</i>	45
4.6 Experiment F - Body width as an alternative to body length	49
4.7 Experiment G - Initial studies with preservatives	50
4.7.1 <i>Preservatives in current use</i>	50
4.7.2 <i>Time in preservative</i>	53
4.8 Experiment H - Culture control	54
 Chapter 5: Body width as an alternative to body length in <i>Calliphora augur</i> and <i>Lucilia cuprina</i>	 56
5.1 Introduction	57
5.2 Materials and methods	58
5.2.1 <i>Sample generation</i>	58
5.2.2 <i>Sample collection</i>	58
5.3 Results	59
5.3.1 <i>Larvae grown at 20°C</i>	59
5.3.2 <i>Larvae grown at 25°C</i>	62
5.4 Discussion	68
5.5 Conclusions	69
 Chapter 6: Studies on developmental media	 70
6.1 Introduction	71
6.1.1 <i>Fresh vs. frozen developmental media</i>	71
6.1.2 <i>Larval growth on different tissues</i>	71

Contents continued:

	page
6.2 Materials and Methods	72
6.2.1 <i>Fresh vs. frozen developmental media</i>	73
6.2.2 <i>Larval growth on different tissues</i>	73
6.3 Results	74
6.3.1 <i>Fresh vs. frozen developmental media</i>	74
6.3.2 <i>Larval growth on different tissues</i>	77
6.3.2.1 Growth of <i>Lucilia cuprina</i> larvae on different sheep's tissues	77
6.3.2.2 Growth of <i>Calliphora augur</i> larvae on different sheep's tissues	84
6.4 Discussion	92
6.4.1 <i>Fresh vs. frozen developmental media</i>	92
6.4.2 <i>Larval growth on different tissues</i>	92
6.5 Conclusions	94
6.5.1 <i>Fresh vs. frozen developmental media</i>	94
6.5.2 <i>Larval growth on different tissues</i>	94
 Chapter 7: Effect of preservative solutions on preservation of <i>Calliphora augur</i> and <i>Lucilia cuprina</i> larvae	 95
7.1 Introduction	96
7.2 Materials and Methods	98
7.2.1 <i>Preservative choice</i>	98
7.2.2 <i>Sample generation</i>	98
7.2.3 <i>Sample collection, handling and preservation</i>	98
7.2.4 <i>Measurement, data handling and statistics</i>	98
7.3 Experiment A – effects of 80% EtOH on larval body length over time in <i>Calliphora augur</i>	99
7.4 Experiment B – effects of different preservative types on feeding third-instar larvae of <i>Calliphora augur</i> and <i>Lucilia cuprina</i>	99
7.5 Results	99
7.5.1 <i>Effects of 80% EtOH on larval body length over time in <i>Calliphora augur</i></i>	99
7.5.2 <i>Effects of different preservative types on feeding third-instar larvae of <i>Calliphora augur</i> and <i>Lucilia cuprina</i></i>	105
7.5.2.1 <i>Calliphora augur</i>	105
7.5.2.2 <i>Lucilia cuprina</i>	111
7.5.2.3 <i>Larvae killed by immersion in preservative</i>	120

Contents continued:

	page
7.6 Discussion	120
7.6.1 <i>Different growth stages of Calliphora augur preserved in 80% EtOH</i>	120
7.6.2 <i>Effect of different preservative types on feeding third-instar larvae of Calliphora augur and Lucilia cuprina</i>	122
7.6.3 <i>Effect of different preservative types on larvae placed into preservatives alive</i>	124
7.7 Conclusions	125
 Chapter 8: Development of <i>Calliphora augur</i> larvae at constant temperatures	127
8.1 Introduction	128
8.2 Materials and Methods	128
8.2.1 <i>Development of Calliphora augur larvae at constant temperatures</i>	128
8.2.2 <i>Estimating time (age) from maggot length</i>	130
8.3 Results	130
8.3.1 <i>Number of lay events required from females of Calliphora augur</i>	130
8.3.2 <i>Development of Calliphora augur larvae at constant temperatures</i>	131
8.3.3 <i>Estimating time (age) from maggot length</i>	147
8.3.4 <i>Check of culture integrity</i>	167
8.4 Discussion	167
8.4.1 <i>Growth of Calliphora augur larvae at constant temperatures</i>	167
8.4.2 <i>Larval temperature preference</i>	171
8.4.3 <i>Comparing early and late generation larval growth</i>	172
8.4.4 <i>Prediction intervals</i>	172
8.5 Conclusions	173
 Chapter 9: General Discussion	174
9.1 Alternative larval measurement	175
9.2 Studies on developmental substrates	175
9.3 Studies on preservatives	176
9.4 Development in <i>Calliphora augur</i>	176
9.5 Conclusions	177
 Bibliography	178
 Appendices:	187
Appendix I iButton temperature plots for density trials	188
Appendix II List of anticipated publications	192

LISTS OF FIGURES AND TABLES

FIGURES:

	page
Figure 2.1	5
Figure 2.2	9
Figure 2.3	15
Figure 2.4	17
Figure 3.1	21
Figure 3.2	21
Figure 3.3	23
Figure 3.4	24
Figure 3.5	26
Figure 3.6	26
Figure 3.7	28
Figure 3.8	30
Figure 4.1	39
Figure 4.2	39
Figure 4.3	43
Figure 4.4	43
Figure 4.5	43
Figure 4.6	46
Figure 4.7	51
Figure 4.8	52
Figure 5.1	60
Figure 5.2	63
Figure 5.3	65
Figure 5.4	67
Figure 6.1	76
Figure 6.2	80
Figure 6.3	83
Figure 6.4	86
Figure 6.5	91

Figures continued

page

Figure 7.1	Effect of 80% EtOH on body length measurements of first-instar <i>Calliphora augur</i>	101
Figure 7.2	Effect of 80% EtOH on body length measurements of second-instar <i>Calliphora augur</i>	102
Figure 7.3	Effect of 80% EtOH on body length measurements of third-instar <i>Calliphora augur</i>	103
Figure 7.4	Effect of 80% EtOH on body length measurements of late third-instar <i>Calliphora augur</i>	104
Figure 7.5	Change in body length of feeding third-instar larvae hot-water killed and preserved in 70% EtOH for 10 days undisturbed	106
Figure 7.6	Change in body length of feeding third-instar larvae hot-water killed and preserved in 75% EtOH for 10 days undisturbed	106
Figure 7.7	Change in body length of feeding third-instar larvae hot-water killed and preserved in 80% EtOH for 10 days undisturbed	107
Figure 7.8	Change in body length of feeding third-instar larvae hot-water killed and preserved in 90% EtOH for 10 days undisturbed	107
Figure 7.9	Change in body length of feeding third-instar larvae hot-water killed and preserved in 100% EtOH for 10 days undisturbed	108
Figure 7.10	Change in body length of feeding third-instar larvae hot-water killed and preserved in 10% formalin for 10 days undisturbed	108
Figure 7.11	Change in body length of feeding third-instar larvae hot-water killed and preserved in Kahle's solution for 10 days undisturbed	109
Figure 7.12	Comparative effects of various preservative solutions on body length of feeding third-instar <i>Calliphora augur</i> larvae	113
Figure 7.13	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in 70% EtOH for 10 days undisturbed	114
Figure 7.14	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in 75% EtOH for 10 days undisturbed	114
Figure 7.15	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in 80% EtOH for 10 days undisturbed	115
Figure 7.16	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in 90% EtOH for 10 days undisturbed	115
Figure 7.17	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in 100% EtOH for 10 days undisturbed	116
Figure 7.18	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in 10% formalin for 10 days undisturbed	116
Figure 7.19	Change in body length of feeding third-instar <i>Lucilia cuprina</i> larvae hot-water killed and preserved in Kahle's solution for 10 days undisturbed	117
Figure 7.20	Comparative effects of various preservative solutions on body length of feeding third-instar <i>Lucilia cuprina</i> larvae	119
Figure 8.1	Development of <i>Calliphora augur</i> as measured by body length in mm at 15°C	138
Figure 8.2	Development of <i>Calliphora augur</i> as measured by body length in mm at 20°C	138
Figure 8.3	Development of <i>Calliphora augur</i> as measured by body length in mm at 25°C	139

Figures continued

page

Figure 8.4	Development of <i>Calliphora augur</i> as measured by body length in mm at 15°C	139
Figure 8.5	Development of <i>Calliphora augur</i> as measured by body length in mm at 15°C	140
Figure 8.6	Variation in size of <i>Calliphora augur</i> larvae grown at 15°C	144
Figure 8.7	Variation in size of <i>Calliphora augur</i> larvae grown at 20°C	144
Figure 8.8	Variation in size of <i>Calliphora augur</i> larvae grown at 25°C	145
Figure 8.9	Variation in size of <i>Calliphora augur</i> larvae grown at 30°C	145
Figure 8.10	Variation in size of <i>Calliphora augur</i> larvae grown at 35°C	146
Figure 8.11	The influence of temperature on development in first-instar <i>Calliphora augur</i> larvae	148
Figure 8.12	The influence of temperature on development in second-instar <i>Calliphora augur</i> larvae	149
Figure 8.13	The influence of temperature on development in second to third transition <i>Calliphora augur</i> larvae	150
Figure 8.14	The influence of temperature on development in feeding third-instar <i>Calliphora augur</i> larvae	151
Figure 8.15	The influence of temperature on development in post-feeding third-instar <i>Calliphora augur</i> larvae	152
Figure 8.16	Proportions of immature <i>Calliphora augur</i> individuals observed on meat and in chaff over time when grown at 15°C	153
Figure 8.17	Proportions of immature <i>Calliphora augur</i> individuals observed on meat and in chaff over time when grown at 20°C	154
Figure 8.18	Proportions of immature <i>Calliphora augur</i> individuals observed on meat and in chaff over time when grown at 25°C	155
Figure 8.19	Proportions of immature <i>Calliphora augur</i> individuals observed on meat and in chaff over time when grown at 30°C	156
Figure 8.20	Proportions of immature <i>Calliphora augur</i> individuals observed on meat and in chaff over time when grown at 35°C	157
Figure 8.21	Estimation of maggot age from body length, and 95% prediction intervals for the age of feeding larvae grown at 15°C	158
Figure 8.22	Estimation of maggot age from body length, and 95% prediction intervals for the age of feeding larvae grown at 20°C	159
Figure 8.23	Estimation of maggot age from body length, and 95% prediction intervals for the age of feeding larvae grown at 25°C	160
Figure 8.24	Estimation of maggot age from body length, and 95% prediction intervals for the age of feeding larvae grown at 30°C	161
Figure 8.25	Estimation of maggot age from body length, and 95% prediction intervals for the age of feeding larvae grown at 35°C	162

TABLES:

TABLES:		page
Table 4.1	Number of <i>Lucilia cuprina</i> larvae hatching per hour at 20°C	34
Table 4.2	Number of <i>Lucilia cuprina</i> larvae hatching per hour at 15°C	34
Table 4.3	Temperatures in degrees Celsius recorded by manual probe and iButton for different densities of <i>Calliphora augur</i> larvae grown on excess liver	37
Table 4.4	Growth of <i>Calliphora augur</i> larvae on fresh vs. frozen/thawed sheep's liver	40
Table 4.5	Mean lengths (mm) ± standard deviation of <i>Lucilia cuprina</i> larvae grown on different sheep's tissues	44
Table 4.6	Total catch numbers for fly traps baited with different sheep's tissues in an urban environment in summer	47
Table 4.7	Summarised catch for fly traps baited with different sheep's tissues in an urban environment in summer	48
Table 5.1	Summary of body length and width data over time for <i>Calliphora augur</i> larvae grown at 20°C	61
Table 5.2	Summary of best fit of body length and width data over time for larvae of <i>Calliphora augur</i> grown at 20°C	61
Table 5.3	Summary of body length and width data over time for <i>Calliphora augur</i> larvae grown at 25°C	66
Table 5.4	Summary of best fit of body length and width data over time for larvae of <i>Calliphora augur</i> grown at 25°C	66
Table 6.1	Summary growth data of <i>Calliphora augur</i> larvae on fresh vs. frozen/thawed sheep's liver	79
Table 6.2	Recoveries of <i>Lucilia cuprina</i> larvae grown on different sheep's tissues	81
Table 6.3	Mean body length (mm) ± std dev. of larval instars and growth stages by day of <i>Lucilia cuprina</i> grown on different sheep's tissues	82
Table 6.4	Recoveries of <i>Calliphora augur</i> larvae grown on different sheep's tissues	87
Table 6.5	Mean body length (mm) ± std dev. of larval instars and growth stages by day of <i>Calliphora augur</i> grown on different sheep's tissues	88
Table 7.1	Change in measured body length of feeding third-instar larvae of <i>Calliphora augur</i> and <i>Lucilia cuprina</i> in various preservative treatments	112
Table 7.2	Table showing effects different preservatives have when live feeding third-instar larvae of <i>Calliphora augur</i> and <i>Lucilia cuprina</i> are preserved without boiling-water fixation	121
Table 8.1	Number of lay events required from <i>Calliphora augur</i> females to run these experiments	131
Table 8.2	Recoveries of immature <i>Calliphora augur</i> grown at 15°C	132
Table 8.3	Recoveries of immature <i>Calliphora augur</i> grown at 20°C	133
Table 8.4	Recoveries of immature <i>Calliphora augur</i> grown at 25°C	134
Table 8.5	Recoveries of immature <i>Calliphora augur</i> grown at 30°C	135
Table 8.6	Recoveries of immature <i>Calliphora augur</i> grown at 35°C	136
Table 8.7	Mean body length (mm) ± std dev. of larval instars and growth stages by day of <i>Calliphora augur</i> grown at different constant temperatures	141

Tables continued

page

Table 8.8	Instar and growth stage summaries for <i>Calliphora augur</i> larvae at various constant temperatures	142
Table 8.9	Shortest recorded times (in hours) to reach immature life stages in <i>Calliphora augur</i>	143
Table 8.10	Comparison of early and late generation larvae of <i>Calliphora augur</i> grown on sheep's liver at 15°C	168

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ABBREVIATIONS

PMI	post-mortem interval	mcg	microgram
DNA	deoxyribonucleic acid	mg	milligram
sp.	species	g	gram
<i>C.</i>	<i>Calliphora</i>	mL	millilitre
<i>Ch.</i>	<i>Chrysomya</i>	h	hour
<i>L.</i>	<i>Lucilia</i>		
		R-sq	R-square
%	percent	R-sq adj	R-square adjusted
+	plus	ANOVA	analysis of variance
±	plus or minus	d.f.	degrees of freedom
		std dev.	standard deviation
pers comm.	personal communication	p=	probability
e.g.	for example	P	probability
i.e.	that is	n=	number
c.f.	compare with		
vs.	versus		
am	morning		
pm	afternoon/evening		
		°C	degrees Celsius
mm	millimetres	EtOH	ethanol
cm	centimetres	CO ₂	carbon dioxide
km	kilometres		
		E	east
		S	south

I sincerely hope you never have need of these findings.