NOTES ON BLOW FLY (DIPTERA: CALLIPHORIDAE) SUCCESSION ON CARRION IN NORTHERN MISSISSIPPI

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ABSTRACT

Blow fly succession on carrion was investigated in Lafayette County, Mississippi. *Phaenicia caeruleiviridis, Phormia regina* and *Cochliomyia macellaria* were dominant species from April through September and *Cynomyopsis cadaverina, P. regina* and *Calliphora livida* dominated during the cooler months (October through March). Although both fish and mammalian carrion were used, and baits were placed in different habitats, no differences between types of bait and types of habitat were observed. The use of *P. caeruleiviridis* and *C. cadaverina* as postmortum indicators is discussed.

Key Words: *Calliphora livida, Cochliomyia macellaria, Cynomyopsis cadaverina, Phaenicia caeruleiviridis, Phormia regina,* carrion decomposition, succession, blow flies.

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INTRODUCTION

Blow flies are common dipterans most often seen in abundance around carcasses which serve as oviposition sites and larval food sources. The developing maggots, which may occur by the thousands in any carcass, can rapidly dispose of a dead animal, thereby rendering a valuable service to the environment. Adults are attracted to carrion until it is nearly dry, but various species visit carcasses only during specific stages of decomposition, thus a succession of species can be observed. Knowledge of blow fly succession patterns in an area is often a useful tool in the area of forensic entomology (Meek et al. 1983; Keh 1985).

Arthropod succession on carrion during the decomposition process is generally divided into microseral stages, but there has been little agreement as to the number of stages. Fuller (1934) recognized only three stages and Payne (1965) divided succession into six stages. The four decomposition stages defined by Johnson (1975), fresh stage, bloat stage, decay stage, and dry stage were recognized in the present study. However, it should be noted that the process of decomposition is continuous and there are no distinct dividing lines between stages.

During 1980 and 1981, while conducting a faunal survey of the Calliphoridae of Mississippi (Goddard and Lago 1983) we investigated blow fly succession on different types of carrion placed in various habitats in Lafayette County. The results presented here represent the first report of blow fly succession patterns in Mississippi.

MATERIALS AND METHODS

Fresh-frozen fish and mammalian carcasses were used as bait in this study (14 mammals and 12 fish). Medium sized (1.4 - 2.7 kg) rabbits or opossums were

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chosen for mammal specimens and 0.5 - 0.9 kg largemouth bass for the fish specimens. Bait animals were killed and frozen immediately until used. Samples of flies were obtained using modified Bishopp fly traps (Brundrett 1953) placed over staked down carrion which was often only partially thawed at the time of placement. Payne (1965) reported that freezing of carrion had no effect on decomposer succession patterns. Flies were removed from traps daily until the carcasses were completely consumed or dehydrated. A highly volatile, atomized insecticide (2 ml allethrin and 4 ml piperonyl butoxide per liter of petroleum distillates) was used to kill the flies before removal from traps. All calliphorids collected were identified by the authors; representative specimens were sent to R. J. Gagne (National Museum of Natural History) for confirmation and vouchers were deposited in the insect collection at the University of Mississippi.

Fly populations were monitored on 26 carcasses — 20 during spring and summer and 6 in the fall and winter. Average air temperatures for north central Mississippi from April through September are 24°C (range ca. 0 to 39°C) and 10°C (range ca. -18 to 33°C) for October through March (NOAA 1981). Fourteen traps were set in pine woods or the edges thereof, and 12 were set in or at the edges of deciduous woods. All sites were located in the Holly Springs National Forest approximately 3.2 km east of Oxford, Mississippi, or at a University of Mississippi biological field station located approximately 12.9 km northeast of Oxford.

RESULTS

Five calliphorid species dominated our succession studies: *Cynomyopsis cadaverina* (Robineau-Desvoidy), *Calliphora livida* Hall, *Phormia regina* (Meigen), *Phaenicia caeruleiviridis* (Macquart), and *Cochliomyia macellaria* (F.). Other species, such as *Calliphora vicina* (Robineau-Desvoidy), *Phaenicia sericata* (Meigen), *Phaenicia cuprina* Wiedemann, and *Pollenia rudis* (F.), were occasionally collected in low numbers (total collected 45, 1, 2, and 2, respectively) and were considered less important in the decomposition process.

Decomposition occurred much faster on warm sunny days than on cooler days, i.e. warmer temperatures shortened the length of time a carcass remained in each decomposition stage. Habitat variations did not affect species diversity in our samples (Table 1). However, carcasses in densely shaded areas generally attracted far fewer flies than those placed in open areas. In addition, the two types of carrion used attracted the same species of flies in approximately the same numbers (Table 1), therefore the following data on succession will not be separated as to carrion or habitat type.

Phaenicia caeruleiviridis, P. regina, and *C. macellaria* were the dominant species collected during warm weather succession studies (Fig. 1). *Phaenicia caeruleiviridis* were usually (95% of the time) the first blow flies attracted to fresh carrion. This species accounted for the majority of flies collected during the fresh stage but then steadily decreased in numbers throughout the remainder of the decomposition process. *Phormia regina* visited carcasses in the fresh stage, but usually only in low numbers (mean of 20 per trial, fresh stage). These flies were present through bloat and decay, often in extremely high numbers, (mean of 1,068 *P. regina* in bloat and decay per succession with a range of 1 - 3,498 daily), and accounted for the majority of specimens captured during these stages. *Cochliomyia*

Table 1. Comparison of species diversity and numbers of flies attracted to mammalian or fish carrion on the first day of exposure in deciduous or pine woods habitats, means in parentheses.*

	Warm weather succession trials†			Cool weather succession trials‡			
	Total *P. caeruleiviridis*	Total *P. regina*	Total *C. macellaria*	Total *C. cadaverina*	Total *C. livida*	Total *P. regina*	Total flies
Deciduous woods	138(6.9)a	86(4.3)a	1	5(.83)a	1	0	231
Pine woods	140(7.0)a	50(2.5)a	0	2(.33)a	1	1	194
Mammal carrion	142(7.1)a	50(2.5)a	0	4(.67)a	1	0	197
Fish carrion	136(6.8)a	86(4.3)a	1	3(.50)a	1	1	228

* Means in the same column followed by the same letter are not significantly different at the 5% level (two sample T-test).
† Total of 20 trials, April - September.
‡ Total of 6 trials, October - March.

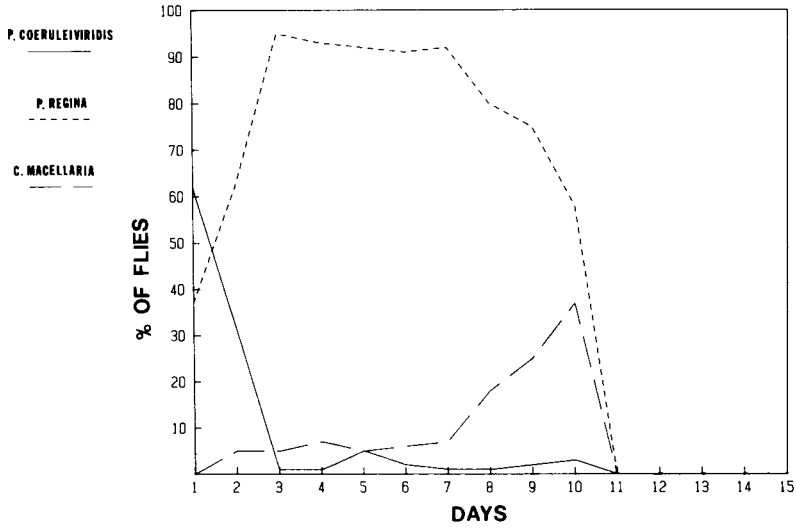

Fig. 1. Typical warm weather (April - September) blow fly succession pattern on carrion in Lafayette Co., MS (1980 - 81). Average air temperature of the study period was 23°C, range 0 to 38°C.

macellaria appeared at fresh carrion only once (1 specimen) but was common during the bloat and decay stages. *Phaenicia sericata, P. cuprina,* and *P. rudis* were collected but were never common on carrion.

Cynomyopsis cadaverina, C. livida, and *P. regina* were most commonly encountered during cool months (Fig. 2). *Cynomyopsis cadaverina* was most commonly collected on fresh carrion during this time, although both *C. cadaverina* and *C. livida* occurred throughout the decomposition process. Often carcasses were not visited by flies of any kind for several days during winter. *Phormia regina* was attracted to bait principally in the bloat and decay stages and *C. vicina* appeared only sporadically and in low numbers (mean of 2.8 per trial) during this period. *Cynomyopsis cadaverina* was the only species consistently active at carrion during winter months.

In spring, the change from the dominant cool weather fauna to warm weather species was not abrupt. Instead, there was a transitional period (a few weeks) during which both cool weather and warm weather species were active, e.g. in late March a fresh carcass would attract both *C. cadaverina* and *P. caeruleiviridis.* Overall *P. regina* was collected most frequently during this transition period and, as might be expected, in spring numbers of *C. livida* and *C. cadaverina* diminished as numbers of *P. caeruleiviridis* increased. In fall the opposite occurred.

DISCUSSION

Results of this study provide additional information to forensic entomologists by identifying calliphorid species that are associated with carrion in northern Mississippi and their successional patterns for two seasons of the year. *Phaenicia caeruleiviridis* was the first fly to appear at carrion in the spring and summer 95%

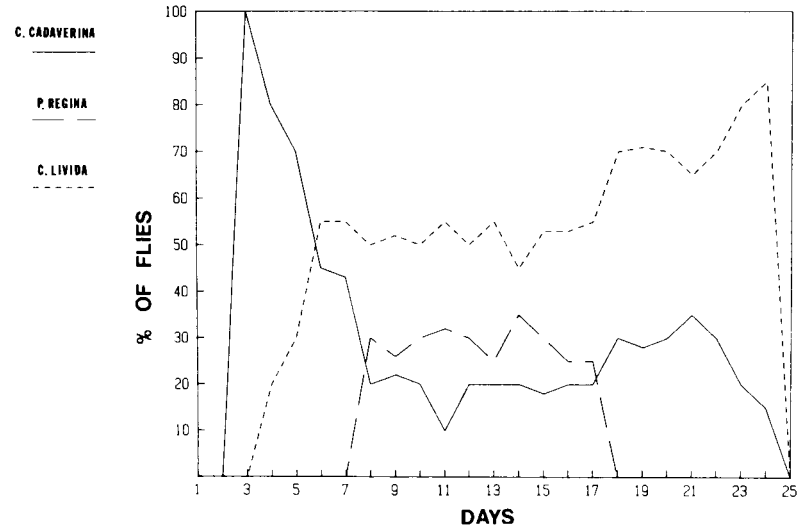

Fig. 2. Typical cool weather (October - March) blow fly succession pattern on carrion in Lafayette Co., MS (1980 - 81). Average air temperature of the study period was 8°C, range -18 to 33°C.

of the time (Table 2) and *C. cadaverina* was the first fly at carrion 83% of the time in the fall and winter. However, in winter, fly appearance of any kind at carrion may take 2 days or more in northern Mississippi.

Table 2. The frequency of blow fly species attracted to fresh-frozen carrion on the first day of exposure, Lafayette County, MS.

Species	Warm months* (20 trials)	Cool months† (6 trials)
Phaenicia caeruleiviridis	19/20 (95%)	–
Phormia regina	10/20 (50%)	1/6 (17%)
Cochliomyia macellaria	1/20 (5%)	–
Calliphora livida	–	2/6 (33%)
Cynomyopsis cadaverina	–	5/6 (83%)

* April through September, average temperature 23°C, range 0 to 38°C.
† October through March, average temperature 8°C, range -18 to 33°C.

Blow fly appearance at carrion is markedly different in relation to geographic location and stage of decomposition. Reed (1958) found *P. caeruleiviridis* and *P. regina* attracted to fresh carrion in Tennessee, which supports the results of our study. However, Payne (1965) reported that *C. macellaria* was the dominant species attracted to fresh carrion in South Carolina (summer). Johnson (1975) did not indicate which calliphorids were first attracted to carrion, but reported *P. sericata* to be the dominant fly species throughout his study in Illinois. We collected *C. macellaria* on fresh carrion only once in the course of our study and *P. sericata* was only occasionally collected. These varied reports indicate the need for future

experiments to further define geographical and seasonal variation in the succession of blow fly species at fresh carrion.

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