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TECHNICAL REPORT
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TECHNICAL REPORT
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INSECT SUCCESSION ON CARRION IN THE EDMONTON, ALBERTA REGION OF CANADA

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EXECUTIVE SUMMARY

Forensic entomology, the study of insects associated with a dead body in order to determine time since death, is a valuable tool in homicide investigations. However, in order to be of value, data must be generated on insect succession on carrion in any region in which it is to be used. This research, conducted over three years in the Edmonton, Alberta, Region of Canada studied insect succession on carrion in all seasons, in several different habitats, including sun and shade, partially buried and buried. These data can now be used in death investigations in this region of Canada.

SOMMAIRE

L'entomologie judiciaire, soit l'étude des insectes associés à un cadavre en vue de déterminer le moment de la mort, est un outil précieux pour les enquêtes sur un homicide. Cependant, pour être utiles, les données sur les vagues successives d'insectes qui envahissent la charogne doivent s'appliquer à la région dans laquelle elles sont utilisées. Cette recherche, qui s'est étalée sur trois ans et qui a été menée dans la région d'Edmonton, en Alberta, au Canada, a permis d'étudier ces vagues d'insectes à chaque saison et dans différents habitats (ensoleillés, ombragés, enfouis partiellement ou complètement). Les données recueillies peuvent maintenant servir aux enquêtes sur des décès survenus dans cette région.

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ABSTRACT

A database for insect succession on carrion in the Mixed Boreal Forest Region of Canada, near Edmonton Alberta, was developed from data generated from 3 years of research. Pig carcasses were used as human models and were placed out in various habitats and scenarios including sun, shade, partial burial, burial, spring, summer, fall and winter. Insect succession on the carcasses was sequential so can be used to determine time of death in homicide investigations. It was impacted by season, level of exposure, and geographic region; being different than that observed in previous research in B.C. Carcasses that were buried were heavily scavenged and removed, which may account for the lack of buried homicide cases found in Alberta. These data provide information on both insect succession and carcass decomposition that can be used in homicide investigations.

ABSTRACT (Non-Technical)

Determining time of death in a homicide is very important in the successful investigation of the death and to the eventual prosecution of a killer. However, when a victim has been dead for some time, as is common in cases of homicide, determining time of death becomes extremely difficult. Forensic entomology, or the study of the insects which colonize human remains, can be used to accurately determine time elapsed since death up to a year or more after death. It has proven invaluable in many homicide cases. However, insect colonization rates and patterns vary from biogeoclimatic zone to zone, so data from one geographic area can not be applied to another. Therefore, a thorough understanding of the insects in a geographical area is needed before forensic entomology can be used in that area. This research involved developing a database of the insects that colonize dead animals in Alberta, in the Mixed Boreal Forest region.

This means that data from this area can be applied to any area in Alberta within this region, as well as areas in Saskatchewan and Manitoba. Concurrent research in Saskatchewan and Manitoba is resulting in databases for the grassland and forest zones of the three prairie provinces. This means that these data can be used in forensic entomology cases across the Prairies of Canada.

INTRODUCTION

Determining when a victim died is often one of the most important questions to be answered in a homicide, as it helps to focus the police investigation into the correct time frame, greatly increasing police efficiency. Time of death becomes particularly important when the victim has been dead for some time. Decomposed or skeletonized remains are particularly hard to identify and knowing when the victim died can often assist in identification and time line prior to death.

Time of death in the early postmortem interval is usually determined by the pathologist, based on medical parameters, such as rigor mortis, algor mortis, livor mortis, vitreous humor potassium content *etc*. (Van Den Oever 1976; Henssge *et al.* 1995). However, all of these parameters are affected by many other factors such as body size, clothing, age, illness, exertion prior to death *etc*. and become less valuable as time passes (Knight 1968; Simpson and Knight 1985; Henssge *et al*. 1995). Most pathologists will not estimate time since death beyond 72 h, and many will not go beyond 24 h. However, homicide victims, by the very nature of the crime, are frequently not discovered for days, weeks, months or more after death. In such cases, forensic entomology is the most reliable and frequently the only method of determining time since death (Kashyap and Pillai 1989). More recently, forensic entomology is also being used in the early postmortem interval as well (Anderson and Cervenka 2001).

Forensic entomology is the study of the insects associated with a dead body in order to determine time since death. Insects are attracted to a body within minutes (Nuorteva 1977; Dillon and Anderson 1995; Anderson and VanLaerhoven 1996; Dillon 1997). They develop at a predictable rate (Chapman 1980) and colonize the body in a predictable sequence (Payne 1965; Early and Goff 1986; Dillon and Anderson 1995; Anderson and VanLaerhoven 1996; Dillon 1997). The development rates of blow flies (Diptera: Calliphoridae) can be used to determine postmortem interval in the first few days or weeks after death. Development data

exist for many Canadian blow fly species (Melvin 1934; Nuorteva 1977; Greenberg 1991; Greenberg and Tantawi 1993; Anderson 2000). These data are generated under lab conditions but maggots or larval blow flies appear to develop in the same way under lab or field conditions (Anderson 2000) as the major factor affecting them is temperature, which can easily be duplicated in the lab.

However, the sequence in which insects colonize remains is affected by many more parameters. Insect colonization of carrion is dependent on many factors, but one of the most important is the geographic region or biogeoclimatic zone in which the remains are found. The biogeoclimatic zone defines the habitat, vegetation, soil type and meteorological conditions of the area. This obviously has a major impact on the types and species of insects present, as well as their seasonal availability. It also has an impact on the decomposition of the remains, which in turn, naturally impacts the insects that colonize. Also, although many families of carrion insects are relatively ubiquitous, the individual species involved in decomposition vary from region to region. For instance, species found in the southern US, and other subtropical zones, such as *Chrysomya* sp. are not found in Western Canada at all and are rare in the rest of Canada, with only one species found in Southern Ontario (Cooper personal communication).

Decomposition itself is quite different in various biogeoclimatic zones (Macgregor 1999b, a). Therefore, the species involved in the sequential colonization of the remains and their times of arrival will vary from region to region. Invariably, certain groups will colonize first, such as blow flies (Calliphoridae) and flesh flies (Sarcophagidae), but the species involved will vary. In 1992, a study on insect succession on carrion in summer in the Lower Mainland of British Columbia was conducted. This work showed conclusively that insect succession on carrion is different in this area, in comparison with other similar temperate regions, such as Britain (Anderson and VanLaerhoven 1996). This highlighted the need to study other regions in Canada. The British Columbia database was extended in the following years, looking at insect succession on above ground carrion in sun and shade, in three seasons and three biogeoclimatic zones (Dillon and Anderson 1995, 1996b, a; Dillon 1997; Dillon and Anderson 1997). This was followed by a study on buried carrion in two biogeoclimatic zones (VanLaerhoven and Anderson 1996; VanLaerhoven 1997; VanLaerhoven and Anderson 1999b) and a study on carrion in freshwater (Hobischak 1997; MacDonell and Anderson 1997; Hobischak and Anderson 1999, 2002). A marine study which involved carcasses placed in the ocean began in 2000.

The results from these studies have shown that factors such as geographic region, season and habitat can have a major effect on insect colonization times (Anderson and N.R. 2001).

It is, therefore, imperative that carrion studies are performed in all areas in which forensic entomology is needed. Data must be accumulated for each region so that it can be used in court. The above databases have already been used in many forensic cases from 1992 onwards.

In 1996, together with the CPRC, it was decided to attempt to develop a database of insect succession on carrion for each of the major biogeoclimatic zones across Canada. The Prairie region, consisting of Alberta, Saskatchewan and Manitoba, are covered by three major biogeoclimatic zones which cross all three Provinces (Figure 1). It was, therefore, decided that one biogeoclimatic zone would be studied in each province. The Edmonton region of Alberta represents Mixed Boreal Forest of the Prairie Provinces (Rowe 1972). Further studies are presently being conducted in Manitoba in the Forest and Grassland zone (Gill *et al.* 1998-2000) and Saskatchewan in the grassland zone (Sharanowski *et al.* 1999-2001) . This report represents the studies in the Alberta region from 1997-1999.

METHODS AND MATERIALS

General

Pig (*Sus scrofa* (L.)) carcasses were used throughout the research. All were full sized, adult pigs, which had died naturally at the slaughterhouse or farm, usually due to crushing or suffocation. All the pigs were clothed, as clothing has been found to influence insect colonization (Dillon and Anderson 1995; Dillon 1997). Each pig was fully clothed in layers of clothing to simulate undergarments and outer wear. Pigs are considered to be the best model for human decomposition (Catts and Goff 1992). Originally, 22 kg (50 lb) pigs were planned, as they are considered to be the best representation of human decomposition. However, work in the Edmonton area indicated that smaller carcass size results in significantly faster decay than medium and larger carcasses and so may not be representative models for human death cases (Komar and Beattie 1998a). Therefore, 80 kg pigs were generally used in this set of studies.

Pigs were placed directly on the ground shortly after death. Collections were made from each carcass by hand. At each collection date, insects were collected from the body, the

clothing and the soil surrounding the remains. Live immature insects were raised to adult hood in the lab, then killed and preserved. Adult insects were preserved immediately. Insects were then sent to Vancouver for identification. Observations on the general carcass appearance were made, and internal carcass temperature was taken with a datalogger.

During the experiments in 1997-1998, the carcasses were covered with a light mesh to discourage scavengers (Figure 2). However, due to the losses to scavengers, primarily coyotes and dogs, more sturdy protection was devised for 1999 (Figure 3).

Most of the experiments were conducted at Ellerslie Research Facility which is a large area of land, southwest of the City of Edmonton. The area consists of deciduous, mixed deciduous and coniferous trees and open agricultural fields. The immediate area around the carcasses was primarily poplar, birch and some spruce. The undergrowth consisted of shrub such as alder and raspberry and tall grasses. The very first set of experiments were conducted at Hasse Lake Provincial Park, but a compliant from a trespasser resulted in this experiment being terminated prematurely, and experiments were moved to Ellerslie Research Facility.

Spring, Hasse Lake, 1997

Hasse Lake is approximately 50 km west of Edmonton and is a public park area, with mixed open areas and forest. Carcasses were placed out in early summer and experiments were begun. On June 12, 1997, three carcasses were clothed and two were placed in a partial burial (Pred-1, Pred-2), and one completely buried (B-1). At the time of exhumation, a soil sample was taken from around the carcass. In addition, two carcasses were clothed and placed in direct sunlight (SFS-1, SFS-2) and two carcasses in shade (SS-1, SS-2). On June 25, a further four carcasses were placed in direct sunlight (SFS-3, SFS-4, SFS-5, SFS-6) and one carcass was clothed and placed in the shade (SS-3). On June 27, three more carcasses were clothed and placed in the shade (SS-4, SS-5, SS-6). Details of the collection and placement of the carcasses are shown in Appendix I and II. Due to a complaint, this experiment had to be terminated early.

Summer, Ellerslie Research Station, 1997

Carcasses were placed out in sun and shade on August 5, 1997 at Ellerslie Research Station. Three carcasses, each weighing 80 kg and fully clothed, were placed in direct sun, and a further three carcasses, each weighing 80 kg and fully clothed were placed in shade on August 5, 1997. Details of the collection and placement of the carcasses are shown in the

Appendix III. These carcasses were observed and sampled from August 1997 until covered with snow, then from May to Mid October 1998.

Fall, Ellerslie Research Station, 1997

Three carcasses were placed out in direct sun on October 9, 1997, (GFS-4, GFS-5, GFS-6). They were observed from October 1997 until they were covered by snow (Appendix IV).

Spring/Early Summer, Ellerslie Research Station, 1998

This set of experiments were designed to repeat the above experiment. Nine pig carcasses were placed out at Ellerslie Research Station, owned by the University of Alberta. This is a much more secure site than that at Hasse Lake. Three carcasses were placed, fully clothed, in direct sun (GFS-10, GFS-11, GFS-12), and a further three carcasses were placed in shade on May 6, 1998 (GSH-10, GSH-11, GSH-12). The carcasses were examined every few days and insects collected from the remains from May 6, 1998 until all the carcasses were covered by snow in Fall/Winter 1998. Details of the collection and placement of the carcasses are shown in Appendix V.

Three further carcasses were placed in a shaded region and covered with brush, to simulate victims in which an effort had been made to disguise the remains on 21 July 1998 (GCV-1, GCV-2, GCV-3). These covered carcasses were observed from July 27 1998 until they were removed by vertebrate scavengers.

Spring/Early Summer, Ellerslie Research Station, 1999

This set of experiments were the last to be completed but are reported here as they are the next season to be studied. Two carcasses were placed in direct sun, (GFS-13, GFS-14), fully clothed on May 18, 1999 and the third in full sun carcass GFS-15, on May 20, 1999. Three carcasses were placed, fully clothed in shade on May 20, 1999 (GSH-13, GSH-14, GSH-15). Details of the collection and placement of the carcasses are shown in Appendix VI.. As well, three further fully clothed carcasses (GBU-1, GBU-2, GBU-3) were buried on May 18, 1999. The buried carcasses were covered with approximately 30 cm of soil. These carcasses had been removed by scavengers by May 20, 1999, 2 days after death.

RESULTS

For easy reading, the results and discussion sections have been broken down into the individual experiments for each year. For each experiment, comments will be made regarding decomposition, insect colonization, and temperature (if obtained), respectively.

Decomposition is an uninterrupted process; however for the convenience of discussing the results, it will be divided into five stages based on the physical decomposition of the carcasses (Anderson and VanLaerhoven 1996). The five stages are:

Fresh stage – this stage begins at the moment of death and continues until bloat is evident (Figure 6)

Bloat stage – gases from the anaerobic bacteria start to accumulate which results in a slight inflation of the abdomen, followed by a gradual bloat of the entire carcass (Figure 7).

Active decay stage – onset of this stage is marked by the complete deflation of the carcass, flesh and skin are still present (Figure 8).

Advanced decay stage – by this time, much of the flesh has been removed, maggots typical leave the remains as prepupal insects during this stage (Figure 9).

Dry/remains stage – very little of the carcass remains except bones, cartilage and some skin (Figure 10).

In general, insects colonized the remains in a predictable sequence over time. Insect colonization varied with shade or sun and with season.

Late Spring, Hasse Lake, 1997

Few insects were noted in this preliminary experiment; however, detailed descriptions of the decompositional stages of the carrion were obtained. There was a definite difference in decompositional stages between partially buried and completely buried carcasses (Table 1). Decompositional characteristics observed in partially buried carcasses were bloat, discolouration, fluid leakage, mummified exposed skin, skin sloughing, disintegration of clothes, advanced decay, skeletonization of selected parts and disarticulation. Coleoptera seemed to dominate the shallow buried carcasses, Pred-1 and Pred-2 for the fresh and bloat stage. Approximately June 26th, 14 days elapsed time since death (ETSD), characteristics of the decay stage were observed.

Protophormia terraenovae (Robineau-Desvoidy) inhibited the mouth region, becoming the dominated species on the carcass (Pred-2). Eventually, maggot masses of *P. terraenovae* were established on the face and head region. By July 7th, 24 days ETSD, the carcasses were starting to be skeletonized and the limbs were disarticulated (Table 1). The advanced decay stage was reached by July 14th, 31 days ETSD, for the shallow buried carcasses. The carcasses remained in this stage for the remainder of the experiment. Also at this time, pupal cases were noticed in the clothes and larvae were evident scattered throughout the body (Table 1). The insects associated with the shallow buried carcasses were predominantly beetles including *Ontholestes cinqulatus* (Gravenhorst), *Chrysochus* sp., and *Silpha* sp. (adults and larvae). The only Dipteran species collected was *P. terraenovae.*

When a buried carcass was exhumed on July 18th, 3 weeks ETSD, it was still in the bloat stage (Table 2). Adipocere seemed to be forming and most of the decay occurred on the feet where the presence of *Hydrotaea* sp. was evident. Skin sloughing was evident causing the internal tissue to be visible. The buried carcass was occupied predominantly by *Carabus* sp., *Creophilus maxillosus* (Gravenhorst) and *Hydrotaea* sp. (Table 1).

Decompositional characteristics were consistent in both habitats; shade and sun; however, time of characteristic varied slightly. Common characteristics were observed including bloat, discolouration, marbling, location of insects with clothing, order of disarticulation and scavenging.

The fresh stage lasted 2 or 3 days in the sun habitat, bloat 3-9 days, and active decay 3-12 days. The advanced decay stage was reached on day 11, 12, 14, 18, 19, and 19 respectively. It was during this stage where most scavenging and mummification occurred. These carcasses remained in this stage, never entering the dry/remains stage before the experiment was terminated due to outside circumstances (Table 2).

For the carcasses in the shade the stages were much longer (Table 4). Fresh stage lasted 2-5 days, bloat 6-15 days. The active decay stage lasted from 6-16 days with 1 carcass never reaching the advanced decay stage. The advanced decay stage was reached by 5 out of 6 carcasses, entering this stage on day 15, 21, 21, 22, and 32 (Table 2). The dry/remains stage was not reached by any of the carcasses before the experiment was terminated.

On June 12, fly eggs were first seen on the face region of a shade carcass, SS-2; however it was June 14, 2 days after death, before most flies started to lay eggs on carcasses in both shade

and sun (Table 3 & 4). Adult and larvae *P. terraenovae* were also evident by the second day ETSD on the carcasses in the sun and 2-4 days ETSD for carcasses in the shade. Maggot masses tended to be in the head region first. Dipteran larvae and flies, specifically *P. terraenovae*, dominated all carcasses, SS-1, SS-2, SFS-1, and SFS-2, unlike the partially buried carcasses in which beetle dominated (Table 3 & 4). For the sun and shade carcasses, numerous beetles were observed; however, *Ontholestes cinqulatus*, *Chrysochus* sp., *Silpha* sp., *Necrodes* sp., and *Creophilus maxillosus* were the only species collected and therefore identified. Species of insects appeared to be consistent whether shade or sun habitat (Table 3 & 4).

Table 5 shows the air temperature recorded by the datalogger in degrees Celsius and the total daily rainfall. For the month of June, the range was from a daily high of 28.5 ^{o}C to a daily low of 2.1^{o}C. Rainfall varied from a trace to 42 mm. For the month of July, the maximum daily high was 30.7^{o}C with a minimum daily low of 4.4^{o}C. The rainfall for July varied from a trace to 30 mm (Table 5).

Late Summer, Ellerslie Research Station, 1997

Table 6 shows observations for the carcasses in shade and sun habitats. At the time of placement, carcasses were already in the bloat stage, except for GFS-2, which was in the fresh stage. Bloat, and discoloration were seen 1 day ETSD, in sun pigs, however, it was less evident on carcasses in the shade habitat. Generally, pigs in the shade habitat tended to have purification and skin blistering, whereas sun pigs did not. Also by 2 days ETSD, carcasses in the sun habitat had reached the advanced decay stage, except GFS-2 which was still in active decay until August 15, 10 days ETSD. Mummification occurred on shade pigs by August 11, 6 days ETSD and by the 13th, 8 days ETSD in the sun habitat. Carcasses in the shade habitat only reached active decay stage at 8 days after death, and advanced decay stage 15-17 days ETSD. Birds were observed scavenging the maggots on August 13, 8 days ETSD, one carcass in the sun and one in the shade. By August 18, 13 days ETSD, bones were beginning to be exposed on the sun pigs.

The mean temperature for the month of August was 23.6 ^{o}C with a maximum daily high of 34 ^{o}C and a minimum low of 6.1 ^{o}C. Rainfall varied from a trace to 30 mm with a monthly total of 134 mm (Table 7).

Adult *Phormia regina* (Meigen) were the first arrivals on carcasses in both the sun and shade (Table 6). By August 8th, 3 days after death, first, second, and third instar of *P. regina* were found on all carcasses in both shade and sun. However, *Phaenicia sericata* (Robineau-Desvoidy) adults and larvae were only collected from GFS-3. By the 13th or 8 days ETSD, the

majority of *P. regina* were observed migrating from the carcasses in the sun; however, larvae were still very active on the carcasses in the shade habitat. Besides *P. regina*, *Silpha* sp., *Necrodes* sp., Acari (mites), ants, and *Tabanus* sp. (horse flies) were the only insects collected until 20 days ETSD.

Beginning August 25, 20 days after death, there was an increase in the number of species of insects on the carcasses in both shade and sun, as well as an increase in the number of individuals of each species present. Insects found on carcasses in the shade included *P. regina*, *Piophila* sp., *Silpha* sp., *Creophilus maxillosus*, *Tabanus* sp., *Carabus* sp., Acari (mites), Araneae (spiders), Formicidae (ants), *Drosophila* sp., and *Necrodes* sp. All these above species were observed on the sun carcasses in addition to *Onthophagus nuchicomis* (Linne), *Oxypoda* sp., *Carpophilus* sp., and an incidental grasshopper. This large number of insects were evident on sun and shade pigs in August and September; however insect activity and the number of different species decreased to a few maggots and a couple of beetles in late September, early October. This trend of decreasing numbers of organisms seem to be reflective of the temperatures (Table 8 & 9). September remained quite warm with a maximum daily high of 25 ^{o}C and a daily low of –1.2 ^{o}C; whereas the maximum daily high for October was 20.2 ^{o}C and a low of –7.6 ^{o}C.

Bird scavenging was evident by September 15, 41 days ETSD, on carcasses in the sun habitat, and on September 17, 43 days ETSD on one carcass in the shade habitat. Bird scavenging was also observed throughout October for both shade and sun carcasses (Table 6).

On May 30 and June 2, 1998, 298 and 301 days ETSD, insects collected from carcasses in the sun habitat included *Phaenicia sericata*, *Protophormia terraenovae*, *Drosophila* sp., *Piophila* sp. Ceratopogonidae larvae and adults, Salpingidae adults, *Carpophilus* sp., *Silpha* sp., *Creophilus maxillosus*, *Philonthus* sp., and Aranaea (spiders) (Table 5). Whereas species found on carcasses in the shade included *Drosophila* sp., *Carpophilus* sp., *Creophilus maxillosus*, *Silpha* sp., and earthworms. By June 23, 322 days ETSD, *Piophila* sp. were becoming common in both habitats, shade and sun. In general GSH-2 had the most Coleoptera present out of the shade carcasses; however all shade carcasses had more Coleoptera than carcasses in the sun habitat. In June, carcasses in the sun seemed to have more Formicidae, mites and spiders than observed on the carcasses located in the shade.

By July 14, 343 days ETSD, there was an increase in insect species on carcasses in the sun (Table 6). These species included *Piophila* sp., *Catops basilaris* (Say), *Creophilus*

maxillosus, Chrysochus sp, *Silpha* sp., and *Ontholestes cingulatus.* These species were seen on all three carcasses in the sun. Insect species on all three carcasses in the shade were also consistent; however fewer species were seen. These species included *Drosophila* sp., *Piophila* sp., *Creophilus maxillosus,* and *Chrysochus* sp.

In August sun carcasses had a big variation in decomposition and huge variation in number of species on the carcasses. The sun carcass GFS-2 continued to have the greatest number of species and individuals including *Piophila* sp., *Catops basilaris, Creophilus maxillosus, Chrysochus* sp, *Silpha* sp., and *Ontholestes cingulatus.* Shade pigs had fewer species and lower numbers, but were fairly consistent for all three pigs (Table 6).

Fall, Ellerslie Research Station, 1997

Carcasses placed out in October 1997 in direct sun attracted very few insects. They were observed from the date of placement, 9 October, until covered in snow in late October, 22 days after death (Table 10). Some adult *Phormia regina* (Meigen) were noted by 6 days after death on one carcass and 13 days on another, but they did not hatch. *P. regina* activity was also noted from 18-31 days after death, until covered by snow, but no eggs or immatures developed. Snow impeded the insect activity.

The fresh stage lasted from date of placement to termination of experiment, 22 days ETSD, with the exception of GFS-6 which showed signs of bloat on October 31st, 22 days ETSD. Other decompositional characteristics observed were bird scavenging, mild discolouration and mummification (Table 10). The carcasses were lost over the winter and were not observed further.

Spring/Early Summer, Ellerslie Research Station, 1998

Table 11 shows the insects collected over time from the carcasses placed out in full sunlight and shade May 6, 1998. The first examination date of the carcasses in the sun occurred on May 30, 24 days ETSD. At this time, there were masses of *Protophormia terraenovae* on the carcass and many were beginning to migrate. During the bloat stage, fewer insect species were collected from the carcasses in the sun including *P. terraenovae, Chrysochus* sp., and *Silpha* sp. Two of the three carcasses had been disturbed by animals. June 2, 27 days ETSD, was the first day the carcasses in the shade had been observed. At this time *P. terraenovae* immatures were scattered throughout the carcasses and beginning to migrate. *Creophilus maxillosus, Necrodes* sp. and *Silpha* sp. were abundant, as well as *Drosophila* sp. By June 4, 29 days ETSD, GFS-11

and GFS-12 had been removed by vertebrate scavengers. The carcasses in the shade had passed the bloat stage and were entering into the decay stage by June 8, 1998. There were significantly more beetles observed and collected from the carcasses in the shade than CFS-10, the only sun carcass left. These beetle species included *Silpha* sp., *Creophilus maxillosus, Onthophagus nuchicomi, Catops basilaris* and *Chrysochus* sp., whereas, *Silpha* sp. and *Necrodes* sp. were the only Coleoptera collected from CFS-10. By June 8, 33 days after death, the head was removed on CFS-10 by vertebrate scavengers (Table 11).

By June 19, GSH-10 was removed by scavengers and GSH-11 was removed by July 11, 1998. On June 26, 1998, 51 days after death, *Piophila* sp. was first discovered on carcasses in both the shade and sun habitats. On August 6, 92 days after death, *Ontholestes cingulatus* was collected from GFS-10; however this species was not observed at any time on carcasses in the shade.

Observations from August 13, 99 days after death to the termination of the experiment, September 30, 1999, 147 days were very similar. *Piophila* sp. was the only species still active on GFS-10 (the only sun carcass left), and *Piophila* sp. and *Chrysochus* sp. were the only active species on the shade carcasses. On both carcasses, *Piophila* sp. appeared to be moving slowly due to cold weather and burrowing deeper into carcass due to rain and snow.

Covered pigs – July 27 to September 30, 1998

The "covered" pigs which were placed into the habitat on July 14 were only lightly covered with brush that did little or nothing to change the insects on them. Carcasses were in full bloat and covered with maggots within the week. All of the maggots were observed migrating from the body around July 27th, 13 days after death (Table 12). A family of robins was seen eating the migrating maggots as they moved to a nearby field to pupate.

On August 2, 19 days after death, GCV-1 the body was flat but insects were active; GCV-2 the body was still bloated and fleshy with insects still active; GCV-3 almost completely skeletonized with no maggots evident. By the time the two-week period was up, most of the maggots were gone and little more than bones and dried skin was left. There were no beetles on these pigs other than a few *Creophilus maxillosus* and *Chrysochus* sp. These are eventually replaced by large numbers of maggots that consumed the body in a matter of weeks.

By August 22, 39 days ETSD, GCV-2 was removed by scavengers and by September 30, 78 days after death, both GCV-1 and GCV-3 were removed by scavengers (Table 12).

Spring/Early Summer, Ellerslie Research Station, 1999

The fresh stage of decomposition began at death and lasted for 2-4 days for carcasses in the sun and 2 days for carcasses in the shade habitat (Table 13). The bloat stage lasted 28 and 32 days for carcasses in sun; whereas, it took anywhere from 24 to 44 days for carcasses in the shade. The active decay stage lasted 25 days for one carcass and 26 days for other carcasses in the sun habitat. The carcasses remained in the active decay stage for 30 to 36 days in the shade habitat. The advanced decay stage was reached at 55 and 58 days ETSD for carcasses in the sun habitat; whereas, carcasses for the shade habitat were 56, 70, and 77 days after death, respectively (Table 13). The experiment was terminated while all carcasses were in the advanced decay stage and before any carcass reached the dry/remains stage.

Table 14 shows the insects collected over time from the spring/early summer carcasses for 1999. On May 18, 1999 only two carcasses were placed in the field. At this time a small number of eggs were observed around the nose and eyes. The third carcass in the sun and the 3 carcasses in the shade were placed 2 days later. Maggot masses were present on both sun and shade carcasses. Regardless of the date of placement, by May 22 all carcasses in both shade and sun were bloated; however, it was less extensive for the carcasses in the shade. Advanced bloat occurred the same time for all carcasses around May 25, 7 or 5 days after death.

During the bloat stage, there was an abundance of insects on carcasses in both the shade and sun habitats. Insects collected from the shade carcasses included *Catops basilaris*, *Creophilus maxillosus*, *Ontholestes cingulatus*, *Silpha* sp., *Chrysochus* sp., *P. terraenovae*, *Silpha* sp., *Onthophagus nuchicomis.* In addition to these species, the sun carcasses included *Nicrophorus* sp., *Hister* sp., *Carabus* sp., and *Rhizophagus* sp. Insect species remained fairly constant throughout the decay stage, except for the appearance of *Piophila* sp. in both habitats. By June 29, 42 days after death, *P. terraenovae* were migrating from the carcasses in the sun and pupating near by; whereas it was July 5, 48 days ETSD, before *P. terraenovae* were migrating from carcasses in the shade.

The number of species collected during the advanced decay stage increased in both habitats. However more variation in species and number were observed on sun pigs with the introduction of *Leiodes* sp. and the reappearance of *Hister* sp., *Nicrophorus* sp., and *Carpophilus* sp (Table 14). Immature *Piophila* sp. were observed on the sun carcasses on July 10, July 15, and August 5th, 53, 58, and 77 days after death respectively. *Piophila* sp. was first noted on GSH-13 on July 10th; however it was August 15, 87 days after death and August 18, 90 days after death before populations on the remaining carcasses became evident.

By July 29, 72 days ETSD, the sun carcass were drying out with the exception of GFS-15 which finally dried out by August 18, 90 days after death. This carcass, GFS-15 was noted as not being like the other two sun carcasses and having a significant decrease in insect populations by August 9, 81 days after death. This carcass was further altered by scavenging which occurred sometime between August 9th and 15th. It was evident that drying out was much slower in the shade habitat than in the sun. On August 9, 81 days after death, GSH-14 was described as "still drying out"; whereas on Aug 26, GSH-15 was "dried out considerably".

By September 27, 132 and 130 days ETSD, insect activity on carcasses in both habitats decreased significantly. The few remaining insects included very slow moving or diapausing *Piophila* sp., *Ontholestes cingulatus*, and the odd *Catops basilaris* (Table 14).

The temperature of sun and shade carcasses were measured every observation day. These temperatures were fairly consistent with those temperatures obtained from the weather station within the Ellerslie Research Station (Table 15).

Buried carcasses May 18, 1999

All carcasses were buried in a 1 ft grave on May 18, 1999. By May 20, 2 days after death, all carcasses were scavenged and consequently lost (Table 16).

It was also noted in general, that clothing on the pigs was often pushed off the body by maggot activity. Figure 12 shows the original clothing placement, and figure 13 shows how the clothing has been pushed up around the neck and down to the feet.

DISCUSSION

This research was done in association with the Anthropology Department at the University of Alberta. The research was focusing on decompositional stages on carrion as well as entomology. Therefore, the experiments provide entomological data for a database for insects associated with carrion in the Alberta forest and grasslands.

This research occurred over 3 years (1997-1999). The experiments were executed during various seasons, testing many habitats; sun, shade, partial burial, burial, and using many field technicians. The result of multiple field technicians limits the continuity of observations, which is clearly demonstrated in the description of decompositional stages. Improvements in design occurred after each experiment; therefore, the problems were not repeated. Date of carcass placement were not identical, due to supply of carcasses, even within the same season in some cases, making some comparisons difficult.

Late Spring, Hasse Lake, 1997

One carcass was on the surface in partial shade, a second was partially buried in a 14 inch grave, and the third was buried with 1 foot of soil covering the carcass. So this gives interesting anecdotal data, but it is difficult to do any comparisons, due to lack of replication. The shallow buried carcass had been dead for 36 hours by the time of placement. It was brought to the site a day after death and then left at the surface over night before it was covered. This makes it confusing when referring to ETSD. This almost mimics a scenario where a body was killed and then transported to a disposal site and buried a day later.

Anderson and VanLaerhoven confirmed that flies are immediately attracted to a body after death (Anderson and VanLaerhoven 1996). The older carcass came from an animal rendering plant, so was protected from fly activity prior to placement. As most flies do not lay eggs at night, the body would not have been exposed until the following morning.

Protophormia terraenovae inhabited both the surface/partial shade and partially buried carcasses. This species is common during the spring months in warmer areas (Smith 1986; Byrd and Castner 2001) and has been collected in shade and sun habitats in BC, although mostly in more northern or higher altitude areas (Dillon and Anderson 1996a; Dillon 1997). They were only found on above ground carcasses or in pitfall traps related to buried carcasses in B.C. (VanLaerhoven and Anderson 1996; VanLaerhoven 1997; VanLaerhoven and Anderson 1999a). The burial carcass was still bloated after 3 weeks, which is consistent with that seen in research in British Columbia (VanLaerhoven and Anderson 1996; VanLaerhoven 1997; VanLaerhoven and Anderson 1999a). Other species collected from the buried carcass were *Hydrotaea* sp., *Carabus* sp. and *Creophilus maxillosus*. These insects are consistent with those collected from other burial experiments (VanLaerhoven and Anderson 1996; VanLaerhoven 1997; VanLaerhoven and Anderson 1999a), but are not restricted to burial, being found in exposed carcasses also (Dillon and Anderson 1995; Anderson and VanLaerhoven 1996; Dillon and Anderson 1996a; Dillon 1997).

Duration of decompositional stages were more consistent on carcasses in the sun than carcasses in the shade. The length of time spent in each stage was longer for carcasses in the shade habitat. The dry/remains stage was not reached by any carcass in the shade or sun habitat before the experiment unfortunately had to be terminated. One carcass in the shade habitat (SS-4) was still in active decay stage when the research ended. This carcass was the only one in the shade habitat which had been deceased for 36 hours by placement, but it seems unlikely that this was have delayed decomposition.

Adult *Phormia regina* were the first arrivals on carcasses in both the sun and shade habitats and second instar larvae were visible by 1 day ETSD, indicating immediate oviposition. This is a species that is often considered to be a later arrival (Lord and Burger 1984; Goddard and Lago 1985; Hall and Doisy 1993), irrespective of carcass size (Denno and Cothran 1976). In B.C. it was collected immediately after death, but did not lay eggs until day 2 (Anderson and VanLaerhoven 1996). *Phaenicia sericata* adults and larvae were collected from only one carcass in the sun habitat. *P. sericata* is not usually found in rural areas (Smith 1986; Anderson and VanLaerhoven 1996), preferring sunlit open areas (Smith 1986). It was not found in any of the studies in B.C. (Dillon and Anderson 1995; Anderson and VanLaerhoven 1996; Dillon and Anderson 1996 b,a; VanLaerhoven and Anderson 1996; Dillon 1997; Dillon and Anderson 1997; VanLaerhoven 1997; VanLaerhoven and Anderson 1999b). The distinction between an urban and rural species usually refers to the presence of human activity such as human garbage, so the fact that the Hasse Lake area is a park may have influenced the presence of such an urban species. The research sites in B.C. where more wilderness areas and had much reduced human activity.

There was no significant difference in the duration of each decompositional stage and insect colonization for the 156 kg pig carcass compared with the other carcasses in the sun habitat, even though the size ranged from 19 – 80 kg. This was also observed in the shade habitat where a 162 lb carcass showed no difference than pig carcasses ranging from 21-80 kg. This contradicts Denno and Cothran who found carcass size had a direct relation to fly populations (Denno and Cothran 1975).

Late Summer, Ellerslie Research Station, 1997

Adult *Phormia regina* were the first arrival on the carcass in both the sun and shade habitats, being present at the time of unloading. So this again supports the evidence at Hasse Lake, that *Phormia regina* can be a pioneer species in some areas. *Phaenicia sericata* was found three days after death, on only one carcass in the sun habitat. Generally *P. sericata* is one of the earliest arriving flies preferring bright sunshine and open habitats (Byrd and Castner 2001), but as it is not normally found in rural areas, the specimens found may have just been from a single introduced specimen.

Piophila sp. larvae were collected earlier than has previously been reported, 24 days after death in the sun habitat and 29 days in the shade habitat. This agrees with Anderson and VanLaerhoven (Anderson and VanLaerhoven 1996) who also collect Piophilidae larvae at 29 days after death. However, *Piophila* sp were evident on carcasses 51 days after death in both sun

and shade habitats in 1998. In 1999 immature Piophilidae were collected 53 and 55 days after death for sun and shade, respectively.

All pigs that were put out in 1997 were in advanced decay in May 1998, when observations resumed. *Protophormia terraenovae* adults were evident only on June 2, 301 ETSD, and were probably only interested in any protein material that may have been left. They did not lay eggs, as there was not enough tissue left to support eggs. *Drosophila* sp. seemed to be the dominating Diptera beginning June 8, 307 ETSD until June 19, when *Piophila* sp. became common again. Coleoptera seemed to dominate the carcasses in both habitats for the remainder of the experiment.

Those carcasses in the shade had substantial soft tissue left, mainly adipocere and skin. Their condition was comparable to the last recorded condition of the pigs put out in the spring of 1999. Carcasses in the sun habitat were dry, desiccated and the bones were separated completely. The remaining carcasses consisted of dry skin, hair and bones. Very little adipocere was left, except for under the clothing near the ground.

Fall, Ellerslie Research Station, 1997

Carcasses were placed October 9, and snowfall occurred immediately after. Freezing of a body does impact decomposition so may also impact insect colonization (Micozzi 1986). Carcasses were not colonized until October 15, 6 ETSD, when fly eggs were evident in the mouth of one carcass; however, these eggs were absent the next observation day. Masses of eggs were observed numerous times but larvae were never evident. This may have been due to the cold temperatures or the high humidity. Adult *Phormia regina* were the only Calliphoridae collected throughout this fall experiment. This is not surprising considering *P. regina* is often referred to as a cool weather fly. *P. regina* is usually present within a few days after death (Anderson and VanLaerhoven 1996), however it was 18 days after death before it was observed or collected from the carcasses. Although winter temperatures will greatly prevent most insect activity, decomposition has been shown to progress, in many cases due to mammalian scavenger activity (Komar 1998).

Spring/Early Summer, Ellerslie Research Station, 1998

Scavenging by vertebrates was very evident in this experiment. By June 4, 29 days ETSD, two carcasses in the sun habitat had been removed by vertebrate scavengers. Also by 44 and 76 days ETSD, carcasses in the shade habitat had also been removed. This contradicts research done by Dillon in B.C. where no or little scavenging was observed during the summer

months (Dillon and Anderson 1995, 1996a; Dillon 1997), indicating possible geographic differences.

In general, bloat occurred much more slowly and lasted longer in the carcasses placed in May than later in the season. The ambient temperature was warm, but the ground was still cold, perhaps slowing down the process.

Onthophagus nuchicomi was evident on only one carcass in the shade habitat at 39 days ETSD and it continued to revisit the carcass until termination of experiment. At 69 days after death, *Catops basilaris* was found on two carcasses in the shade habitat and was not evident again. The appearance of *Catops* is slightly later than Smith (Smith 1975) who found *Catops tristis* (Panzer) beneath a single fox carcass from one to two months after death in England, and when immature Dipterans were gone.

Covered pigs – July 27 to September 30, 1998

The "covered" pigs were only lightly covered with brush that did little or nothing to change the insects colonization patterns. By the time the two-week period was up, most of the maggots were gone and little more than bones and dried skin were left. These pigs were exposed to equal periods of sun and shade. This same condition of large maggot masses and fast decomposition was also noted in the additional pigs that were placed later in the summer of 1999. Scavenging played a major role in this experiment, as 1 carcass was removed by August 22, 39 days ETSD, and the remaining two were gone by September 30, 78 days after death. This contradicts observations by death investigators (Stair Personal Communication) which noted completely articulated skeletons are common in summer and intense scavenged remains are typical of winter deaths.

Spring/Early Summer, Ellerslie Research Station, 1999

The duration for each decompositional stage was significantly longer for all stages except the fresh stage when compared with 1997 data. This may partially be due to the difference in field technician's observations, as well as temperature and size of pig carcasses. For carcasses in the shade, the bloat stage was less pronounced than those carcasses in the sun habitat. The bloat, decay and advanced decay stages had a wider range and longer duration than the sun habitat. Data for 1998 was incomplete and could not be compared in the same manner.

For one carcass that was dead 36 hours at the time of placement, the bloat stage was 4 days longer however, duration of decay and advanced decay were consistent with other two carcasses in sun habitat. This 36 hour delay did not have any affect on the later decomposition as well as, insect colonization. One sun carcass, GFS-15, did not decompose in the same manner se the other carcasses in the sun habitat. It was dried out at 90 days after death compared with 72 ETSD for the other two carcasses in the sun habitat. Besides the difference in decompositional characteristics, there was a significant decrease in insect populations by August 9th, 81 days ETSD.

The largest number of species were noted during the advanced decay stage. A greater variation in species and number of species was observed on carcasses in the sun habitat versus the shade. A greater number of insect species was collected in 1999. This may be due to the same technician collecting in 1998 and 1999; therefore knowing what to look for and being more consistent collecting and noting observations. Immature *Piophila* sp were collected 53 and 55 days after death evident on carcasses in the sun and shade, respectively. However, immature

Piophila sp. were observed much earlier, at 24 and 29 days ETSD, in the 1997 experiment. By September 27, 132 and 130 ETSD, insect activity was very limited, almost exclusively slow moving or diapausing *Piophila* sp.

Scavenging was reported to be most common in the advanced decay stage in the 1997 Hasse Lake experiments. This was also replicated in the spring/early fall experiments at Ellerslie Research Station in 1999.

Buried carcasses May 18, 1999

The buried carcasses were once again, rapidly scavenged and lost. This was probably due to packs of domestic dogs loose in the neighbourhood. When this research was in the development stages, it seemed prudent to add burial to the research. However in discussions between GSA and OB, it became apparent that in over 20 years of forensic anthropology case work and investigation in Alberta, OB had only dealt with burial cases a handful of times. In contrast, in BC, bodies are frequently buried (VanLaerhoven and Anderson 1999a). Originally, this was considered to possibly be a difference in scenario or some other geographic or social difference between Alberta and BC. However, as all the attempts to bury carrion in this Alberta study, as well as in the Manitoba study (Gill *et al.* 1998-2000), it becomes apparent that perhaps victims are buried in these provinces as commonly as in BC, but are removed and destroyed by scavengers so much faster, that they are never recovered.

The regular observation that maggot activity pushed the clothing to the neck and feet confirms observations by Komar and Beattie (Komar and Beattie 1998b) in this region. These authors suggested that this clothing displacement could be thought to represent sexual assault rather than maggot activity. This was disputed by (Peden *et al.* 2000) with work in Tennessee which did not notice such clothing displacement. However, the Tennessee work failed to recognize the clear geographical and faunal differences between Alberta and Tennessee. Maggot masses and insect activity was much greater in carcasses observed in this study, than by that presented by Peden *et al.* (Peden *et al.* 2000) in Tennessee. This again highlights the need to conduct research locally as such differences may have a major impact on an investigation.

CONCLUSIONS

Insects colonized carrion in the Mixed Boreal Forest region of Alberta in a predictable sequence. This sequence, was impacted by exposure to direct sunlight, burial, and season. Although the general colonization by families was similar to that reported from other areas, the timing of arrival, tenure on the remains and the actual species was different. These data can now

be used to determine time of death in homicide victims found in this region of Canada in all seasons and in a variety of habitats and exposure levels. Scavenging by large canids resulted in carcass loss in several situations, and may be a common problem in homicide investigations. This work is complemented by research conducted in BC, Manitoba and Saskatchewan, generating databases that can be used from the Pacific Ocean to Central Canada.

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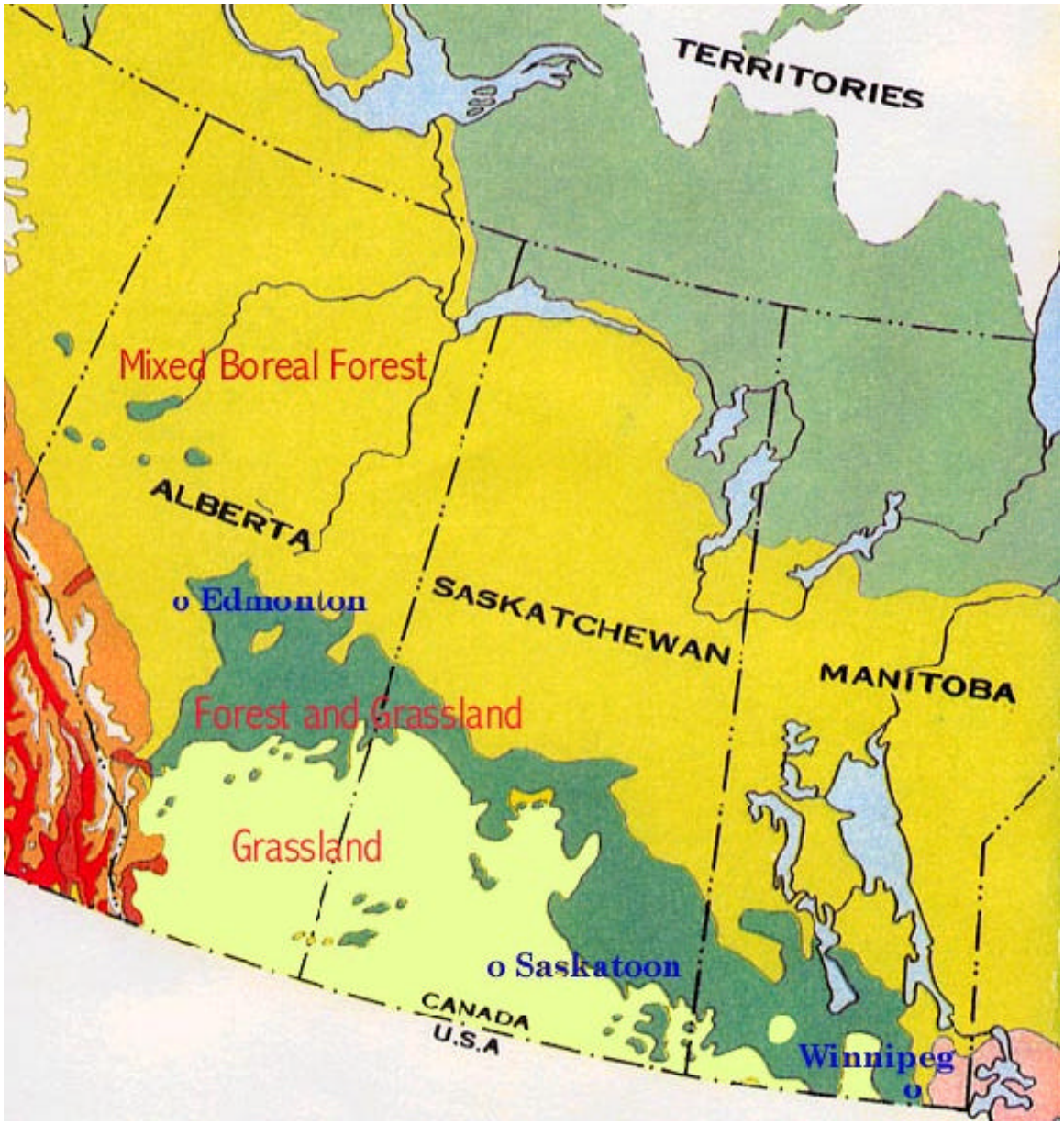

Figure 2. Original protection for carcasses used in 1997-1998 (Photo by CS)

Figure 3. Upgraded carcass protection used in 1999 (Photo by CS)

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Table 1. Alberta summer data 1997, for carcasses buried and partially buried, Hasse Lake.

DATE	ETSD	Shallow Burial		Burial
		Pred-1	Pred-2	B-1
June 12, 1997	0	Fresh	Grave 14' deep Unburied first day Already bloated and discoloured	
June 13	1	Head completely discoloured green	Grave filled in Head exposed No insects	
June 14	2	Fly eggs in collar of dress *Ontholestes cinqulatus* (A) Bloating gone	Strong smell Lots of beetles	
June 15	3	No change	No change	
June 16	4	Only beetles Slight green discolouration continues No bloat	*Ontholestes cinqulatus* (A)	
June 17	5	Some fluid leakage No visible maggots	Skin drying out	
June 18	6	Beetle cluster at mouth Mummified exposed skin	Brown foam from mouth No maggots Less odour	
June 19	7	Discolouration fading	*Protophormia terraenovae* larvae in mouth Brown foam	

Table 1. Alberta summer data 1997, for carcasses buried and partially buried, Hasse Lake contd.

DATE	ETSD	Shallow Burial		Burial
		Pred-1	Pred-2	B-1
June 20	8	No visible change	No change Exposed skin mummifying No visible insects	
June 21	9	No visible change	*Protophormia terraenovae* (I) and foam on face	
June 22	10	No change No visible insects	Exposed as *Protophormia terraenovae* (I) begin eating face	
June 23	11	No change	*Protophormia terraenovae* (I) in head region	
June 24	12	More beetles More flies	Foam Many *Protophormia terraenovae* (I) Skin sloughing	
June 25	13	More beetles Fly eggs on head	Many *Protophormia terraenovae* (I) around head Skin slippage Complete skull shifted back	
June 26	14	Finally starting to go Skin sloughing *Protophormia terraenovae* (I) beneath skin	Foam *Protophormia terraenovae* (I) on face still	
June 27	15/0	Blisters broken Beetles Exposed bone in areas	Jacket beginning to disintegrate off	Probe inserted into 1” incision in the throat

Table 1. Alberta summer data 1997, for carcasses buried and partially buried, Hasse Lake contd.

DATE	ETSD	Shallow Burial		Burial
		Pred-1	Pred-2	B-1
June 28	16/1	*Protophormia terraenovae* (I) in chest Exposed maxilla No beetles	Foam everywhere *Protophormia terraenovae* (I)	
June 29	17/2	Thick fluid leakage from head Skin sloughing Small millipede	Foam	
June 30	17/3	Foam under clothes	Foam and gunk *Chrysochus* sp. (A)	
July 1	18/4	More *Protophormia terraenovae* (I) at shoulder Forelimb exposed bone	Dry bone on skull	
July 2	19/5	Lots of beetles at legs and chest region including *Chrysochus* sp. (A) and *Silpha* sp. (I,A) Adult flies on body and *Protophormia terraenovae* (I) exposed through small hole in throat region		
July 3	20/6	No foam Lots of insects	Skull clean *Protophormia terraenovae* (I) below	
July 4	21/7	Shell of dried skin filled with *Protophormia terraenovae* (I)	Mandible still articulated	
July 5	22/8	*Protophormia terraenovae* (I) at throat Foam by legs and head	Clothes disintegrating	

Table 1. Alberta summer data 1997, for carcasses buried and partially buried, Hasse Lake contd.

DATE	ETSD	Shallow Burial		Burial
		Pred-1	Pred-2	B-1
July 6	23/9	No change	No change	
July 7	24/10	Forelimbs disarticulated Lower head skeletonized Beetles and *Protophormia terraenovae* (I)	No change	
July 8	25/11	Forelimbs completely disarticulated *Protophormia terraenovae* (I)	No change	
July 9	26/12	Tons of beetles Legs still have mass of *Protophormia terraenovae*	No change	
July 10	27/13	*Protophormia terraenovae* (I) on legs Foam	No change	
July 11	28/14	*Protophormia terraenovae* (I) on legs Foam	No change	
July 12	29/15	Less *Protophormia terraenovae* (I) on legs and only under clothing	No change	
July 13	30/16	*Protophormia terraenovae* (I) under clothes Body collapsed	No change	
July 14	31/17	Advanced decay stage	Pupal cases in clothes	
July 15	32/18	*Chrysochus* sp. (A) everywhere Fluid leakage from head		

Table 1. Alberta summer data 1997, for carcasses buried and partially buried, Hasse Lake contd.

DATE	ETSD	Shallow Burial		Burial
		Pred-1	Pred-2	B-1
July 16	33/19	Lots of beetles Foam *Protophormia terraenovae* (I) on legs		
July 17	34/20	Tons of beetles No *Protophormia terraenovae* (I) visible		
July 18	35/21	Skin become lumpy and white		(3 weeks) Skin sloughing, meat of the body showing through Adipocere seemed to be forming on the body Mild odour Some discolouration Most decay on feet in presence of maggots At the exhumation lots of flies were immediately attracted to the body Dirt Sample: Muscidae, *Hydrotea* sp. (I) *Carabus* sp. (A) Staphylinidae, *Creophilus maxillosus* sp. (I)

Table 2. Duration of decompositional stages for buried, partially buried, sun and shade carcasses at Hasse Lake.

Stage	Pred-1	Pred-2	B-1	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
Fresh	1	n/a	unk	2	3	3	3	3	2	2	2	2	n/a	n/a	5
Bloat	21	10	21*	5	3	9	7	6	9	14	12	12	15	9	6
Decay	10	8		12	5	7	4	3	7	16	7	8	15*	6	10
Advanced Decay	4	5		19*	11*	19*	14*	12*	18*	32*	21*	22*		15*	21*
Dry/ Remains	36*	23*													

n/a pig was dead for 36 hours at time of placement
* day current stage was entered, experiment was terminated therefore duration of stage can't be calculated
unk unknown duration of fresh stage, carcass was buried and stage was not observed

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
June 12, 1997	0	No external trauma	Very fresh Some trauma to anus				
June 13	1	No change	No insects				
June 14	2	Extreme insect activity Much bloating Thousands of flies	Mild discoloration No egg deposits				
June 15	3	Bloating Flies and egg masses Marbling and discolouration	A few beetles, no maggots Eggs on face Mild bloating				
June 16	4	Strong odour Fluid leaking from mouth and head Maggot mass under forelimbs	*Ontholestes cinqulatus* (A) Nothing visible on face Visible eggs at anus				
June 17	5	Skin blistering Fluid seeping *Protophormia terraenovae* (I) everywhere	Mass of *Protophormia terraenovae* (I) near anus Face, skin mummified				

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
June 18	6	Two distinct sizes of *Protophormia terraenovae* (I) Less odours Black blisters	Body cavity collapsed Clothing very stained Some destruction of face				
June 19	7	*Protophormia terraenovae* (I) very active Chest collapsed	*Protophormia terraenovae* (I) attacking face				
June 20	8	*Protophormia terraenovae* (I) very active on and under clothes Brown foam everywhere	Dry bone Mummified skin on face *Protophormia terraenovae* (I) on head Intervertebral disk exposed but present				
June 22	9	Exposed rib cage *Protophormia terraenovae* (I) have removed clothing Foam gone Pools of water	*Protophormia terraenovae* (I) still moving around				

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
June 25	13/0	Exposed vertebra Mummified skin Hooves off *Protophormia terraenovae* (I) off body	No more *Protophormia terraenovae* (I) Insects have moved off	2 x incisions 2 tattoos Very fresh Anus extruded	X incision in butt Extruded butt Fresh stage	3 x incisions (shoulder, belly, hips) Fresh	3 x incisions (shoulder, belly, hips)
June 26	14/1	Still lots of *Protophormia terraenovae* (I) Leathery skin Foam	Little insect activity	Some discoloration Many adult flies Some bloating	No visible bloating or discoloration Adult Diptera present Fresh stage	Some green discoloration with bloating	Green discoloration Flies
June 27	15/2	Skull and vertebrate column exposed	No change	Flies at head and anus	Tiny *Protophormia terraenovae* (I) in mouth Slight bloating	Flies	*Protophormia terraenovae* (I) in mouth Discoloration
June 28	16/3	Foam is back Flooded *Protophormia terraenovae* (I) leaving for ground	No change	*Protophormia terraenovae* (I) in mouth Green discoloration in head and chest Bloating	Feeding third instar *Protophormia terraenovae* (I) in face Less bloating than yesterday	Nose black and dry No maggots visible	*Protophormia terraenovae* (I) in face Green and marbling

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
June 29	17/4	Grey discoloration *Protophormia terraenovae* (I)	No change	Adult Diptera everywhere and *Protophormia terraenovae* (I) in mouth Green coloration	Green lividity Adult Diptera everywhere and *Protophormia terraenovae* (I) on face	Marbling on belly Ear bones exposed No eggs	Tongue mummified Flies everywhere
June 30	18/5	Bleaching of mandible *Protophormia terraenovae* (I) on grass	Formicidae(ants) and *Chrysochus* sp. (A) arrived Intervertebral disk still there	*Protophormia terraenovae* (I) in mouth	Ooze out of anus *Protophormia terraenovae* (I) on face	Small *Protophormia terraenovae* (I) in mouth	Chest discoloration and bloated Clustering of flies
July 1	19/6	Isolated *Protophormia terraenovae* (I) in protected spots Intervertebral disk intact	No insects visible Intervertebral disk still there	*Protophormia terraenovae* (I) along ground near head region	More ooze out of anus *Protophormia terraenovae* (I) mass on head	Ears drying out Incisions desiccating	Very discoloured, black and green Large chest bulge *Protophormia terraenovae* (I)
July 2	20/7	Advanced decomposition Grey mould on clothes More *Protophormia terraenovae* (I) maggot activity in shaded spots also found inside the exposed skull	No action visible except lots of *Protophormia terraenovae* (I)	Lots of *Protophormia terraenovae* (I) at chest, throat and ground line	Body bloated Shirt moving across chest Mass of *Protophormia terraenovae* (I) on head, stomach and near ground Adult flies all over body	Face dry and mummified Skin like leather	Smell decreasing Chest swelling Skin dry

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
July 3	21/8	Intervertebral disk holding	*Protophormia terraenovae* (I) and ants Intervertebral disk holding	Lots of fluid out of chest *Protophormia terraenovae* (I) at ground line Clothes moving	Under pants skin blistering Stripped off pants	*Protophormia terraenovae* (I) at ground line and in clothes	Skin blistering *Protophormia terraenovae* (I) everywhere
July 4	22/9	Isolated *Protophormia terraenovae* (I) in outer clothes	Crickets, spiders and ants present	*Protophormia terraenovae* (I) everywhere and causing clothes to move	Clothes coming off, including socks	*Protophormia terraenovae* (I) only at ground line A loose carpel by paw	*Protophormia terraenovae* (I) in cave of chest at ground line
July 5	23/10	Very few isolated *Protophormia terraenovae* (I)	No activity	Panties moved off *Protophormia terraenovae* (I) everywhere	Skin of stomach is discoloured	Rib cage open Chest empty Panties moved off	Very wet and greasy Foam from mouth Shirt moving back
July 6	24/11	Isolated *Protophormia terraenovae* (I) in outer clothes	Tons of beetles	Bra visible Less "gunk" spread than SFS-4	*Protophormia terraenovae* (I) found on roadway going to pupate (75 feet) Active decay	Body collapsed Pants right off *Protophormia terraenovae* (I) scattered	Dried up Some foam Arm dropped Panties moved off
July 7	25/12	Very small *Protophormia terraenovae* (I) Under clothes	Beetles and crickets	Body collapsed Strong odour	Very greasy Body collapsed *Protophormia terraenovae* (I) Very putrid odour	Dry mummified remains No flesh but skin	*Protophormia terraenovae* (I) everywhere Pants off

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
July 8	26/13	No change Very wet and greasy	No change Removed fence	Still lots of *Protophormia terraenovae* (I) Skin not mummified	Sock removed 1 ft away *Protophormia terraenovae* (I) Greasy Grey mould on face	Isolated *Protophormia terraenovae* (I) on clothes	Honeycombs and *Protophormia terraenovae* (I) in holes in skin
July 9	27/14	Some guts still there but mummified	No change	Red ants everywhere No odour	Another mass maggot migration 75 feet (exactly the same)	A few isolated *Protophormia terraenovae* (I) No beetles	Still tons of *Protophormia terraenovae* (I) Greasy
July 10	28/15	No change	Less skin on face Many beetles	Body collapsed	No real body left *Protophormia terraenovae* (I) under skin	No maggots	Body collapsed *Protophormia terraenovae* (I)
July 11	29/16	No smell Wet and rainy	Skin off face	Foam Colour lighter Not much body left	Less visible activity	No change	Rib cage exposed Steam off body
July 12	30/17	No change	No change	Heavy rain Some foam	No change	No change	Rib cage exposed
July 13	31/18	Water logged Pupal floating Some live *Protophormia terraenovae* (I)	Body removed Intervertebral disk separated	Piece of anus 1 ft from body	Tiny flies Exposed hip Mould on clothes	New carpel bone on shirt	Lots of adult flies New *Protophormia terraenovae* (I) in mouth Advanced decay

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
July 14	32/19	New *Protophormia terraenovae* (I) under skin		Some *Protophormia terraenovae* (I) Smells slightly Advanced decomposition	Advanced decomposition	No activity	Advanced decay Not much maggot activity
July 15	33/20	Isolated *Protophormia terraenovae* (I) but can still be heard		Less odour Active *Protophormia terraenovae* (I) can be heard Little activity	Still *Protophormia terraenovae* (I) under skin Intervertebral disk disintegrating	No activity	Carnivore scavenging of anus Grey mould
July 16	34/21	Still *Protophormia terraenovae* (I)		Grey mould *Protophormia terraenovae* (I)	Some *Protophormia terraenovae* (I) Tiny flies Less odour	No change Exhumed	Limited *Protophormia terraenovae* (I) activity Mummified skin
July 17	35/22	*Protophormia terraenovae* (I) can be heard Tiny flies		No change	Tiny flies *Necrodes* sp. (A) *Protophormia terraenovae* (I) can be heard		Still *Protophormia terraenovae* (I) under clothing
July 18	36/23	No change		No change	No change		Lots of adult Diptera
July 19	37/24	No change		Not dry	No change, no noise		Carnivore chewing on shirt

Table 3. Alberta summer data 1997, for carcasses in full sun, Hasse Lake contd.

DATE	ETSD	SFS-1	SFS-2	SFS-3	SFS-4	SFS-5	SFS-6
July 20	38/25	Exhumed		No change	No change		Still discoloration
July 21	39/26			No change	No change		Only *Protophormia terraenovae* (I)

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
June 12 1997	0	Caged, laying on left side No trauma	Fresh No external trauma Fly eggs on eyes				
June 13	1	Head slightly discoloured	No change				
June 14	2	Head bloating Eggs deposited on eyes and mouth	Green discoloration Large egg deposits at eyes and mouth				
June 15	3	Beetles present Some bloating Eggs deposits on eyes and mouth	Bloating Approximately 1 day behind SS-1 Flies in mouth				
June 16	4	Eggs over face Bloating No maggots	Mass of *Protophormia terraenovae* (I) at neck Head black Full bloat Some *Ontholestes cinqulatus* (A)				
June 17	5	Body bloated Flies and beetles No maggots	Mouth filled with *Protophormia terraenovae* (I)				

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
June 18	6	Lots of fly eggs and beetles No maggots	Lots of insect activity in mouth No facial features left Bloating gone				
June 19	7	No change No mummification	More *Protophormia terraenovae* (I) Discolouration				
June 20	8	No beetles, no maggots, no discolouration Little bloating	Brown foam around maggots Crackling sound				
June 22	10	Pouring rain Very small *Protophormia terraenovae* (I) in mouth No beetles	Pouring rain Dental arches protruding from skull *Protophormia terraenovae* (I) at head and feet				
June 25	13/0	*Protophormia terraenovae* (I) in mouth More overall activity	Dress very stained Hip skin slipped Skin black	Date of placement 3 x incisions No extended butt			

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
June 26	14/1	Lots of beetles Small *Protophormia terraenovae* (I)	Foam *Protophormia terraenovae* (I) at hips	Eggs on face Nymphalidae (butterfly)			
June 27	15/2/0	Chest collapsed *Protophormia terraenovae* (I) on face and gut Beetles	Foam *Protophormia terraenovae* (I) Face gone	Green marbling Flies in anus	Date of placement No incision Some discoloration Slight bloating	Date of placement Stomach bloated Slightly green (same level of decomposition as SS-4)	Date of placement Foot long incision across hip Some discoloration and marbling
June 28	16/3/1	Upper chest collapsed Shirt moved Foam and *Protophormia terraenovae* (I)	Foam Strong odour Shorts off	Panties and shoe off Marbling	Very green and marbled	Green bloated stomach	A few flies in wound, some discoloration and marbling
June 29	17/4/2	Foam *Protophormia terraenovae* (I) on gut and upper face, larger ones on gut region	Less *Protophormia terraenovae* (I) Less foam Shorts off	Very green Flies everywhere No maggots	No maggots Very green	Fly eggs in mouth	Some discoloration and marbling No flies on face
June 30	18/5/3	Beetles feeding on *Protophormia terraenovae* (I) Foam Clothing moving	Less *Protophormia terraenovae* (I) Stocking off foot	Small *Protophormia terraenovae* (I) in mouth No masses	No maggots Faded green	Skin drying out Eggs on mouth	Flies on incision

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
July 1	19/6/4	Skin like leather, stiff	Reduced *Protophormia terraenovae* (I) activity Some greyish mould	No change	A few eggs on face	Egg masses on face and chin	A few eggs on face
July 2	20/7/5	Advanced decomposition and active decay Adult flies Nymphalidae (butterfly) Pupal casing found on back *Protophormia terraenovae* (I) found in eye sockets	Advanced decomposition and decay Adult flies on body Skull exposed and grey Intestines exposed *Chrysochus* sp. (A) *Protophormia terraenovae* (I) over entire body	Maggot masses at face and stomach *Protophormia terraenovae* (I) larger at stomach	Lots of eggs on face, some *Silpha* sp. (I) No maggots	Nymphalidae (butterfly) *Protophormia terraenovae* (I) on face	*Protophormia terraenovae* (I) at incision
July 3	21/8/6	Fresh fly eggs on clothes Face gone Chest collapsed	*Chrysochus* sp. (A) on dry bone *Protophormia terraenovae* (I) more scattered	*Protophormia terraenovae* (I) all over gut Clothing coming off	Tiny *Protophormia terraenovae* (I) on mouth Fresh eggs	*Protophormia terraenovae* (I) on head Beetles	Bright yellow foam from *Protophormia terraenovae* (I)
July 4	22/9/7	Lots of adult flies Face has little activity	No longer any true body Mummified skin and maggots	Chest cavity with *Protophormia terraenovae* (I)	Mass of *Protophormia terraenovae* (I) at mouth	Head gone Shirt stained Eggs all over back	Foam gone *Protophormia terraenovae* (I) all over butt, but none on head

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
July 5	23/10/8	Less visible activity Less beetles Less odour	Grey mould on face Waxy smell Lots of *Protophormia terraenovae* (I)	Maggot line and discoloration follow clothes	Tiny *Protophormia terraenovae* (I) in mouth	*Protophormia terraenovae* (I) only at head Body still bloated Head disarticulated	No change
July 6	24/11/9	Black mummified organs Less activity	Some action but less *Protophormia terraenovae* (I)	*Protophormia terraenovae* (I) everywhere	*Protophormia terraenovae* (I) on head Skin dry Shirt stained	Head gone Shirt stained Eggs all over back	Brown foam No maggots on face
July 7	25/12/10	No insects in face Mass of *Protophormia terraenovae* (I) in stomach area	Lots of little flies Shoe filled with pupae	Lots of dead *Protophormia terraenovae* (I) at gut ooze periphery	Mass of *Protophormia terraenovae* (I) in ears	Bad smell Stomach gone Head dry and abandoned	Mass of *Protophormia terraenovae* (I) on hind region, none on head
July 8	26/13/11	*Protophormia terraenovae* (I) at gut Bad odour	Lots of beetles *Protophormia terraenovae* (I)	*Protophormia terraenovae* (I) along clothes, out of anus	Head hollowed out *Protophormia terraenovae* (I) on ground line Skin slippage	Bad smell *Protophormia terraenovae* (I) are grey	Head only small *Protophormia terraenovae* (I)
July 9	27/14/12	Less *Protophormia terraenovae* (I) activity Greasy smell Beetles	Tons of pupae in head and feet	Tons of *Protophormia terraenovae* (I) No beetles	*Protophormia terraenovae* (I) at ground line and clothes only	Very bad smell Exposed bone everywhere	Head going now White foam

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
July 10	28/15/13	Isolated *Protophormia terraenovae* (I) Some dry muscles on legs	Beetles Very few isolated *Protophormia terraenovae* (I)	Beige foam Body collapsed	*Protophormia terraenovae* (I) at head and ground line	No body left Underwear still in place	Beige foam at head *Protophormia terraenovae* (I) on clothes
July 11	29/16/14	Still *Protophormia terraenovae* (I) Beetles Bad odour	Fat globules by hips Lots of exposed bone	White foam Tons of *Protophormia terraenovae* (I) Pupal cases in shoes	Foam *Protophormia terraenovae* (I) No odour	All bones exposed *Protophormia terraenovae* (I) at gut region	Lots of white foam
July 12	30/17/15	Foam Little activity	Same as above	Foam	Grey collared *Protophormia terraenovae* (I)	More *Protophormia terraenovae* (I)	Foam *Protophormia terraenovae* (I)
July 13	31/18/16	Pupae on body Beetles on pants *Protophormia terraenovae* (I) on gut region	Carpel bones away from body New beetles	Strong smell Stocking coming off Foam	Foam *Protophormia terraenovae* (I)		
July 14	32/19/17	Scavenged – both socks and feet taken 1 sock with bone still in it found 3 feet away 20 feet away, along same path, sock with foot bones	Beetles Pupal cases of *Protophormia terraenovae*	Still lots of *Protophormia terraenovae* (I)	Body collapsed Head hollow		

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
July 15	33/20/18	No movement to scavenged parts Little activity	*Chrysochus* sp. (A) on dry bone Less odour	Little smell Body in half	Tons of *Protophormia terraenovae* (I) Clothes stained		
July 16	34/21/19	Tons of *Chrysochus* sp. (A) on skin and bone Strong odour	Brown ooze Some maggots Skull clean	Odour Bones exposed No true maggot mass	Mass of *Protophormia terraenovae* (I) at head and groin Tiny flies		
July 17	35/22/20	Beetles everywhere No carnivorous activity		Tons of tiny flies No visible maggots Advanced decomposition	Panties taken off Very black		*Protophormia terraenovae* (I) No tiny flies Fat on gravel
July 18	36/22/21	More bone exposed		Exposed bone on lower half of body	Foam		Adult flies caught in foam
July 19	37/23/22	Tiny amount of foam at gut		No change	*Protophormia terraenovae* (I) at leg region only		Advanced No more mass Not much body *Protophormia terraenovae* (I) migrating

Table 4. Alberta summer data 1997, for carcasses in shade, Hasse Lake contd.

DATE	ETSD	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
July 20	38/24/23	Still foam Beetles No odour		Ants Tiny flies Less odour Exposed bone *Creophilus maxillosus* (A)	Still active Tiny flies		Scared away a deer near remains No chewing visible
July 21	39/25/24			Exposed bone *Silpha* sp. (I,A) Tiny flies	Still active *Protophormia terraenovae* (I) at rear end only *Silpha* sp. (I) still present		No change in insects or decomposition

Table 5. Daily ambient air temperature and precipitation for Hasse Lake, 1997 (Data also reported in Komar and Beattie 1998.)

DATE	Maximum °C	Minimum °C	Mean °C	Precipitation (mm)
12 June 1997	26.0	-	-	Trace amounts
13 June 1997	17.0	-	-	30
14 June 1997	29.1	-	-	Trace amounts
15 June 1997	28.0	-	-	-
16 June 1997	24.0	-	-	4
17 June 1997	30.0	-	-	4
18 June 1997	21.0	-	-	4
19 June 1997	17.0	-	-	Trace amounts
20 June 1997	13.5	10.0	11.6	14
21 June 1997	17.7	9.7	11.7	35
22 June 1997	13.2	7.1	9.3	42
23 June 1997	16.7	5.1	10.1	30
24 June 1997	26.0	7.1	14.2	10
25 June 1997	28.5	5.5	15.9	-
26 June 1997	23.8	6.0	12.7	Trace amounts
27 June 1997	27.1	2.3	13.1	10
28 June 1997	21.0	5.0	10.5	4
29 June 1997	16.1	2.1	8.1	-
30 June 1997	18.0	2.6	10.9	-
1 July 1997	21.1	6.8	13.6	-
2 July 1997	22.8	4.4	14.5	-
3 July 1997	27.7	6.0	16.0	-
4 July 1997	29.3	7.0	17.8	-
5 July 1997	27.0	5.7	17.7	-
6 July 1997	25.0	10.2	17.1	-
7 July 1997	26.8	6.6	18.0	-
8 July 1997	26.8	8.5	18.0	-
9 July 1997	26.5	9.6	19.1	-
10 July 1997	17.7	8.9	13.4	Trace amounts
11 July 1997	17.3	8.6	11.5	25
12 July 1997	19.5	8.9	12.6	4
13 July 1997	26.6	10.8	20.4	25
14 July 1997	30.7	8.7	18.6	-
15 July 1997	29.0	9.1	18.5	-
16 July 1997	27.0	9.1	17.1	8
17 July 1997	21.2	6.1	13.3	Trace amounts
18 July 1997	27.1	11.6	18.2	30
19 July 1997	28.7	7.4	17.5	-
20 July 1997	29.1	8.1	-	-
21 July 1997	28.7	-	-	-

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 5, 1997	0	Bloating, some putrefaction, green discolouration. Incision on foot	Fresh, no sign of bloating Skin damage on hips	*P. regina* present as unloaded, bloating Avulsed intestines	Bloating, large trauma to neck	Putrefaction beginning, bloat	Minimal bloating, minimal discolouration
Aug. 6	1	Adult Calliphoridae Fluid leakage, tongue black, putrefaction, full bloat,.	Adult Calliphoridae Green discolouration seen, Bloated	*P. regina* (1^{st},2^{nd}, A) under clothing Full bloat Green coloration	*P. regina* (E, A) Full bloat, some putrefaction, fly eggs seen, many adult blow flies Full bloat	Mass of *P. regina* (1^{st}) in the mouth Adult Calliphoridae Full bloat, fluid leakage from mouth, and putrefaction.	Adult Calliphoridae Anus extruded, green discolouration, lots of adult blow flies present, body at full bloat
Aug. 8	3	*P. regina* (1^{st},2^{nd},3^{rd}, A) Maggot masses throughout body, particularly in wounds. Skin blistering, bloat	*P. regina* (1^{st},2^{nd}, 3^{rd}, A). Maggot masses in head, mouth, chest and under edge of body near ground. Skin black and dry (mummified).	*Phaenicia sericata* (1^{st},2^{nd},3^{rd}, A). Masses in wounds, mouth and under edge of body near ground. Bloat, maggots in mass under edge of body. Gut extruded Green coloration	*P. regina* (1^{st},2^{nd},3^{rd}, A) Maggot masses in head, chest and stomach. Putrefaction, skin blistering	*P. regina* (1^{st}, 2^{nd}, $3^{rd,}$ A) Mass in mouth and throughout body, skin blistering, still in bloat	*P. regina* (1^{st},2^{nd},3^{rd}, A) eggs present. Maggot masses present in anus, groin and under body. Anus extruded, green discolouration to body. Eggs on left side of chin, full bloat Maggot masses in anus, groin and under edge of body near ground

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 11	6	Calliphoridae larvae in masses throughout body Skin dry, mummification honeycombed, from maggot activity vertebrae and ribs exposed Advanced decay.	*P. regina* (mostly 3rd, and earlier instars). Active decay. Maggots all over body, masses, honeycombing of skin due to maggot activity. Masses throughout body Mummification	*Phaenicia sericata*, and *P. regina* (1st,2nd,3rd, A). Skin dried, honeycombing from maggots in skin, active decay, many maggot masses all over body.	*P. regina* Skin dried, mummification, stomach still bloated, chest collapsed. Maggot masses throughout body and at surface	Larval Calliphoridae throughout body, mostly 3rds. Masses in head, stomach, under edge of body near ground and under clothes. Chest collapsed, maggots moved clothes Still in bloat.	Larval Calliphoridae throughout body Chest region collapsed, lots of Calliphoridae larvae on body. Third instars present at back end, and firsts and seconds on stomach, head and clothes. Maggot masses throughout body. Still in bloat.
Aug. 13	8	Most maggots have left body (left on day 7), some under skirt and under skin at stomach. Small number of tiny adult flies seen Birds attracted, advanced decay. Honeycombing throughout abdominal area	*P. regina* (prepupal, and a few early instars). Maggots under skin. Active decay, prepupal maggots leaving body. Some dead maggots on body. Most flesh gone	*Phaenicia sericata* and *P. regina* (prepupal) Maggots on sweater and under skin. Advanced decay, some maggots under skin, prepupal maggots leaving body.	*P. regina* (prepupal and some early instars). Active decay, skin leathery and black, (mummification), honeycomb pattern observed. Maggot masses throughout body. Prepupal maggots leaving body.	Some prepupal Calliphoridae Younger instars present as masses throughout body. Stomach collapsed, active decay, skin on stomach black and leathery (mummification). Birds (robins) scavenging prepupal maggots	Larval Calliphoridae throughout body Masses throughout body. Clothes pushed away by maggots, honeycombing on face, from maggot activity, skin on stomach mummified. Maggot masses throughout body. Active decay

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 15	10	Very few maggots left Skin creamy, advanced decay. A few maggots still on head and groin.	Calliphoridae larvae found throughout body. Skin creamy, advanced decay, discolouration at stomach still. Maggots still present throughout entire body	Calliphoridae larvae scattered over entire body. Advanced decay, teeth scattered	*P regina* (prepupal also larvae). Maggot masses throughout body. Active decay, foaming from maggots, skin soft.	Larval Calliphoridae still present in masses throughout body, some drowned. Skin creamy colour, soft	*Silpha* sp. (l) (10-20 seen in neck region) 'Foam' from maggots present. Skin soft and grey. Maggot masses throughout body. Active decay
Aug. 18	13	Acari Some adult Calliphoridae Tiny flies Advanced decay. No maggots on surface, few under skin and clothes	Tiny adult flies seen Calliphoridae larvae under clothes and skin. Advanced decay, white/grey mould appearing, bones exposed. Some maggots still present, moving hooves.	Tiny adult flies seen. Skin leathery, mould on body, some bones exposed, a few maggots under clothing and skin. Body flat, bones exposed. Most flesh gone. Advanced Decay	Calliphoridae larvae Acari Formicidae Maggots under skin and clothes White mould	Larval Calliphoridae still present in masses throughout body. Bird scavenging, hooves fallen off, skin soft.	*Silpha* sp. (I, A) Acari Still a few maggots present. Some adult flies on body. White foam under dress, skin is mummified and hooves have come off. Some maggot masses still under skin and clothes and on hind leg. Some teeth fallen out.

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 20	15	Many tiny flies. Mandible exposed. Very few maggots under clothes and skin.	Tiny adult flies seen Calliphoridae larvae under clothes and skin. Bones exposed, mould present.	Tiny adult flies seen. Very few Calliphoridae larvae under skin and clothes, some on surface. Greasy, mould still present.	*Necrodes* sp. (A) *Silpha* sp. (I, A) Acari Maggots under skin and clothes. Advanced decay, body dry, maggots mostly in grass around body.	Some maggot masses still present in isolated areas. Tiny adult flies. Head and stomach dry, mummified. Active decay.	*Silpha* sp. (l) A few *P regina* (I) under clothes. Lots of tiny flies on body Tabanidae (A) seen. Body is dry/mummified.
Aug. 22	17	Many tiny flies on body, going into openings in body	*Silpha* sp. (I) Calliphoridae larvae few Tiny adult flies. Body wet and greasy, skin black.	Hundreds of tiny flies seen. Very few Calliphoridae larvae visible on surface. Greasy, skin tough. 2 *Tabanus* sp. (A)	Many tiny flies seen, however no beetles P. regina (I) under skin and under edge of body by ground 2 *Tabanus* sp. (A)	Many *Silpha* sp. (I) Some *P. regina* (I). Advanced decay, skin on back soft, some isolated maggots	*Silpha* sp (A,I) still present. Lots of tiny flies on body. A few *P. regina* (I).
Aug. 25	20	Exposed bone bleaching. No maggots. Many tiny flies swarming around body, especially the head. *Tabanus* sp. (A)	Tiny adult flies. Calliphoridae adults and a few larvae under clothes and skin. *Carabus* sp. (A) *Onthophagus nuchicomis* (A).	*Necrodes* sp. (A) *Creophilus maxollsus* (I) Hundreds of tiny flies seen. Body wet. A few Calliphoridae maggots seen. Grasshopper seen	*Silpha* sp. (I) Many tiny flies seen Calliphoridae larvae – few. Acari present on head	*Silpha* sp. (I) Some *P. regina* (I) under clothes Acari Tiny adult flies. Clothes discoloured	*Silpha* sp. (A, I), *Creophilus maxillosus* (I) Tiny adult flies *Tabanus* sp. (A) Very few *P. regina* (I) present

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 27	22	Adult Calliphoridae on openings in skin. Tiny flies No maggots seen	Calliphoridae adults Very few Calliphoridae maggots Some tiny adult flies	*Oxypoda* sp. (A) Hundreds of tiny flies seen Calliphoridae maggots Piophilidae larvae Body wet.	Silphidae, *Silpha* sp. (I) *Rhizophagus* sp. (A) Tiny flies seen Acari. Skin wet in spots..	Dead *Silpha* larvae Tiny adult flies Adult Calliphoridae Very few Calliphoridae larvae Piophilidae larvae Skin is wet.	*Silpha* sp. (A,I) Very few Calliphoridae larvae still present
Aug. 29	24	*Piophila* sp. (I) under coat. Adult Calliphoridae Tiny adult flies. More bones exposed.	Many Calliphoridae adults and very few larvae Many tiny adult flies. Body wet and greasy.	Carabidae (A) *Oxypoda* sp. (A) *Necrodes* sp. (A) *Silpha* sp. (A) *Creophilus maxillosus* (A) *Piophila* sp. (I) Acari. Body wet.	*Carabus* sp. (A) *Silpha* sp. (A) Acari Very few Calliphoridae larvae	Acari Araneae. Very little activity.	Very few Calliphoridae larvae still present. Silphidae still present Some Acari No adult flies
Sept. 3	29	*Piophila* sp. (I) *Carpophilus* sp.(A) *Creophilus maxillosus* (A, I) Acari Adult Calliphoridae	Calliphoridae adults, many Some tiny adult flies Araneae. Body wet.	*Onthophagus nuchicomis* (A) *Silpha* sp. (I) Acari. *Piophila* sp. (I) Body wet.	Some adult Calliphoridae *Piophila* sp. (I) Body wet.	Tiny adult flies Acari *Creophilus maxillosus* (I) Body wet.	*Silpha* sp. (I) Drosophilidae (A) Many Acari. *Creophilus maxillosus* sp. (I) *Piophila* sp. (I, A)

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Sept. 5	31	*Piophila* sp. (I) *Creophilus maxillosus* (A) Calliphoridae (A) Acari.	Calliphoridae (A) Many tiny adult flies. Body very wet.	*Oxypoda* sp. (A) *Creophilus maxillosus* (A) Acari *Piophila* sp. (I) Body wet. Lots of adult flies	Slugs on body Acari Some tiny flies present.	*Silpha* sp. (I) Drosophilidae (A) *Creophilus maxillosus* (I) *Piophila* sp. (I) Body very wet	Acari Some Silphidae *Piophila* sp. (I) Slugs on body. *Drosophila* sp. (A) Tiny flies on body
Sept. 8	34	*Piophila* sp. (I) *Creophilus maxillosus* (I) Acari Tiny adult flies Formicidae	Calliphoridae adults, some. Acari *Creophilus maxillosus* (I). Body very wet.	*Creophilus maxillosus* (A,I) Acari *Piophila* sp. (I) Body very wet.	Acari. Slugs on body *Creophilus maxillosus* (A, I) No flies	*Creophilus maxillosus* (A,I) Slugs on body.	No adult flies on body *Piophila* sp. (I) Body drier.
Sept. 15	41	No insects. Advanced stage/	Bird scavenging, No insects. Advanced stage.	Advanced stage. No activity, a few adult flies.	No insects. Advanced stage	2 maggots observed	20 new maggots on gut and ground lines were observed Advanced stage
Sept. 17	43	some adult flies seen	Heavy carnivore scavenging. No insects. Skin drying and white.	No insects. Skin disintegrating	No insects	No insects	10 maggots seen. Birds feeding on them.

Table 6. Alberta August 1997- October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Sept. 22	48	Tiny flies No maggots or beetles	No insects. Heavy carnivore scavenging, head and jaw displaced	Tiny flies seen, occasionally landing on body (~10)	*Necrodes* sp. (A). skull bones broken, adult beetles on leaves	Dead maggots seen Bird scavenging on belly, skin broken	Isolated maggots
Sept. 24	50	bird guano on body Skin white, no insects on body	adult flies around, no activity on body	Calliphoridae (A) skin greasy *Tabanus* sp. (A)	Acari	4 maggots seen	Calliphoridae (I) *Piophila* sp. (I)
Sept. 26	52	No insect activity, clothes rock hard.	no insect activity on body, black flies in air	No insects. Skin disappearing.	Acari. Bird damage, to gut	3 live maggots seen. Bird scavenging to hind limbs	Some isolated *Piophila* sp. (I) seen.
Sept. 29	55	No insect activity. Strong wind, skin disintegrating.	No insects. High winds	No insect activity	No insect activity. Skin hard.	No insect activity	No insect activity
Oct. 1	57	*Phormia regina* (A)	No insect activity	No insect activity	*Creophilus maxillosus* (I) Acari Bird scavenging.	Some adult insects hovering *Silpha* sp. (L)	tiny flies hovering
Oct. 3	59	no insect activity on body	Cicadellidae (leaf hopper)	no insect activity on body	no insect activity on body	no insect activity on body	no insect activity on body
Oct. 6	62	no insect activity on body. Jaw split at symphysis.	no insect activity on body	no insect activity on body	no insect activity on body	no insect activity on body	no insect activity on body

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Oct. 8	64	Bird scavenging of thorax. No insect activity	No insects, light snow on body	No insects, light snow	No insect activity, light snow	No insects	No insects
Oct. 10	66	no insect activity on body	no insect activity on body	no insect activity on body	no insect activity on body	No insect activity on body	no insect activity on body
Oct. 13	69	no insect activity on body. Skin falling apart.	no insect activity on body. Heavy frost on body.	no insect activity on body. Skin almost gone	no insect activity on body. Frost on body	no insect activity on body. Frost on body. Bird scavenging to face.	no insect activity on body. Bird scavenging. Some dead maggots seen.
Oct. 15	71	No insects. Throat scavenged by birds	No insects	No insects. Skin almost gone, bird scavenging.	No insects. More bird scavenging to gut.	No insects. Skin Hard	possibly *Piophila* sp. (I) Bird scavenging.
Oct. 17	73	No insects	No insects	No insects	No insects	No insects	No insects. Skin soft.
Oct. 20	76	No insects	No insects	No insects	No insects	No insects	No insects
Oct. 22	78	*Phormia regina* (A)	No insects, canid scavenging to head	No insects. Spine exposed.	No insects. Scavenging to hind limbs.	No insects. More bird damage to stomach.	No insects
Oct. 24	80	Snow covered. No insects	Snow covered. No insects	Snow covered. No insects	Snow covered. No insects	Snow covered. No insects	Snow covered. No insects
Oct. 27	83	No insects. Skin soft again.	No insects. Foot scavenged by canids.	No insects. High winds	No insects. Tooth displaced, bone exposed.	No insects. Bird scavenging	No insects. Heavy frost on body.

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Oct. 29	85	No insects	No insects	No insects. Body still wet.	No insects. Heavy frost on body	No insects/ Frost on body. Cat faeces in mouth	No insects. Bird scavenging.
Oct. 31	87	No insects	No insects	No insects. Bones displaced, body wet and fatty.	No insects. Frost on body.	No insects	No insects
May 13, 1998	281			*Drosophila* sp. (P)			
May 30	298		No insect activity any more. Empty pupal cases in soil and clothing. Piophilidae Insects attracted once flesh disturbed	Calliphoridae puparia *Phaenicia sericata* (P) Ceratopogonidae (I,P) *Drosophila* sp. (A) *Carpophilus* sp. (A) *Silpha* sp. (I) *Creophilus maxillosus* (A) Aranaea (A) many seen Adipocere			

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
June 2	301	Empty puparia in the clothing and on the ground - *Protophormia terraenovae* (P, A) *Phaenicia sericata* (P) Salpingidae, (A), *Philonthus* sp. (A) *Creophilus maxillosus (*I) Araneae, egg mass and adults			*Carpophilus* sp. (A) *Creophilus maxillosus* (I, A) Not many insects present	*Drosophila* sp. (A) *Carpophilus* sp. (A) *Silpha* sp. (I) *Creophilus maxillosus* sp. (A,I) in clothing and around body Earthworms	*Silpha* sp. (I) – all over Very little fauna now Empty pupal case from Calliphoridae everywhere
June 4	303		*Piophila* sp. empty pupal cases *Carpophilus* sp. (A) *Creophilus maxillosus* (A,I) *Formica* sp. (A) seen all over body	*Necrobia* sp. (A) *Carpophilus* sp. (A) Acari			

Table 6. Alberta August 1997- October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
June 8	307	*Silpha* sp. (I) in wet ground, under clothing. Many spiders One *Chrysochus* sp (A)	*Drosophila* sp. (A) crawling all over areas disturbed by collector *Chrysochus* sp (A)	*Drosophila* sp. (A) *Necrobia* sp. (A) *Carpophilus* sp. (A) Acari *Onthophagus nuchicomis* (A) Little insect activity on surface, all under clothing	Many little adult flies, probably *Drosophila* sp. *Carpophilus* sp. (A) *Creophilus maxillosus* (A) *Philonthus* sp. (A) Not many insects present	*Silpha* sp. (I)	*Silpha* sp. (I, A) *Creophilus maxillosus* (A)
June 11	310	*Creophilus maxillosus* (I) *Drosophila* sp. not as abundant as other flies *Chyrsochus* sp (A) Araneae (A)	Acari - few *Drosophila* sp. (A) No maggot activity Many little flies	Very little change Spiders *Chrysochus* sp (A) Many little flies	Few little flies, as compared with other pigs	*Silpha* sp. (I) *Drosophila* (A)	*Silpha* sp. (I, A) *Creophilus maxillosus* (A) *Drosophila* sp. (A)
June 14	313	*Carabus* sp. (A) found under clothing	*Formica* sp. appears to be ant hill under head. *Carpophilus* sp. (A)	Lepidoptera Chrysalis in hair Adult flies copulating – probably Drosophilidae *Chrysochus* sp (A) Spiders, Acari *Silpha* sp. (L)	No change	*Silpha* sp. (I) *Drosophila* (A)	*Silpha* sp. (I, A) *Creophilus maxillosus* (A) *Drosophila* sp.(A)

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
June 19	318	*Onthophagus nuchicomis* (I) A few maggots still present. *Chrysochus* sp. (A)	*Onthophagus nuchicomis* (A)	Adult flies copulating – probably Drosophilidae *Chrysochus* sp (A) Spiders, Acari *Silpha* sp. (I)	*Piophila* sp. (I)	Acari – many	*Drosophila* sp. (I) *Piophila* sp. (I) in small masses.
June 23	322	*Piophila* sp. (E, I) *Formica* sp. (A) Mites – Acari Spiders – Araneae	*Chrysochus* sp (A) seen Piophilidae not seen	Acari Adult flies – prob. Drosophilidae *Onthophagus nuchicomis* (A)	Not much tissue left *Piophila* sp. (I)	*Piophila* sp. (I) *Drosophila* sp. (A) *Carpophilus* sp. (A) *Silpha* sp. (I) *Creophilus maxillosus* sp. (A,I)	*Piophila* sp. (I) not as many as on GSH#2
June 26	325	*Piophila* sp. (I)	*Chrysochus* sp (A) seen	*Piophila* sp. (I) Many *Creophilus maxillosus* (A)	*Piophila* sp. (I)	*Piophila* sp. (I) *Drosophila* sp. (A) *Carpophilus* sp. (A) *Silpha* sp. (I) *Creophilus maxillosus* (A,I)	*Piophila* sp. (I)

Table 6. Alberta August 1997- October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
June 29	328	*Piophila* sp. (I)	*Formica* sp. (A, I)	*Piophila* sp. (I) Many *Creophilus maxillosus* (A) seen	*Piophila* sp. (I)	*Piophila* sp. (I) *Drosophila* sp. (A) *Carpophilus* sp. (A) *Silpha* sp. (I) *Creophilus maxillosus* (A,I)	*Piophila* sp. (I)
July 3	332	*Piophila* sp. (I) very active	Pig very dry *Piophila* sp. (I) – not so many as on other pigs	*Piophila* sp. (I) *Creophilus maxillosus* (I) *Silpha* sp. (I) found in the crevices	*Carpophilus* sp. (A) *Creophilus maxillosus* (A,I) Acari	Acari *Piophila* sp. (I) *Drosophila* sp. (A) *Carpophilus* sp. (A) *Silpha* sp. (I) *Creophilus maxillosus* sp. (A,I)	*Creophilus maxillosus* (A) Acari
July 7	336	*Piophila* sp. (I)	*Piophila* sp. (I)	Many *Piophila* sp. (I) in adipocere – making it foamy.	Many *Piophila* sp. (I)	*Piophila* sp. (I) Not much beetle activity	Vertebrate scavenging *Piophila* sp. (I) *Chrysochus* sp. (A) Very little else
July 11	340	*Piophila* sp. (I)	*Piophila* sp. (I)	*Piophila* sp. (I)	*Piophila* sp. (I)	*Piophila* sp. (I)	*Piophila* sp. (I) *Chrysochus* sp. (A)

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
July 14	343	*Piophila* sp. (I) *Catops basilaris* (A)	*Creophilus maxillosus* (A) *Chrysochus* sp. (A) *Silpha* sp. (I) *Ontholestes* sp. (A)	*Piophila* sp. (I) *Creophilus maxillosus* (I) *Chrysochus* sp. (A) *Silpha* sp. (I) *Ontholestes* sp. (A)	*Piophila* sp. (I) *Creophilus maxillosus* (A) *Drosophila* sp. (A) *Silpha* sp. (I)	*Piophila* sp. (I) *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)
July 21	350	*Piophila* sp. (I) *Catops basilaris* (A)	*Catops basilaris* (A) *Chrysochus* sp. (A) *Creophilus maxillosus* (A) *Silpha* sp. (I) *Ontholestes* sp. (A)	*Piophila* sp. (I) *Creophilus maxillosus* (I) *Chrysochus* sp. (A) *Silpha* sp. (I) *Ontholestes* sp. (A)	Carcass dry Few *Piophila* sp. (I) *Silpha* sp. (I) *Creophilus maxillosus* (A)	*Piophila* sp. (I) *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)
July 24	353	*Piophila* sp. (I) *Catops basilaris* (A)	*Catops basilaris* (A) *Chrysochus* sp. (A) *Creophilus maxillosus* (A) *Ontholestes* sp. (A)	*Piophila* sp. (I) *Creophilus maxillosus* (I,A) *Silpha* sp. (I) *Chrysochus* sp. (A)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Piophila* sp. (I) *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)
July 27	356	Body is just skin and bones, very little adipocere only insects are beetles plus spiders	Body very dry *Catops basilaris* (A), *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I) *Creophilus maxillosus* (I, A) *Chrysochus* sp. (A)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Piophila* sp. (I) *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 2	362	Very dry body	Body very dry *Piophila* sp. (I) *Catops basilaris* (A), *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I) *Creophilus maxillosus* (A)	*Piophila* sp. (I)
Aug. 6	366	Dry	Same as above (A)	Acari – many Body very dry, most beetle larvae gone. *Piophila* sp. (I)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Aug. 13	373	Dry	Body very dry *Piophila* sp. (I) *Catops basilaris* (A), *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Aug. 18	378	Dry	Body very dry *Piophila* sp. (I) *Catops basilaris* (A), *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Aug. 22	382	Dry	Body very dry *Piophila* sp. (I) *Catops basilaris* (A), *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Aug. 28	388	Dry	Body very dry *Piophila* sp. (I) *Catops basilaris* (A), *Chrysochus* sp. (A) *Creophilus maxillosus* (A)	*Piophila* sp. (I)	*Piophila* sp. (I), *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Sept. 2	393	Dry	Same as above	*Piophila* sp. (I)	*Piophila* sp. (I), *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Sept. 7	398	Dry	Very little insect activity, no new *Piophila* sp. (P) seen	*Piophila* sp. (I)	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)

Table 6. Alberta August 1997 - October 1998 data, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-1	GFS-2	GFS-3	GSH-1	GSH-2	GSH-3
Sept. 11	402	Dry	*Piophila* sp. (I) only in wet areas	Temperature dropping, decrease in insects seen	*Piophila* sp. (I) *Creophilus maxillosus (*A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Sept. 15	406	Dry	*Piophila* sp. (I) only in wet areas	No change	*Piophila* sp. (I) *Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Sept. 21	412	Dry	*Piophila* sp. (I) only in wet areas	No change	*Piophila* sp. (I)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Sept. 25	416	Dry	*Piophila* sp. (I) only in wet areas	No change	*Creophilus maxillosus* (A)	*Chrysochus* sp. (A) Piophilidae (I)	Piophilidae (I)
Sept. 30	421	Dry	*Piophila* sp. (I) only in wet areas	No change	*Piophila* sp. (I)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Oct. 6	427	Dry	*Piophila* sp. (I) only in wet areas	Body very dry, few insects A few Acari	*Creophilus maxillosus* (A)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)
Oct. 14	435	Dry	*Piophila* sp. (I) only in wet areas	No change	*Piophila* sp. (I)	*Chrysochus* sp. (A) *Piophila* sp. (I)	*Piophila* sp. (I)

Table 7. Daily ambient air and soil temperatures and precipitation for Ellerslie Research Station for August 1997.

DATE	Max °C	TIME (hours)	Min °C	TIME (hours)	Mean °C	Precipitation (mm)	Soil Temperature maximum °C	Soil Temperature maximum °C
5 Aug. 1997	34.0	1200	19.3	2300	-	-	-	-
6 Aug. 1997	32.3	1000	13.5	0600	21.5	-	-	-
7 Aug. 1997	32.8	0600	15.7	2200	21.4	-	25.5	17.9
8 Aug. 1997	18.8	1100	7.6	2200	11.5	20	17.2	16.1
9 Aug. 1997	18.0	1300	7.1	0100	12.7	-	16.3	14.3
10 Aug. 1997	29.6	1000	6.1	0600	16.1	-	17.0	13.6
11 Aug. 1997	24.2	1300	9.8	0600	16.2	-	17.1	14.3
12 Aug. 1997	30.1	1000	9.8	1500	18.1	-	16.8	14.5
13 Aug. 1997	22.1	1700	10.5	1800	15.6	trace	16.6	15.0
14 Aug. 1997	21.5	1100	13.8	2300	17.5	-	16.5	15.3
15 Aug. 1997	13.6	1300	10.5	2300	12.4	30	16.1	14.6
16 Aug. 1997	13.3	1500	9.1	0900	10.8	25	14.5	13.6
17 Aug. 1997	15.8	1330	13.4	1930	14.5	14	140	13.1
18 Aug. 1997	14.0	1045	-	-	-	4	-	-
19 Aug. 1997	22.4	1400	12.3	2300	18.3	-	-	-
20 Aug. 1997	24.2	1230	8.8	0700	13.0	-	-	-
21 Aug. 1997	24.7	1700	15.3	1400	20.8	4	15.9	14.0
22 Aug. 1997	19.6	1200	8.1	2300	11.1	4	15.9	13.9
23 Aug. 1997	26.2	1100	10.0	0300	15.6	-	15.6	15.5
24 Aug. 1997	25.0	1000	9.7	0700	16.0	4	15.3	14.1
25 Aug. 1997	29.1	1000	7.5	0600	16.0	-	15.1	-
26 Aug. 1997	23.8	1330	8.9	0700	15.9	-	15.6	-
27 Aug. 1997	26.2	1230	12.6	2330	19.8	-	16.2	15.3
28 Aug. 1997	26.9	0930	7.7	0530	12.6	-	15.5	13.5
29 Aug. 1997	30.1	1130	12.1	2330	18.4	-	14.7	14.5
30 Aug. 1997	26.0	1030	6.5	0730	14.6	-	14.7	12.8
31 Aug. 1997	12.1	1230	8.2	0730	9.5	25	14.2	12.9
MONTHLY MEANS	23.6	-	10.5	-	15.6	134	16.2	-

Table 8. Daily ambient air and soil temperatures and precipitation for Ellerslie Research Station for September 1997

DATE	Max °C	TIME (hours)	Min °C	TIME (hours)	Mean °C	Precipitation (mm)	Soil Temperature maximum °C	Soil Temperature maximum °C
1 Sept. 1997	19.4	1700	4.9	0700	12.4	4	13.4	11.3
2 Sept. 1997	25.1	1600	9.3	0700	16.5	-	13.2	12.1
3 Sept. 1997	21.4	1600	14.3	0600	17.7	2	14.4	-
4 Sept. 1997	16.7	1200	11.8	1600	13.5	75	14.7	14.2
5 Sept. 1997	20.6	0900	6.2	0400	12.6	2	14.2	9.0
6 Sept. 1997	17.6	1000	9.5	0600	12.5	-	13.8	13.2
7 Sept. 1997	18.2	1200	-	-	-	-	-	-
8 Sept. 1997	17.2	1800	8.7	2300	12.6	-	13.4	-
9 Sept. 1997	22.5	1400	6.0	0600	13.3	-	13.5	11.5
10 Sept. 1997	22.3	1400	6.9	0800	14.4	-	13.8	11.7
11 Sept. 1997	16.6	1800	10.3	0700	13,1	-	13.0	12.5
12 Sept. 1997	13.7	1500	7.7	2200	11.4	6	13.2	12.2
13 Sept. 1997	11.9	1300	4.7	0300	7.9	4	13.0	9.9
14 Sept. 1997	6.6	1000	4.3	1100	5.4	8	-	-
15 Sept. 1997	7.7	1500	5.3	0500	6.5	16	-	-
16 Sept. 1997	11.4	1630	3.5	2300	7.8	4	-	-
17 Sept. 1997	6.9	1700	1.5	0200	4.5	-	-	-
18 Sept. 1997	6.9	1900	2.0	2300	4.3	18	9.2	8.5
19 Sept. 1997	16.0	1700	-1.2	0600	6.4	-	9.2	7.3
20 Sept. 1997	20.2	1500	5.3	0900	12.0	-	10.5	8.6
21 Sept. 1997	21.3	1600	5.2	0800	12.8	-	-	5.7
22 Sept. 1997	21.7	1800	5.0	0900	12.4	-	11.1	-
23 Sept. 1997	25.0	1800	7.2	0900	15.0	-	11.6	7.0
24 Sept. 1997	24.3	1500	6.6	0800	14.6	-	12.1	10.8
25 Sept. 1997	24.7	1700	13.5	2300	19.7	-	11.0	-
26 Sept. 1997	24.6	1400	7.5	2300	13.5	-	12.1	-
27 Sept. 1997	17.3	1300	2.9	0800	10.2	-	-	-
28 Sept. 1997	18.6	1600	7.2	0800	12.6	Trace	11.3	-
29 Sept. 1997	15.2	1400	4.7	0600	9.1	-	-	-
30 Sept. 1997	22.0	1700	4.2	0200	11.8	-	10.7	9.1

Table 9. Daily ambient air and soil temperatures and precipitation for Ellerslie Research Station for October 1997.

DATE	Max °C	TIME (hours)	Min °C	TIME (hours)	Mean °C	Precipitation (mm)	Soil Temperature maximum °C	Soil Temperature maximum °C
1 Oct. 1997	17.1	1500	3.3	0700	10.9	-	9.8	9.7
2 Oct. 1997	13.6	1600	7.8	1300	10.4	-	12.3	11.8
3 Oct. 1997	15.1	1300	0.0	0700	5.3	-	12.1	10.5
4 Oct. 1997	9.7	1500	0.9	2300	4.9	-	11.2	9.7
5 Oct. 1997	15.4	1400	-0.1	0900	4.8	-	10.5	9.2
6 Oct. 1997	20.2	1400	-3.4	0600	4.3	-	10.1	7.7
7 Oct. 1997	4.0	1100	-1.0	2300	1.8	Trace	9.8	8.9
8 Oct. 1997	-0.3	1800	-2.3	0900	-1.3	Trace	9.2	7.8
9 Oct. 1997	2.0	1500	-1.1	1200	0.0	14	7.7	7.2
10 Oct. 1997	3.4	1700	-0.8	1300	1.3	Trace	7.7	7.1
11 Oct. 1997	2.5	1900	-1.6	1700	1.6	-	7.7	7.4
12 Oct. 1997	1.7	1600	-5.1	2300	-1.0	-	7.4	5.7
13 Oct. 1997	5.3	2300	-7.6	0600	0.0	-	6.1	3.5
14 Oct. 1997	14.3	1600	3.2	2300	7.4	-	8.8	5.5
15 Oct. 1997	16.0	1300	-0.3	0300	7.1	-	9.3	6.6
16 Oct. 1997	19.0	1400	-2.7	0800	15.7	-	11.0	7.9
17 Oct. 1997	9.1	0200	1.2	2200	6.3	26 (rain)	10.8	8.3
18 Oct. 1997	8.6	1200	-1.2	0800	2.8	6 (rain)	8.0	5.4
19 Oct. 1997	4.0	1100	-3.0	0700	-1.0	-	6.3	4.0
20 Oct. 1997	-	-	-	-	-	-	5.5	3.8
21 Oct. 1997	12.4	1600	-	-	-	-	6.8	4.2
22 Oct. 1997	7.2	1200	-	-	-	-	6.8	6.1
23 Oct. 1997	-	-	-	-	-	-	-	-
24 Oct. 1997	1.0	1100	-2.5	1300	-	30	4.2	3.7

Table 10. Alberta fall data 1997, for carcasses in full sun, Ellerslie Research Station.

DATE	ETSD	GFS-4	GFS-5	GFS-6
9 Oct. 1997	0	Fresh X-incision on hock Snow on body No insects	Fresh X-incision on hock No flies	Fresh X-incision on hock No flies anywhere
10 Oct.	1	Snow covered body No insects	No change Snow covered body No insects	Snow on body No insects
13 Oct.	4	Flesh frozen No insects No bloat	Flesh frozen No insects	Frost on body and clothes No insects
15 Oct.	6	Bird scavenging to X on hock No eggs or adult flies	Fly eggs in mouth (size of quarter) No bloat	No flies or eggs No bloat
17 Oct.	8	More bird damage No eggs or insects Fresh	*Creophilus maxillosus* (A) No eggs anywhere No bloat	No change No insects No bloat
22 Oct.	13	Bird droppings all over body No insects No bloat	A few eggs in mouth No bloat No Flies	A few tiny eggs in mouth No bloat No flies
24 Oct.	15	Body snow covered No insects Fresh	Body covered in snow No insects	Body covered in snow No insects
27 Oct.	18	1 *P. regina* seen No eggs	Mild discoloration of stomach 2 *P. regina* (A) seen	2 *P. regina* (A) seen No eggs No bloat
29 Oct.	20	Flesh mummifying No insects	A few eggs in mouth Skin mummified	Face mummifying, no bloat No insects
31 Oct.	22	1 *P. regina* seen No eggs No bloat	6 *P. regina* (A) Eggs in mouth	Bloat Belly discolouring No eggs or insects

Table 11. Alberta Late Spring/Early Summer Data (May – September 1998) - Insects Seen And Collected.

DATE	ETSD	SUN			SHADE		
		GFS-10	GFS-11	GFS-12	GSH-10	GSH-11	GSH-12
May 6, 1998	0	Date of placement Fully clothed	Date of placement Fully clothed	Date of placement Fully clothed	Date of placement Fully clothed	Date of placement Fully clothed	Date of placement Fully clothed
May 30, 1998	24	Mass of *Protophormia terraenovae* (P) *Chrysochus* sp. (A) *Silpha* sp. (I)	*Protophormia terraenovae* (I, A), No pupae seen, but many migrating prepupae *Silpha* sp. (I) Bloated carcass has been disturbed by animals	*Protophormia terraenovae* (I, P, A) *Silpha* sp. (I,A) Carcass has been disturbed by animals	No collection	No collection	No collection
June 2	27	No collection	No collection	No collection	*Creophilus maxillosus* (A) Calliphoridae (I, P) third instar and prepupal. Seen migrating in large numbers across a road, 10 meters away.	*Necrodes* sp. and *Silpha* sp.(I, A) Calliphoridae pupae and newly emerged adults *Protophormia terraenovae* (A, P, I) Body bloated	*Protophormia terraenovae* (A, P, I) *Silpha* sp. (I, A)
June 4	29	*Silpha* sp. (I) *Protophormia terraenovae* newly emerged adult Acari Maggot masses still active	Removed by vertebrate scavengers	Removed by vertebrate scavengers	No collection	No collection	No collection

Table 11. Alberta Late Spring/Early Summer Data (May – September 1998) - Insects Seen And Collected contd.

DATE	ETSD	SUN			SHADE		
		GFS-10	GFS-11	GFS-12	GSH-10	GSH-11	GSH-12
June 8	33	*Drosophila* sp. (A) all over body Many *Silpha* sp. (I) Many emerging Calliphoridae adults Head removed by vertebrate scavengers.	-	-	*Drosophila* sp. (A) Some Calliphoridae (I, P, A) *Silpha* sp. (I) decreasing in numbers Body deflated	*Drosophila* sp. (A) Some Calliphoridae (I, P, A) *Silpha* sp. (I) decreasing in numbers Body deflated	*Drosophila* sp. A) and some Calliphoridae (I, P, A) *Silpha* sp. (I) decreasing in numbers Body deflated
June 11	36	Empty puparia, pupae and newly emerged adults *Protophormia terraenovae*. *Silpha* sp. (I) *Chrysochus* sp. (A)	-	-	*Drosophila* sp. (A) Many Calliphoridae(I, P, A) *Silpha* sp. (I) very few	*Drosophila* sp. (A) Many Calliphoridae(I, P, A) *Silpha* sp. (I) very few	*Drosophila* sp. (A) Many Calliphoridae(I, P, A) *Silpha* sp. (I) very few
June 14	39	*Protophormia terraenovae* (I, A) Very little beetle activity	-	-	Vertebrate scavenging.	Calliphoridae adults emerging *Onthophagus nuchicomis* (A) Some maggot activity deep in body	Many newly emerged adult Calliphoridae *Creophilus maxillosus* (A)
June 19	44	Newly emerged Calliphoridae adults *Drosophila* sp. (A)	-	-	Removed by vertebrate scavengers	Some maggots still present. *Drosophila* (A). numbers decreasing	Some maggots still present. *Drosophila* (A). numbers decreasing

Table 11. Alberta Late Spring/Early Summer Data (May – September 1998) - Insects Seen And Collected contd.

DATE	ETSD	SUN			SHADE		
		GFS-10	GFS-11	GFS-12	GSH-10	GSH-11	GSH-12
June 23	48	Newly emerged Calliphoridae adults (hiding in clothing) A few maggots still left. *Silpha* (sp.)	-	-	-	Some maggots still present. *Drosophila* (A). numbers decreasing	Many newly emerged Calliphoridae
June 26	51	*Piophila* sp. (I)	-	-	-	Some maggots still present. *Drosophila* (A). numbers decreasing	*Piophila* sp. (I) present
June 29	54	Mould growing on body	-	-	-	*Piophila* sp. (I) Some maggots still present. *Drosophila* (A). numbers decreasing	*Piophila* sp. (I)
July 3	58	More animal scavenging Many *Piophila* sp. (I)	-	-	-	Ants on body *Piophila* sp. (I) *Chrysochus* sp. (A)	Decrease in fauna. *Piophila* sp. (I) *Chrysochus* sp. (A)
July 7	62	Many *Piophila* sp. (I)	-	-	-	*Onthophagus nuchicomis* (A) *Chrysochus* sp. (A) quite common *Piophila* sp. (I) *Silpha* sp. (I)	*Chrysochus* sp. (A) quite common *Piophila* sp. (I) *Silpha* sp. (I)

Table 11. Alberta Late Spring/Early Summer Data (May – September 1998) - Insects Seen And Collected contd.

DATE	ETSD	SUN			SHADE		
		GFS-10	GFS-11	GFS-12	GSH-10	GSH-11	GSH-12
July 11	66	No change	-	-	-	Vertebrate scavengers removing back end	*Chrysochus* sp. (A) quite common *Piophila sp. (I)* *Silpha* sp. (I)
July 14	69	Many *Chrysochus* sp. (A) *Piophila* sp. (I) *Creophilus maxillosus (*A)	-	-	-	Many *Silpha* sp. (I) *Catops basilaris* (A)	*Catops basilaris* (A) found under clothing *Piophila* sp. (I) *Silpha* sp. (I)
July 21	76	*Necrodes* sp. (A)	-	-	-	Removed by vertebrate scavengers	No change
July 24	79	No change	-	-	-	-	No change
July 27	82	No change	-	-	-	-	No change
Aug. 2	88	*Piophila* sp. (I)	-	-	-	-	No change
Aug. 6	92	*Piophila* sp. (I) *Necrodes* sp. (A) *Ontholestes cingulatus* (A)	-	-	-	-	*Chrysochus* sp. (A), *Piophila* sp. (I), *Creophilus maxillosus* (A)
Aug. 13	99	*Piophila* sp. (I) very active Adipocere frothing	-	-	-	-	*Chrysochus* sp. (A), *Piophila* sp. (I)

Table 11. Alberta Late Spring/Early Summer Data (May – September 1998) - Insects Seen And Collected contd.

DATE	ETSD	SUN			SHADE		
		GFS-10	GFS-11	GFS-12	GSH-10	GSH-11	GSH-12
Aug. 18	104	No change	-	-	-	-	*Chrysochus* sp. (A), *Piophila* sp. (I)
Aug. 22	108	No change	-	-	-	-	*Chrysochus* sp. (A), *Piophila* sp. (I)
Aug. 28	114	No change	-	-	-	-	*Chrysochus* sp. (A) *Piophila* sp. (I)
Sept. 2	119	No change	-	-	-	-	*Chrysochus* sp. (A) *Piophila* sp. (I)
Sept. 7	124	No change	-	-	-	-	Very little activity, only *Chrysochus* sp. (A) and *Piophila* sp. (I)
Sept. 11	128	No change	-	-	-	-	Very little activity, only *Chrysochus* sp. (A) and *Piophila* sp. (I)
Sept. 15	132	No change	-	-	-	-	*Chrysochus* sp. (A) and *Piophila* sp. (I)

Table 11. Alberta Late Spring/Early Summer Data (May – September 1998) - Insects Seen And Collected contd.

DATE	ETSD	SUN			SHADE		
		GFS-10	GFS-11	GFS-12	GSH-10	GSH-11	GSH-12
Sept. 21	138	*Piophila* sp. (I) large and moving slowly due to cold weather	-	-	-	-	*Chrysochus* sp. (A) *Piophila* sp. (I)
Sept. 25	142	*Piophila* sp. (I) burrowed deeper due to rain, and snow.	-	-	-	-	Similar to GFS#10 No insects despite clothing for protection, except *Piophila* sp. (I) Frothing evident
Sept. 30			-	-	-	-	No change

Table 12. Alberta spring/early summer data 1998, for covered carcasses, Ellerslie Research Station

DATE	ETSD	GCV#1	GCV#2	GCV#3
July 14, 1998	0	Placement of carcass, lightly covered with brush	Placement of carcass, lightly covered with brush	Placement of carcass, lightly covered with brush
July 21, 1998	7	Carcass bloated and covered with maggots	Carcass bloated and covered with maggots	Carcass bloated and covered with maggots
July 27, 1998	13	Prepupal larvae migrating from body	Prepupal larvae migrating from body	Prepupal larvae migrating from body. No masses left
Aug. 2	19	Body flat, but insects active. Most maggots gone. Newly emerged adult Calliphoridae seen More *Creophilus maxillosus* (A) than on uncovered pigs	Half of remains removed by vertebrate scavengers. Still bloated and fleshy in remaining half Maggots still active	Almost completely skeletonized, except for dry skin, bones and hair. Almost no maggots *Creophilus maxillosus* (A)
Aug. 22	39	Very few insects left Some new maggots in wet areas Hornets Few beetles of any sort	Removed by vertebrate scavengers	Same as above, very few insects
Aug. 28	45	*Chrysochus* sp. (A) A few maggots left		Few stray maggots, weather cooler First appearance of *Chrysochus* sp. (A)
Sept. 30	78	Removed by vertebrate scavengers		Removed by vertebrate scavengers

Table 13. Duration of decompositional stages for shade and sun carcasses at Ellerslie Research Station for 1999.

STAGE	SHADE			SUN		
	1	**2**	**3**	**1**	**2**	**3**
Fresh	4	n/a	2	2	2	2
Bloat	28	32	28	44	24	32
Decay	26	26	25	31	30	36
Advanced Decay	58*	58*	55*	77*	56*	70*

n/a pig was dead for 36 hours at time of placement
* beginning on day, experiment was terminated before skeletal remains was reached

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
May 18, 1999	0	Placement of carcass in sun 80-100 lbs Pig was fully dressed covering at least 75 % of body	Placement of carcass in sun Bloated, and green (already 2-3 days old) 80-100 lbs Pig was fully dressed covering at least 75 % of body				
May 20	2/0	Small number of fly eggs around nose and eyes	Small number of fly eggs around nose and eyes	Placement of carcass 150-250 lbs Pig was draped in clothing No signs of decomposition (fresh died within 24-48 hours) Small number of fly eggs around nose and eyes	Placement of carcass Pig was draped in clothing No signs of decomposition (fresh died within 24-48 hours) Small number of fly eggs around nose and eyes	Placement of carcass Pig was draped in clothing No signs of decomposition (fresh died within 24-48 hours) Small number of fly eggs around nose and eyes	Placement of carcass Biggest pig at 250 lbs Pig was draped in clothing No signs of decomposition (fresh died within 24-48 hours) Small number of fly eggs around nose and eyes

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
May 22	4/2	Beginning to bloat *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A)	Really bloated Has holes in skin *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A)	Beginning to bloat *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A)	Bloat but less than in the sun Marbling	Bloat but less than in the sun Marbling *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A)	Bloat but less than in the sun Marbling *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A)
May 25	7/5	Advanced bloat Immature maggots *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A) Anus is protruding	Advanced bloat *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) *Silpha* sp. (I, A) and *Chrysochus* sp. (A)	Advanced bloat *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) *Silpha* sp. (A), *Carabus* sp. (A), and *Chrysochus* sp. (A)	Advanced bloat *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A), *Silpha* sp. (A, I), and *Chrysochus* sp. (A)	Advanced bloat *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A), *Silpha* sp. (A), and *Chrysochus* sp. (A)	Advanced bloat *Catops basilaris* (A) *Creophilus maxillosus* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A)

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
June 6	19/17	Body is still bloated Large number of *Silpha* sp. (A, I), *Hister* sp. (A), *Nicrophorus* sp. (A), *Catops basilaris* (A), *Ontholestes cingulatus* (A) and *Chrysochus* sp. (A) and *Creophilus maxillosus* (A) Lots of fly eggs on the clothing and a mass in the armpit	Body still very bloated Lots of *Silpha* sp. (A, I) and few *Creophilus maxillosus* (A), *Ontholestes cinqulatus (A), Catops basilaris* (A) and *Chrysochus* sp. (A Fly eggs on the clothing and orifices	Bloat is beginning to recede Very little fly activity Few *Rhizophagus* sp. (A) Lots of *Ontholestes cinqulatus (A), Catops basilaris* (A) and *Chrysochus* sp. (A)	Large bloated pig Spot on the back is oozing fat Small numbers of *Ontholestes cinqulatus (A), Catops basilaris* (A), *Silpha* sp. (A) and *Chrysochus* sp. (A)	Maggot mass on the underside of the body - temp 23°C *Ontholestes cinqulatus (A), Catops basilaris* (A), *Silpha* sp. (A) and *Chrysochus* sp. in numbers than GSH-13 Body is bloated	Very bloated Large mass on the underside *Ontholestes cinqulatus* (A), *Catops basilaris* (A), *Silpha* sp. (A) and *Chrysochus* sp. (A)
June 11	24/22	Bloat has subsided *Protophormia terraenovae* (I) very large in size Large number of *Silpha* sp. (A) are congregating in the head region, *Chrysochus* sp. (A) and *Silpha* sp. (I) are wondering over the body under the clothing	Body is still bloated Large mass of small *Protophormia terraenovae* (I) under the shoulder area Few of *Silpha* sp. (A) and *Chrysochus* sp. (A), *Creophilus maxillosus* (A) and many spiders	Body is still fairly bloated Evidence of maggot activity on the underside of the pig and quite a bit of fly activity There are small numbers of *Ontholestes cinqulatus* (A), *Creophilus maxillosus* (A) *Silpha* sp. (A) and *Chrysochus* sp. (A)	Body is very bloated Large number of *Silpha* sp. (A, I) congregating in the head region, especially the mouth Small number of *Onthophagus nuchicomis (A), Creophilus maxillosus* (A) and *Chrysochus* sp. (A)	Less bloat than other pigs Large maggot mass on the underside of the body, temp 25°C Wound on back of pig attracting *Protophormia terraenovae* (I) to colonize There are large numbers of *Silpha* sp. (A) around the mouth area	Large mass still present on the underside *Ontholestes cinqulatus (A), Creophilus maxillosus* (A), *Silpha* sp. (A) and *Chrysochus* sp. (A)

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
June 15	28/26	The front half of the body is flattened from the maggot mass at the armpit region, Mass temp 30 ^{0}C Fewer *Chrysochus* sp. (A) and very few *Silpha* sp. (I, A) found on body	Body is decreasing in bloat *Protophormia terraenovae* (I) are only on the underside of the body *Silpha* sp. (A), *Creophilus maxillosus* (A) and *Chrysochus* sp. (A) visible Arms and legs are completely disarticulated Great deal of fly activity	Large mass has developed in the mouth, mass temp 28^{0}C *Catops basilaris* (A), *Silpha* sp. (A), *Ontholestes cinqulatus* (A), *Creophilus maxillosus* (A) and *Chrysochus* sp. (A) Body is partially deflated and wet on the surface, despite the heat	Body is very bloated with lots of beetle activity, *Silpha* sp. (A, I), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Chrysochus* sp. (A) There is no significant maggot activity except in the patch of oozing fat on the back	Body has deflated due to maggot mass on the underside *Silpha* sp. (A,I), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Chrysochus* sp. (A)	Mass still on underside, body still bloated Large amount of extruded fluid from the rectum is attracting flies *Silpha* sp. (A, I), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus* sp. (A)
June 19	32/30	Body has flattened due to the *Protophormia terraenovae* (I), which have spread all over the body Couple of *Silpha* sp. (A) left but not many	Bloat is gone Large variety of insects in larger numbers Body is very wet	*Protophormia terraenovae* (I) are beginning to pupate *Ontholestes cinqulatus* (A), *Chrysochus* sp. (A) are present	Body is still bloated Small *Protophormia terraenovae* (I) are showing up under the skin Lots of *Silpha* (I, A) found all over the body	Body has been reduced on the underside by *Protophormia terraenovae* (I) Mass temperature 23 ^{o}C	Still semi-bloated, but decreasing

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
June 19 Con't	32/30	Large number of *Protophormia terraenovae* (P) under clothing and in the surrounding grass *Onthophagus nuchicomis* (A) and *Chrysochus* sp. (A)	*Silpha* sp. (A,I), *Onthaphagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Chrysochus* sp. (A)	Great deal of variety in species present today New mass smaller (1^{st} instar) *Protophormia terraenovae* (I) hatched today under the skin	Insects present; *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A)	More *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A) than observed on GSH-13	*Silpha* sp. (A, I), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus* sp. (A)
June 23	36/34	*Protophormia terraenovae* (I) from under arm have moved down the body to the rear, some pupae *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A)	Body has flattened out Large amount of insects Larger numbers of *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A) than GFS15 *Protophormia terraenovae* (I) are still very active under clothing	Same conditions as before It has been cool for the last few days, so *Protophormia terraenovae* (I) haven't developed very much All of the insects are hiding under the clothing from the wind *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A).	There is a mass of *Protophormia terraenovae* (I) starting under the armpits. Still large number of *Silpha* sp. (I, A), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A), and *Chrysochus* sp. (A)	*Protophormia terraenovae* (I) on the underside have continued to flatten the body Mass temperature 24 ^{0}C Large number of *Silpha* sp. (A)	Bloat has subsided *Protophormia terraenovae* (I) are still very active all over the body Lots of *Silpha* sp. (I)

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
June 29	42/40	Body is flat *Protophormia terraenovae* (I) are migrating and some pupating *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A).	Body is completely flattened Small flies around *Protophormia terraenovae* (I) are still present, but have spread all over the body *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A).	*Protophormia terraenovae* (I) developing on all parts of the body, especially in the peck holes created by birds The body is very wet and decreasing in size Mostly *Chrysochus* sp. (A) *Silpha* sp. (I, A), *Ontholestes cinqulatus* (A)	Body is still bloated Large numbers of *Silpha* (I, A) mass of *Protophormia terraenovae* (I) under arm has grown and mass temperature 38^0C *Chrysochus* sp (A)	*Protophormia terraenovae* (I) have spread all over the body, continuing to decrease its volume Large variety of insects *Silpha* sp. (I, A), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus* sp. (A).	Large variety of insects *Silpha* sp. (I, A), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus sp*. (A) Flatter than last time
July 5	48/46	*Protophormia terraenovae* (I) are migrating and some pupating *Silpha* sp. (A) all gone, but larvae were most abundant, *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A) are decreasing in numbers	Large numbers of Calliphoridae adults congregating on the body Very little of this pig left Small numbers of *Chrysochus* sp. (A), and *Silpha* sp. (I), as well as *Protophormia terraenovae* (I) *Ontholestes cinqulatus* (A) and *Drosophila* sp. (A)	*Protophormia terraenovae* (I) of many sizes Large number of *Silpha* sp. (I) and *Chrysochus* sp. (A) (10-15 of each), also *Onthophagus nuchicomis* (A), *Ontholestes cinqulatus* (A), and *Carpophilus* sp. (A)	The body is finally deflating Large number of *Protophormia terraenovae* (I) and *Silpha* sp. (I,A) Not many *Creophilus maxillosus* (A) *Ontholestes cinqulatus* (A) and *Chrysochus* sp. (A)	Large number of *Protophormia terraenovae* (I) found under the jacket Head is almost completely skeletonized Few *Silpha* sp. (A, I) lingering around, also *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus* sp. (A)	Most *Protophormia terraenovae* (I) migrated into grass, however, some under the clothing *Silpha* sp. (A), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus* sp. (A).

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
July 10	53/55	There are a few large *Protophormia terraenovae* (I) left, most have pupated *Silpha* sp. (A), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A) Masses of *Piophila* sp. (I) in the slop under the skin by the ribs	There are less flies swarming than last visit, however, *Drosophila* sp. (A) observed Quite a few *Silpha* sp. (I) Masses of mites that appear to like the fluffy stuff *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A)	The body appears wet despite the hot and dry surrounding temperature There is liquid coming from the mouth Lots of little flies *Silpha* sp. (A), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), *Catops basilaris* (A), and *Chrysochus* sp. (A)	*Protophormia terraenovae* (I) are still present and are very large, *Piophila* sp. (I) are present as well Large numbers of *Silpha* sp. (I) on the surface of the pig and adults decreasing in numbers *Chrysochus* sp. (A) and present	Still very large maggot around, some starting to pupate Diversity of insects is smaller than previously *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A)	Few stray *Protophormia terraenovae* (I) left *Silpha* sp. (I), *Ontholestes cinqulatus* (A), *Onthophagus nuchicomis* (A), and *Chrysochus* sp. (A)
July 15	58/56	Few *Protophormia terraenovae* (I) left, mostly pupae and empty cases There are lots of mites and skippers Few *Silpha* sp. (I), *Ontholestes cinqulatus* (A), *Catops sp.* (A) and *Chrysochus* sp. (A)	Newly emerged flies present Body remains are sloppy fat, mummified skin and bones *Piophila* sp. (I) are present also *Drosophila* sp. (A), *Ontholestes cinqulatus* (A, I), *Silpha* sp. (I) and *Chrysochus* sp. (A)	Insects are small in numbers today due to weather There are very few *Protophormia terraenovae* (I) visible from the outside Quite a large variety present *Drosophila* sp. (A), *Chrysochus* sp. (A), *Silpha* sp. (I), *Ontholestes cinqulatus* (A), and *Creophilus maxillosus* (I)	*Protophormia terraenovae* (I) have moved around the pig Maggot mass temperature 25 ^{0}C *Chrysochus* sp. (A), *Silpha* sp. (I), and *Piophila* sp. (I)	Body is wet and sloppy with liquid all around attracting flies Still lots of large *Protophormia terraenovae* (I) *Chrysochus* sp. (A), *Silpha* sp. (I), and *Ontholestes cinqulatus* (A)	Remaining *Protophormia terraenovae* (I) are very large and scattered *Chrysochus* sp. (A), *Silpha* sp. (I), *Onthophagus nuchicomis* (A), and *Ontholestes cinqulatus* (A)

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
July 20	63/61	There are lots of active *Piophila* sp. (I) Body is flat and drying out There are emerging flies on the body *Chrysochus* sp. (A), *Silpha* sp. (I), *Creophilus maxillosus* (I) and *Ontholestes cinqulatus* (A)	Body is dry There are still a few *Silpha* sp. (A) around, as well as *Carpophilus* sp. (I, A), *Chrysochus* sp. *Ontholestes cinqulatus* (A) and *Piophila* sp. (I)	Body is wet despite a few days of warm weather There are lots of blue flies buzzing around and landing *Rhizophagus* sp. (I) *Chrysochus* sp. (A), *Silpha* sp. (I), *Creophilus maxillosus* (I) and *Drosophila* sp. present There is also *Carpophilus* sp. (A) for the first time on this pig	Lots of swarming flies, small and large Good variety of insects, more than usual *Chrysochus* sp. (A), *Silpha* sp. (I), *Creophilus maxillosus* (I) and *Ontholestes cinqulatus* (A) *Piophila* sp. (I)	Large *Protophormia terraenovae* (I) still around A few more types of insects evident, but nothing in large numbers *Chrysochus* sp. (A), *Silpha* sp. (I), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Ontholestes cinqulatus* (A) Body is drying out and is very flat	Still a few *Protophormia terraenovae* (I) Body is drying out A little wet on the underside *Chrysochus* sp. (A), *Silpha* sp. (I), *Creophilus maxillosus* (A) and *Ontholestes cinqulatus* (A), less in numbers than GSH-14
July 25	68/66	Same as July 20; *Chrysochus* sp. (A), *Silpha* sp. (I), *Creophilus maxillosus* (I) and *Ontholestes cinqulatus* (A) Lots of little flies and *Piophila* sp. (A)	A few *Piophila* sp. (I) left, found only under clothing on ground Insects similar to last few days *Ontholestes cinqulatus* (A) *Chrysochus* sp. (A), *Leiodes* sp. (A), and *Carpophilus* sp. (A)	There are still quite a few *Protophormia terraenovae* (I), but they are mostly internal	Condition of the body has stayed much the same in the last few days Lots of variety *Chrysochus* sp. (A), *Silpha* sp. (I), *Piophila* sp. (I), *Drosophila* sp. (A) and *Ontholestes cinqulatus* (A)	Most of the *Protophormia terraenovae* (I) have pupated Very few *Silpha* sp. (I) *Ontholestes cinqulatus* (A), and *Creophilus maxillosus* (I) left, but lots of *Chrysochus* sp. (A) State of body hasn't changed much	No changes from previous day other

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
July 29	72/70	Lots of *Creophilus maxillosus* (I) and *Piophila* sp. (I) *Chrysochus* sp. (A), *Silpha* sp. (I), and *Ontholestes cinqulatus* (A) Body is quite dry on surface, but wet underneath	Very flat and dry *Ontholestes cinqulatus* (A) *Chrysochus* sp. (A), and *Carpophilus* sp. (A) A few *Piophila* sp. (I)	There is a mass on the underside near the front of the pig *Rhizophagus* sp. are still present, but seen only among hairs Few *Silpha* sp. (I), *Chrysochus* sp. (A), *Carpophilus* sp. (A) *Creophilus maxillosus* (I) present Body is still quite fleshy, but no longer bloated	Some of the *Piophila* sp. (I) have migrated to pupate *Chrysochus* sp. (A), *Silpha* sp. (I), and *Ontholestes cinqulatus* (A)	Very few *Protophormia terraenovae* (I) remaining, just a few stray ones under clothing near the ground No large numbers of anything *Chrysochus* sp. (A), *Catops basilaris* (A), *Chrysochus* sp. (A), *Silpha* sp. (I), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Ontholestes cinqulatus* (A)	Not much change Body getting dry Very few individuals left *Chrysochus* (A), *Catops basilaris* (A), *Chrysochus* sp. (A), *Silpha* sp. (I), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Ontholestes cinqulatus* (A), *Silpha* sp. (I), and *Ontholestes cinqulatus* (A)
Aug. 5	79/77	*Chrysochus* sp. (A), *Catops basilaris* (A), *Chrysochus* sp. (A), *Silpha* sp. (I), *Onthophagus nuchicomis* (A), *Creophilus maxillosus* (A) and *Ontholestes cinqulatus* (A)(I), *Creophilus maxillosus* (I)	Large quantities of mites giving fluffy appearance Quite a few more insects today than last time: *Catops basilaris* (I), *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A,) *Chrysochus* sp. (A), and *Piophila* sp. (I) ,	Decreased numbers of *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), and *Rhizophagus* sp. (A). Body is flat and wet There are flies buzzing around, but not much landing	Still quite a few *Ontholestes cinqulatus* (A,) *Chrysochus* sp. (A), and *Piophila* sp. (I) , Skin is drying out	*Ontholestes cinqulatus* (A,) and *Chrysochus* sp. (A)	*Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (I, A)

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
Aug. 5 Con't	79/77	*Ontholestes cinqulatus* (A) and *Piophila* sp. (I)		*Piophila* sp. (I) are seen for the first time on this carcass			
Aug. 9	83/81	This pig has the most abundant mass of *Piophila* sp. (I) *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A)	Body is dry and taken over by ants, mites, and spiders *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A) and *Piophila* sp. (I)	Not much on the body like before, and not behaving like other 2 in sun the amount of insects has decreased greatly; few *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (I, A), *Drosophila* sp. (A), *Rhizophagus* sp. (I)	Body is still quite fleshy, but changing quite a bit in the last while Big decrease in the numbers and types of insects A few *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A) and *Piophila* sp. (I)	Body is flat and drying out Large number of *Ontholestes cinqulatus* (A) only a few *Creophilus maxillosus* (A), and *Chrysochus* sp. (A) This pig decomposed the faster than GSH 13 but slower than GSH15	Flat the fastest out of all the shade pigs smaller number near the end *Chrysochus* sp. (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), *Drosophila* sp. (A) and Acari
Aug. 15	89/87	Large number of *Ontholestes cinqulatus* (A) ants, and mites A few *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Onthophagus nuchicomis* (A), and *Drosophila* sp. (A)	Lots of variety in small numbers; *Catops basilaris* (A), *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A) and *Piophila* sp. (I) Dry Greatest number of mites seen	Animals have disturbed this one One of the front legs has some of the flesh taken as well as some of the clothing *Piophila* sp. (I) are scattered and *Rhizophagus* sp. (I) are still in the hairs *Chrysochus* sp. (A), *Carpophilus* sp. (A),	*Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), Acari and *Piophila* sp. (I) Body keeps drying out, but still has a lot left to it	No change in condition Quite a few *Creophilus maxillosus* (A, I) *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A), and *Chrysochus* sp. (A)	*Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), *Chrysochus* sp. (A), *Drosophila* sp. (A), *Piophila* sp. (I), and mites

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
Aug. 18	92/90	Mites giving a fluffy appearance in the dryer areas. *Piophila* sp. (I) are increasing in numbers, or are spreading out *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), and *Ontholestes cinqulatus* (A)	Lots of little flies buzzing around today and thousands of mites. Lots of variety; *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Catops basilaris* (A), and *Ontholestes cinqulatus* (A) Smaller number of *Piophila* sp. (I) are active in the small bit of adipocere and liquid that has pooled in clothing	Total volume of the body decreasing and drying out *Piophila* sp. (I) are active in the adipocere especially under the bone There are lots of little flies buzzing including *Drosophila* sp. (A) and *Piophila* sp. (A) *Chrysochus* sp. (A), *Carpophilus* sp. (A), and *Rhizophagus* sp. (A)	Fluffy material is here *Piophila* sp. (I) are active, most noticeable on the back where there was fat oozing	Mites are accumulating *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A), *Drosophila* sp. (A) and *Piophila* sp. (I)	Mites creating fluffy material on the lower part of carcass *Piophila* sp. (I) are evident in the adipocere Not as much insects as the other shade pigs though, due to its drier state *Chrysochus* sp. (A), *Ontholestes cinqulatus* (A), and *Drosophila* sp. (A)
Aug. 26	100/98	Little flies are all over the body and buzzing around including *Drosophila* sp. (A), and *Piophila* sp. (A) *Piophila* sp. (I) are visible	Not much change Same condition, just progressively drier	There is very little change physically Mites are visible *Rhizophagus* sp. (A) are present and appear to have gotten larger Lots of little flies	The body was flattened out in the last couple of days *Piophila* sp. (I) still active, as well as a few *Protophormia terraenovae* (I) that remain	Lots of *Piophila* sp. (I) especially where there is adipocere and it froths after the rain	Body has dried out considerably Lots of little flies including *Drosophila* sp. (A)

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
Aug. 26 Con't	100/98	Lots of activity: *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A,I), and *Ontholestes cinqulatus* (A), *Nicrophorus* sp. (A), and *Rhizophagus* sp. (A)	*Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), and *Ontholestes cinqulatus* (A), *Rhizophagus* sp. (A) and *Piophila* sp. (I, A)	*Chrysochus* sp. (A), *Carpophilus* sp. (A) Few *Piophila* sp. (I) left	*Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A) and mites	*Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), and *Ontholestes cinqulatus* (A), *Drosophila* sp. (A), and mites. Body is slowly beginning to dry out	*Piophila* sp. (I) are visible also *Chrysochus* sp. (A), *Ontholestes cinqulatus* (A) and *Drosophila* sp. (A), and mites
Sept. 12	117/115	*Piophila* sp. (I) and mites still active *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A), *Leiodes* sp. (A), and *Hister* sp. (A)	*Ontholestes cinqulatus* (A), *Chrysochus* sp. (A), *Piophila* sp. (A), *Drosophila* sp. (A), and mites	Not much changed Little warmer today, so *Piophila* sp. (I) are moving a bit faster *Creophilus maxillosus* (A), *Chrysochus* sp. (A), *Carpophilus* sp. (A), and mites	Still lots of *Carpophilus* sp. (A), *Creophilus maxillosus* (A) and *Piophila* sp. (I)	No change	No change
Sept. 7	112/110	*Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (I), and *Ontholestes cinqulatus* (A), *Nicrophorus* sp. (A), *Piophila* sp. (I) and mites Appearance of *Leiodes* sp. (A) *Hister* sp. (A),	Some larger wet spots have developed from the rain in the last few days *Piophila* sp. (I) found in these spots *Ontholestes cinqulatus* (A), *Chrysochus* sp. (A) and mites	*Creophilus maxillosus* (A) are back *Piophila* sp. (I) still active, *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Drosophila* sp. (A), and mites	*Carpophilus* sp. (A) are quite abundant also *Creophilus maxillosus* (A), *Ontholestes cinqulatus* (A), *Piophila* sp. (A) and mites	*Chrysochus* sp. (A), *Carpophilus* sp. (A), *Creophilus maxillosus* (A), and *Ontholestes cinqulatus* (A), *Piophila* sp. (A), and mites	*Hister* sp. (A) and *Piophila* sp. (I) Decreasing numbers of *Ontholestes cinqulatus* (A), *Chrysochus* sp. (A), *Drosophila* sp. (A), and mites Much drier than 13 and 14

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
Sept. 12	117/115	No change in condition of the body *Piophila* sp. (I) and mites still active *Chrysochus* sp. (A), *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A), *Leiodes* sp. (A), and *Hister* sp. (A)	*Ontholestes cinqulatus* (A), *Chrysochus* sp. (A), *Piophila* sp. (A), *Drosophila* sp. (A), and mites	Not much changed Little warmer today, so *Piophila* sp. (I) are moving a bit faster *Creophilus maxillosus* (A), *Chrysochus* sp. (A), *Carpophilus* sp. (A), and mites	Still lots of *Carpophilus* sp. (A), *Creophilus maxillosus* (A) and *Piophila* sp. (I) No change in condition of body	No change	No change Didn't see *Hister* sp. (A)
Sept. 22	127/125	Clump of fluffy material (produced by mites) on the shoulder, also mites visible Good variety of insect species today *Ontholestes cinqulatus* (A), *Chrysochus* sp. (A), and *Carpophilus* sp. (A) Body under skin appears to be only adipocere now, with the *Piophila* sp. (I) feeding in it	No change in condition It has dried up a bit from the rain *Ontholestes cinqulatus* (A), *Chrysochus* sp. (A), *Piophila* sp. (A), and mites	Body is almost all adipocere no *Piophila* sp. (I) found under skin and bones Very cold night Mites are visible in addition to clump of fluffy material by the shoulder *Chrysochus* sp. (A), *Ontholestes cinqulatus* (A), *Carpophilus* sp, (A), *Catops* sp. (A),	Not much left but *Piophila* sp. (I) *Carpophilus* sp. (A), *Ontholestes cinqulatus* (A), and a few *Protophormia terraenovae* (I)	Little in the way of variety and very few of what is there: *Ontholestes cinqulatus* (A), *Carpophilus* sp, (A), and *Piophila* sp. (I)	*Piophila* sp. (I) still present but moving slowly *Ontholestes cinqulatus* (A), *Carpophilus* sp, (A), and mites

Table 14. Alberta spring/early summer data 1999, for carcasses in sun and shade, Ellerslie Research Station contd.

DATE	ETSD	SUN			SHADE		
		GFS-13	GFS-14	GFS-15	GSH-13	GSH-14	GSH-15
Sept. 27	132/130	*Leiodes* and *Hister* adults no longer present Other than skippers, mites and a few *Ontholestes cinqulatus* (A) and *Carpophilus* sp. (A), there is little left	*Piophila* sp. (I) are slowing down Otherwise not much change in condition	*Piophila* sp. (I) are pretty much the only insect left, a couple of *Chrysochus* sp. (A) Very cold at night	*Piophila* sp. (I) are moving quite slow, no evidence of pupation *Ontholestes cinqulatus* (A) visible	*Piophila* sp. (I) are still there but moving slow It is getting cold at night	Just *Piophila* sp. (I) present Very dry
Oct. 12	147/145	Other than a few species of *Ontholestes cinqulatus* (A) and *Piophila* sp. (I) little is left Cold at night now	Most of the insects are gone except the *Piophila* sp. (I) and the odd *Chrysochus* sp. (A) Body is very dry It is quite cold at night	It is now freezing at night *Piophila* sp. (I) are slowing down, but not pupating, only insect is the odd *Chrysochus* sp. (A)	*Piophila* sp. (I) and mites are most abundant life also *Catops* sp. (A) and *Ontholestes cinqulatus* (A)	*Piophila* sp. (I) are all that is left and not yet pupating Very cold night	No change *Piophila* sp. (I) slow from cold weather, no sign of pupating
Oct. 26	161/159	Only *Piophila* sp. (I) are still there, but buried deep and moving slow	Only *Piophila* sp. (I) still there, but moving very slowly (most of them are frozen)	Only dead *Piophila* sp. (I) or those buried deep in the body	Significant decrease in life since last time, only *Piophila* sp. (I)	Only *Piophila* sp. (I) present and are moving slow (or diapause?)	Just *Piophila* sp. (I) left, mostly dead (or diapause?)

Table 15. Temperature data for 1999 comparison between recorded values and Ellerslie Weather Station

Date	Time (hours)	Pig Temp (SUN) ^{O}C	Pig Temp (SHADE) ^{O}C	Weather Station Temp ^{O}C
May 18	1530			13.39
May 20	1630			15.3
May22	1200			16.09
May 25	1200	30	27	25.18
June 6	1915	13	13	13.16
June 11	1200	25	16	17.57
June 15	1415	25	18	24.29
June l9	1630	13	13	13.28
June 23	1030	12	12	12.13
June 29	1630	24	25	19.99
Ju1y 5	1700	15	15	14.5
July 10	1200	29	21	23.91
July 15	1700	10	10	10.58
July 20	1630	27	24	26.31
July 25	1630	20	15	16.01
July 29	1745	22	20	19.6
Aug. 5	1630	22	22	22.17
Aug. 9	1800	23	22	22.67
Aug. 15	1330	24	21	21.45
Aug. 18	1630	25	22	26.27
Aug. 26	1715	23	18	20.09
Aug. 30	1630	11	11	11.17
Sept. 7	1630	13	11	13.17
Sept. 12	1400	22	16	17.38
Sept. 16				23.63
Sept. 22	1700	23	16	21.81
Sept. 27	1630	10	9	
Oct. 12	1715	9	7	
Oct. 26	1745	6	5	

Table 16. Alberta spring/early summer data 1999, for buried carcasses, Ellerslie Research Station.

DATE	ETSD	GBU-1	GBU-2	GBU-3
May 18, 1999	0	Pig was fully dressed, covering at least 75% of body Buried in holes 1 ft below the surface Covered with chicken wire sheets that were pinned at the corners with landscape pins	Pig was fully dressed, covering at least 75% of body Buried in holes 1 ft below the surface Covered with chicken wire sheets that were pinned at the corners with landscape pins	Pig was fully dressed, covering at least 75% of body Buried in holes 1 ft below the surface Covered with chicken wire sheets that were pinned at the corners with landscape pins
May 20	2	Buried pigs were scavenged and removed	Buried pigs were scavenged and removed	Buried pigs were scavenged and removed

APPENDIX I LATE SPRING CARCASSES – HASSE LAKE 1997

PIG	DATE OF DEATH	TIME OF PLACEMENT	HABITAT	WT. AT DEATH	COMMENTS
Pred-1	June 12, 1997	June 12, 1200 hours	Surface/ partial shade	26 kg	Fresh
Pred-2	June 11, 1997	June 12, 1200 hours	Shallow burial/ shade	26 kg	Dead 36 hours at placement, unburied first day, grave 14' deep, already bloated and discoloured
B-1	June 27, 1997	June 27, 1400 hours	Burial/sun	28 kg	Torso is 1 foot deep, Probe inserted into 1" incision in the throat
SFS-1	June 12, 1997	June 12, 1200 hours	Full **sun**, on ground	156 kg	No external trauma
SFS-2	June 12, 1997	June 12, 1200 hours	Full **sun**, on ground	19 kg	Very fresh, some trauma to anus
SFS-3	June 25, 1997	June 25, 1200 hours	Full **sun**, on ground	80 kg	2 x incisions, very fresh, anus extruded
SFS-4	June 25, 1997	June 25, 1230 hours	Full **sun**, on ground	80 kg	X incision in butt, fresh stage
SFS-5	June 25, 1997	June 25, 1330 hours	Full **sun**, on ground	21 kg	3 x incisions (shoulder, belly, hips), fresh
SFS-6	June 25, 1997	June 25, 1330 hours	Full **sun**, on ground	80 kg	3 x incisions (shoulder, belly, hips), fresh

APPENDIX II LATE SPRING CARCASSES – HASSE LAKE 1997

PIG	DATE OF DEATH	TIME OF PLACEMENT	HABITAT	WT. AT DEATH	COMMENTS
SS-1	June 12, 1997	June 12, 1200 h	full **shade** on ground	36 kg	Cage lying on left side, no trauma
SS-2	June 12, 1997	June 12, 1200 h	full **shade** on ground	162 kg	Fresh, no external trauma, fly eggs on eyes
SS-3	June 25, 1997	June 25, 1410 h	full **shade** on ground	80 kg	3 x incisions, no extended butt
SS-4	June 26, 1997	June 27, 1200 h (already dead 36 hours)	full **shade** on ground	80 kg	No incisions, some discolouration, slight bloating
SS-5	June 27, 1997	June 27, 1200 h	full **shade** on ground	21 kg	Stomach bloated, slightly green (same as SS-4)
SS-6	June 27, 1997	June 27, 1230 h	full **shade** on ground	59 kg	Foot long incisions across hip, some discolouration and marbling

APPENDIX III LATE SUMMER CARCASSES – ELLERSLIE RESEARCH PARK 1997/1998

PIG	DATE OF DEATH	TIME OF PLACEMENT	HABITAT	WT. AT DEATH	COMMENTS
GFS 1	August 5, 1997, 0800 h	August 5, 2015 h	full **sun**, on ground	80 kg	Fully clothed
GFS 2	August 5, 1997, 0800 h	August 5, 2030 h	Full **sun**, on ground	80 kg	Fully clothed, some skin damage on hips
GFS 3	August 5, 1997, 0800 h	August 5, 2100 h	Full **sun** on ground	80 kg	Fully clothed, maggots were present on pig while unloading. Avulsed intestines caused by unloading
GSH 1	August 5, 1997, 0800 h	August 5, 1900 h	full **shade** on ground	80 kg	Fully clothed, large trauma to the neck
GSH 2	August 5, 1997, 0800 h	August 5 1930 h	full **shade** on ground	80 kg	Fully clothed
GSH 3	August 5, 1997, 0800 h	August 5 2000 h	full **shade** on ground	80 kg	Fully clothed, One foot incision on side

APPENDIX IV FALL CARCASSES – ELLERSLIE RESEARCH PARK – 1997/1998

PIG	DATE OF DEATH & PLACEMENT	HABITAT	APPROX. WT. AT DEATH	COMMENTS
GFS-4	October 9, 1997	Full **sun,** on ground	80 kg	Fully clothed
GFS-5	October 9, 1997	Full **sun,** on ground	80 kg	Fully clothed
GFS-6	October 9, 1997	Full **sun,** on ground	80 kg	Fully clothed.

APPENDIX V EARLY/MID SUMMER CARCASSES – ELLERSLIE RESEARCH PARK 1998

PIG	DATE OF DEATH & PLACEMENT	HABITAT	APPROX. WT. AT DEATH	COMMENTS
GFS 10	May 6, 1998	Full **sun,** on ground	80 kg	Fully clothed
GFS 11	May 6, 1998	Full **sun,** on ground	80 kg	Fully clothed. Removed by animals by June 4, 1998
GFS 12	May 6, 1998	Full **sun,** on ground	80 kg	Fully clothed. Removed by animals by June 4, 1998
GSH 10	May 6, 1998	Full **shade**, on ground	80 kg	Fully clothed. Removed by animals by June 19, 1998
GSH 11	May 6, 1998	Full **shade**, on ground	80 kg	Fully clothed. Removed by animals by July 21, 1998
GSH 12	May 6, 1998	Full **shade**, on ground	80 kg	Fully clothed.
GCV 1	July 21, 1998	**Covered** by brush	80 kg	Fully clothed. Removed by animals by September 30, 1998
GCV 2	July 21, 1998	**Covered** by brush	80 kg	Fully clothed. Removed by animals by August 22, 1998
GCV 3	July 21, 1998	**Covered** by brush	80 kg	Fully clothed. Removed by animals by September 30, 1998

APPENDIX VI EARLY/MID SUMMER CARCASSES – ELLERSLIE RESEARCH PARK 1999

PIG	DATE OF DEATH	TIME OF PLACEMENT	HABITAT	APPROX. WT. AT DEATH	COMMENTS
GFS-13	May 19/20, 1999	May 20, 1630 h	Sun	80 kg	Very fresh, some bird damage to hind quarters
GFS-14	Late May 17, 1999	May 18, 1630 h	Sun	80 kg	Bloated when received
GFS-15	Late May 17, 1999	May 18, 1630 h	Sun	80 kg	Very fresh
GSH-13	May 19/20, 1999	May 20, 1630 h	Shade	80 kg	Very fresh
GSH-14	May 19/20, 1999	May 20, 1630 h	Shade	80 kg	Very fresh
GSH-15	May 19/20, 1999	May 20, 1630 h	Shade	80 kg	Very fresh
GBU-1	Late May 17, 1999	May 18, 1630 h	Buried	60 kg	30 cm soil above carcass, soil very clay based, many oligochaetes. Placed in part sun/part shade
GBU-2	Late May 17, 1999	May 18, 1630 h	Buried	60 kg	30 cm soil above carcass, soil very clay based, many oligochaetes. Placed in part sun/part shade. Starting to bloat, green in abdomen.
GBU-3	Late May 17, 1999	May 18, 1630 h	Buried	60 kg	30 cm soil above carcass, soil very clay based, many oligochaetes. Placed in part sun/part shade.