CARRION BEETLE RESPONSES TO POIKILOTHERM AND HOMOIOTHERM CARRION (COLEOPTERA: SILPHIDAE)[1]

Paul P. Shubeck[2]

ABSTRACT: Two traps baited with cold-blooded vertebrate carrion and two traps baited with warm-blooded carrion were in continual operation in Hutcheson Memorial Forest for 34 weeks during 1975. Of the seven species of Silphidae attracted to the traps five species were taken in numbers suitable for statistical analysis. *Nicrophorus orbicollis* manifested a significant difference (paired comparisons – Student's t-test) in its' response to fish carrion over chicken carrion. None of the other four species – *N. tomentosus, Silpha noveboracensis, S. inaequalis, S. americana* – showed a significant difference (paired comparisons – Student's t-test) in responding to poikilotherm and homoiotherm carrion.

DESCRIPTORS: Coleoptera, Silphidae; *Nicrophorus orbicollis, N. tomentosus, Silpha noveboracensis, S. inaequalis, S. americana;* cold-blooded carrion, warm-blooded carrion, Hutcheson Memorial Forest.

Observations have appeared in the literature which indicate that some silphid species prefer one kind of carrion over others. When writing about the insects of New Jersey, Smith (1910) stated that *Nicrophorus americanus* was found ". . . almost exclusively on reptiles," but that *N. marginatus* was found "Throughout the state, on carrion of all kinds . . . " He also stated that *Silpha lapponica* was found "Throughout the state; specifically on fish; but also on snakes, toads and other reptilia." Jaques, in his guide to beetles (1951) stated that *N. americanus* was found ". . . under snakes." Dillon and Dillon (1961), when referring to *N. marginatus,* stated that "This species is found especially on cold-blooded vertebrate carrion." In regard to *S. lapponica* they stated that "This species occurs especially on dead frogs, toads, snakes, and other cold-blooded carrion." The preceding statements apparently are based on field observations and not on controlled experimental data.

The observations that some silphid species appear to prefer carrion from certain taxa does not seem to have greatly influenced the choices of carrion by researchers conducting ecological studies on the carrion microcosm. When examining several papers that have appeared during the past two decades I noted that two authors used fish (Walker, 1957; Pirone, 1974), one used lizards and toads (Cornaby, 1974), one used chicken legs (Shubeck, 1968, 1969, 1971), and three used mammals (Reed, 1958; Payne, 1965; Johnson, 1975). The choices of carrion type in each case seemed to be based on the anticipated availability of carrion supply during the course of the study.

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[2]Biology Department, Montclair State College, Upper Montclair, N.J.

In an attempt to obtain data on possible differences in drawing power of kinds of carrion on silphid species it was decided to design a study whereby carrion from a poikilotherm (cold-blooded vertebrate) as well as carrion from a homoiotherm (warm-blooded vertebrate) would be available simultaneously to the beetles. Since a major study on the species composition and phenology of carrion beetles in The William L. Hutcheson Memorial Forest had been planned for 1975, this project was incorporated into the major study. Hutcheson Memorial Forest (hereafter referred to as H M F) is a mature mixed oak forest on the Piedmont Plateau of New Jersey. It is located near East Millstone, in Somerset County.

Methods

This study was conducted in H M F about 70 meters south-east of the weather instrument shelter which is located at the north edge of the forest. The beetles were trapped in four No. 10 food cans, each of which was concealed in a wooden box with a rain cover. These traps have been described elsewhere (Shubeck, 1976). The traps were situated in a circle on the forest floor so that there was a north, east, south, and west trap along the arc of a circle having a radius of 5 meters. The north and south traps were baited with fish while the east and west traps were baited with chicken legs (drumsticks). It was not necessary to compensate for possible effect of wind direction since wind speed is negligible in the forest (Wales, 1967). The carrion bait in each trap consisted of one "fresh" fish or chicken leg in an 8 3/4 oz styrofoam cup and one "stale" fish or chicken leg in an 8 3/4 oz styrofoam cup. These traps were serviced once per week, during the study, at which time the oldest carrion (and cup) was replaced with fresh carrion (and cup) and the beetles collected and preserved in jars containing 70% alcohol. At all times, therefore, there were two traps baited with fish, each having a fish 1-7 days old (fresh) and one 8-14 days old (stale), and two traps baited with chicken legs, each having a leg 1-7 days old and one 8-14 days old. This technique (Pirone, 1974) resulted in the presence of fairly uniformly "attractive" carrion on a continual basis. The weight of each fish (smelt) and each chicken leg was about 90 grams. On occasion fresh smelt was not available and packaged frozen smelt (whole) was substituted. The latter were about 1/3 the size of the former so when used, three small fish (about 30 grams each) were substituted.

Results and Discussion

Although seven species of Silphidae were taken in Hutcheson Memorial Forest during the eight months of this study, two species, *Necrodes*

surinamensis and *Nicrophorus pustulatus* were collected in very low numbers and these data were therefore not included in the statistical analysis that follows. Five species were collected in fair to abundant numbers and these species, as well as their attraction to poikilotherm and homoiotherm carrion are shown in Table 1. In an attempt to ensure the validity of the data used, the few "stragglers" of each species, that appeared earlier and later than the bulk of the population's individuals, were not included in Table 1 nor in the statistical analysis. The fact of the matter is that very few individuals were thus excluded! In the case of *Silpha noveboracensis,* 2032 out of 2033 individuals (99.95%) were included; all *S. inaequalis* were included; 564 of 572 individuals (98.6%) of *S. americana* were included; 181 of 200 individuals (90.5%) of *Nicrophorus tomentosus* and 311 of 316 individuals (98.42%) of *N. orbicollis* were included.

Superficial examination of the data for the five species shown in Table 1 made it appear that in all but one case *(Silpha inaequalis)* there was a preference for the poikilotherm (fish) carrion. However, statistical analysis of the data told a different story. The data was analyzed using the paired comparisons test. The analysis was designed to determine, for each species, if there was a significant difference in the number of beetles captured in the traps with cold-blooded carrion and the number of beetes captured in the traps with warm-blooded carrion. In each case the level of significance, α, was set at .01. The following are the conclusions. For the species *Silpha noveboracensis,* there is not sufficient evidence to say that there is a significant difference in the number at the respective carrion-type traps ($t = .920$). Although a slight majority of *S. inaequalis* was taken at the chicken-baited traps, there is not sufficient evidence to say that there is a significant difference ($t = -.577$). For *S. americana* ($t = .796$), there was again not sufficient evidence to say that there is a significant difference in the number at each trap. Turning to the genus *Nicrophorus,* the same conclusion holds for *N. tomentosus* ($t = 2.606$). However, for the species *N. orbicollis,* there is sufficient evidence to suggest that there is a difference in the number of beetles found in the two different types of traps ($t = 4.483$). This result is significant even for $\alpha = .0005$. Clearly then, *N. orbicollis* was found to be better able to distinguish between the cold-blooded carrion bait and the warm-blooded carrion bait, and it seems to prefer the cold-blooded. One might wonder why, of five silphid species tested in HMF, only one appears to be attracted more to one carrion bait (the cold-blooded one) than the other. It is possible that the answer may be found in a recent study conducted in HMF which showed that of the five species in question, only *N. orbicollis* was nocturnally active (Shubeck, 1971). The other four species were diurnal. It might be that the odors given off by decomposing cold-blooded carrion

(specifically fish) are unique in some way and thereby make it easier for nocturnal carrion beetles to locate the carrion in the dark.

It is interesting to note also that none of the three silphids mentioned at the beginning of this paper was taken during 1975, or during the summers of 1961-1974 (published and unpublished data). Two of these species were supposedly common in N.J. and all of them were said to be found on cold-blooded carrion.

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Table 1. Weekly collections of silphid species attracted to poikilotherm and homoiotherm carrion at Hutcheson Memorial Forest in 1975. The figures in the first column give the month and day of collection.

	Species A		Species B		Species C		Species D		Species E	
	Fish	Chick.	Fish	Chick.	Fish	Chick.	Fish	Chick.	Fish	Chick.
4-19	12	3	17	13						
4-26	6	2	17	3						
5- 3	8	5	11	18						
5-10	30	29	67	44	5	3			5	1
5-17	13	4	30	14	91	37			4	1
5-24	8	2	9	14	42	57			1	2
5-31	6	3	12	3	29	13			3	0
6- 7	1	2	4	6	10	2			4	5
6-14	1	0	37	43	3	5			6	1
6-21	38	146	22	148	5	13	6	4	2	1
6-28	238	284	74	102	4	10	26	20	11	0
7- 5	552	283	26	6	10	3	11	11	4	8
7-12	185	93	10	3	34	7	29	9	22	5
7-19	60	13	2	1	23	10	12	2	19	3
7-26	2	3			18	68	4	3	8	1
8- 2					2	7	0	1	1	0
8- 9					12	4	0	0	4	4
8-17					2	0	0	1	16	7
8-23					4	2	10	1	5	1
8-30					10	5	18	9	5	7
9- 6					2	0	3	1	11	2
9-13					4	2			10	5
9-20					4	0			37	17
9-27					2	0			21	6
10- 4									6	1
10-11									7	2
10-18									2	2
10-25									14	1
Totals	1160	872	338	418	316	248	119	62	228	83

Species A = *Silpha noveboracensis*
Species B = *Silpha inaequalis*
Species C = *Silpha americana*
Species D = *Nicrophorus tomentosus*
Species E = *Nicrophorus orbicollis*