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# Carrion Beetles (Coleoptera: Silphidae) of Northeastern Iowa: A Comparison of Baits for Sampling

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Carrion beetles (Coleoptera: Silphidae) were inventoried over a 8-week period from June into August of 1996 at 10 sites in 4 counties of extreme northeastern Iowa. Carrion preference and relative abundance of carrion beetles were studied by use of non-lethal pitfall traps constructed from large plastic plant pots and baited with aged fish, beef liver, chicken, or piglets. A total of 3,183 carrion beetles were collected, representing 11 different species. The most commonly encountered species of carrion beetles in northeastern Iowa included *Necrophila americana* (71.5%) and *Oiceoptoma novaboracense* (18.5%). When comparing baits, chicken and fish attracted the greatest number of carrion beetle species, individual beetles, and the most diverse assemblage of beetles as compared to beef liver and piglets. No American Burying Beetles (*Nicrophorus americanus*), a federally-listed endangered species last documented in Northeastern Iowa in 1921, were found. We propose aged chicken as the most useful bait for future surveys of carrion beetles.

INDEX DESCRIPTORS: carrion beetles, Silphidae, pitfall trapping.

Carrion beetles (Coleoptera: Silphidae) are important components of ecological food webs in their role of disposing animal carcasses (Wilson and Knollenberg 1984). Carrion beetles are known to locate recently deceased carrion primarily by olfaction (Milne and Milne 1944, Milne and Milne 1976, Shubeck 1968, Abbott 1927). Surveys for carrion beetles have taken advantage of this carrion location behavior by using baited pitfall traps. Live or non-lethal pitfall traps work well for surveys, as they are easily assembled, manageable, and effective in releasing bait odors without killing incoming beetles (Newton and Peck 1975).

The primary objective of this study was to obtain baseline information on the carrion beetle fauna of northeastern Iowa and to determine presence or absence of the American burying beetle (*Nicrophorus americanus* Olivier). The American Burying Beetle is an endangered species, not found in Winneshiek County, Iowa since 1921 (Raithel 1991), and currently thought to be extirpated from the state. A secondary objective of this study was to determine effectiveness of chicken, beef liver, fish, or piglet as baits for attracting carrion beetles.

## METHODS

### Study Sites

Ten sites in four counties located in extreme northeastern Iowa (Fig. 1) were surveyed for carrion beetles. These sites included original tallgrass prairie, shrubby old fields, flood plains, peat marshes, and wooded areas (Table 1), and were selected based primarily on their proximity to the Upper Iowa River or other major riverways.

### Beetle Sampling

We followed the Kozol (1991) U.S. Fish and Wildlife Service survey protocol using baited non-lethal pitfall traps. Pitfall traps were constructed from plastic plant pots (30 cm dia by 30 cm deep) with 1 cm open holes in the bottom to allow water drainage. Pots were buried in the ground with the upper lip flush with the surface of the ground. A 0.95 liter (1 quart) Mason jar covered with nylon window screen containing 200 to 300 g of ripe bait was placed in the bottom of each pitfall trap. All baits were allowed to ripen in closed containers in the sun for 2 to 3 days prior to use. Chicken-wire mesh screen was staked over each trap to deter vertebrate scavengers from disturbing the traps. Plywood rain covers were then sloped over each trap to prevent the traps from becoming flooded with water which can mask the bait odor and drown specimens during times of precipitation (Conley 1982). Traps were checked early in the morning before the heat of the day, and any specimens captured were identified, counted, and removed from the trap to an area upwind to try to prevent the same specimen from returning to the same trap. Representative specimens were collected for each species as voucher specimens and are held in the research insect collection of the Sherman Hoslett Museum of Natural History at Luther College, Decorah, Iowa.

### Preliminary Survey

An initial survey at 10 sites occurred between 19 June and 8 July 1996 in which fish (trout) were used as bait. At each site, four traps were monitored to determine the abundance and richness of carrion utilizing species at these sites.

### Bait Comparison Survey

Beginning the week of 8 July 1996, we began a comparison of the attractiveness to carrion beetles of four different types of baits. The same four traps at each site and trapping procedures were used as in the preliminary survey, although each trap now contained one

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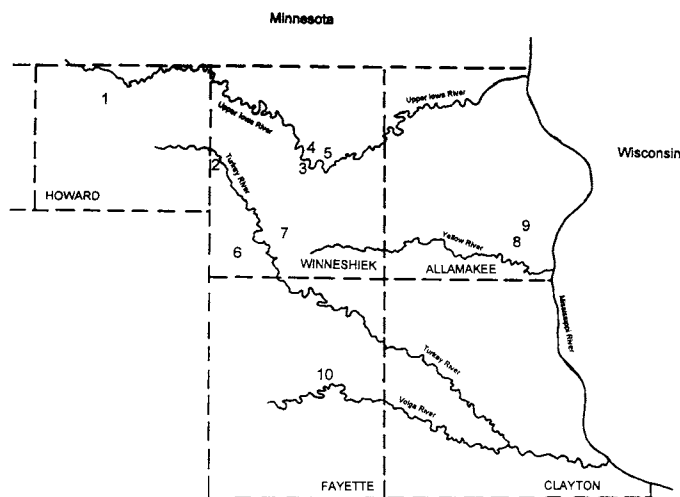


Fig. 1. Location of ten sites surveyed for carrion beetles (Coleoptera: Silphidae) in northeastern Iowa during the summer of 1996. Specifics on each site are listed in Table 1.

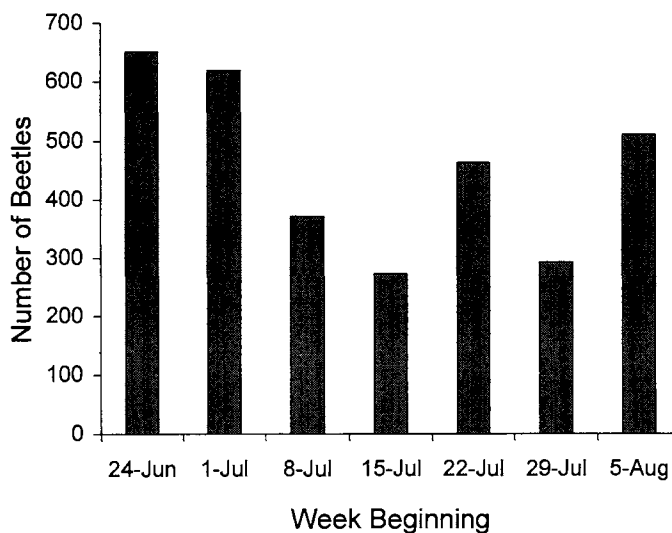


Fig. 2. Total number of carrion beetles (Coleoptera: Silphidae) captured each week from ten sites in Northeastern Iowa from 15 June to 8 August 1996.

of four different types of bait. Bait treatments included 1) dead fish (a 4–5" trout), 2) chicken breasts, legs, and/or gizzards, 3) beef liver, and 4) dead piglets. Traps continued to be checked until the survey was ended the week of 8 August 1996.

Statistical Analysis

Data were analyzed using analysis of variance (ANOVA) to examine effects of bait type on the following variables: beetle abundance, species richness, Shannon's Diversity Index ( $H'$ ), and Evenness ( $J$ ).

RESULTS

Preliminary Survey

Peak carrion beetle numbers were present primarily in the beginning and ending weeks of our survey (Fig. 2). A total of 1,633

carrion beetles representing 10 different species were collected in the traps from 10 sites baited with fish over the period between 19 June and 8 July (Table 2). Over 77% of these beetles were *Necrophila americana* (L.), while an additional 19% of the total catch consisted of two other species, *Oiceoptoma novaboracense* (Forster) and *Necrodes surinamensis* (Fab.). On average, each trap collected 2.15 beetles/trap/day.

Bait Comparison Survey

A total of 1,550 carrion beetles representing 9 species were collected in the 31 day period between 8 July and 8 August (Table 2), for an average of 1.25 beetles captured/trap/day. Almost 92% of these beetles captured between 8 July and 8 August were two species, *N. americana* (65.7%) and *O. novaboracense* (26%). These species were attracted to all bait types.

Table 1. Ten sites in northeastern Iowa surveyed for carrion beetles (Coleoptera: Silphidae) with four baited live pitfall traps during 1996.

| SITE | SITE NAME                                      | COUNTY     | HABITAT                                             |
|------|------------------------------------------------|------------|-----------------------------------------------------|
| 1    | Hayden Prairie State Preserve                  | Howard     | 240 acre original tallgrass prairie                 |
| 2    | Cardinal Marsh                                 | Winneshiek | Marshy grassland with woods surrounding             |
| 3    | Chattahoochie Park                             | Winneshiek | Shrubby old field adjacent to Upper Iowa River      |
| 4    | Hoslett Field Study Area                       | Winneshiek | Box elder flood plain adjacent to Upper Iowa River  |
| 5    | Freeport Marsh                                 | Winneshiek | Small peat marsh adjacent to Upper Iowa River       |
| 6    | Chipera Prairie Preserve                       | Winneshiek | 77 acre original tallgrass prairie                  |
| 7    | Lake Meyer Nature Center                       | Winneshiek | Shrubby old field on top of hill next to Lake Meyer |
| 8    | Big Paint/Little Paint, Yellow River St Forest | Allamakee  | Deciduous forest adjacent to streams                |
| 9    | Scenic Overlook, Yellow River State Forest     | Allamakee  | Coniferous and deciduous woods on top of bluff      |
| 10   | Volga River State Recreational Area            | Fayette    | Shrubby old field                                   |

Table 2. Carrion beetles (Coleoptera: Silphidae) from 10 different sites in northeastern Iowa collected in live pitfall traps baited with fish from 19 June to 8 July 1996, and baited with four different types of carrion from 8 July to 8 August 1996.

|                                               | PRELIMINARY SURVEY | BAIT COMPARISON |         |            |        | TOTAL |
|-----------------------------------------------|--------------------|-----------------|---------|------------|--------|-------|
|                                               |                    | FISH            | CHICKEN | BEEF LIVER | PIGLET |       |
| <i>Necrophila americana</i> (Linnaeus)        | 1259               | 233             | 143     | 529        | 113    | 2277  |
| <i>Oiceoptoma novaboracense</i> (Forster)     | 185                | 85              | 147     | 120        | 51     | 588   |
| <i>Necrodes surinamensis</i> (Fabricius)      | 125                | 4               | 29      | 1          | 1      | 160   |
| <i>Nicrophorus tomentosus</i> (Weber)         | 23                 | 15              | 17      | 17         | 4      | 76    |
| <i>Nicrophorus orbicollis</i> (Say)           | 18                 | 6               | 9       | 12         | 3      | 49    |
| <i>Oiceoptoma inaequale</i> (Fabricius)       | 10                 | 0               | 0       | 0          | 0      | 10    |
| <i>Nicrophorus marginatus</i> (Fabricius)     | 5                  | 1               | 1       | 0          | 1      | 8     |
| <i>Nicrophorus pustulatus</i> (Herschel)      | 4                  | 3               | 1       | 0          | 0      | 8     |
| <i>Nicrophorus hybridus</i> (Hatch & Angell)  | 3                  | 0               | 0       | 0          | 0      | 3     |
| <i>Thanatophilus lapponicus</i> (Herbst)      | 1                  | 0               | 0       | 1          | 0      | 2     |
| <i>Nicrophorus investigator</i> (Zetterstedt) | 0                  | 1               | 1       | 0          | 0      | 2     |
| Number of Beetles                             | 1633               | 348             | 348     | 680        | 173    | 3183  |
| Number of Species                             | 10                 | 8               | 8       | 6          | 6      | 11    |
| Shannon's Diversity Index ( $H'$ )            |                    | 0.953           | 1.229   | 0.684      | 0.885  |       |
| Evenness ( $J$ )                              |                    | 0.458           | 0.591   | 0.382      | 0.477  |       |

Beef liver attracted almost twice as many carrion beetles as fish and chicken, while piglet attracted the fewest. However, this was not significantly different ( $F=2.047$ ;  $df=3,36$ ;  $P=0.12$ ). Fish and chicken each attracted 8 carrion beetle species, while beef liver and piglet each attracted only 6 species. This difference was also not statistically significant ( $F=2.452$ ;  $df=3,36$ ;  $P=0.079$ ). Chicken attracted the most diverse assemblage of beetles as calculated by Shannon's diversity index, followed by fish, piglet, and beef liver. A statistical comparison of the beetle diversity attracted to each of the baits showed that this was significantly different ( $F=3.697$ ;  $df=3,36$ ;  $P=0.02$ ). Chicken also attracted the most evenly distributed assemblage of carrion beetle species, but with no significant difference ( $F=2.131$ ;  $df=3,36$ ;  $P=0.11$ ) between the four baits.

## DISCUSSION

As far as we know, this was the first survey of the silphids of Northeastern Iowa, and 11 different species of carrion beetles were found. One beetle captured on 25 July 1996 had characteristics typical of an American Burying Beetle, *Nicrophorus americanus* Olivier. The pronotum and frons were bright red in color, and the elytra had orange markings on a dark brown background. We initially identified this beetle as *N. americanus*, which was last collected in Wineshiek County, Iowa, in 1921. However, close examination of the orange elytra patterns and a black basal segment on the antennal club revealed the beetle was a teneral adult of *Nicrophorus orbicollis* (Say).

Although no American Burying Beetles (*N. americanus*) were found, a great deal of information about the existing carrion beetle fauna of northeastern Iowa was obtained. *Necrophila americana* accounted for over two-thirds of all carrion beetles captured, with one half of those being attracted to beef liver. *Oiceoptoma novaboracense* was also common, as these two species comprised over 90% of all carrion beetles captured.

The remaining carrion beetle assemblage was comprised mostly of *Nicrophorus* species, with the exception of *Necrodes surinamensis* (Fabr.). These species were found in low abundance, but were relatively even in their distribution among the sites. One reason for collecting fewer *Nicrophorus* than expected may be that the timing of our study did not correspond to the peak activity of *Nicrophorus*, which typically

occurs in June (Kozol et al. 1988). It was rare to find more than five beetles of any *Nicrophorus* in the same trap on the same day together (D.R. Coyle, pers. obs.).

Kozol et al. (1988) also stated that some species of *Nicrophorus* have a second population peak in mid to late summer. These findings correlate with our results (Fig. 2), which shows the end of an early summer population peak in June and the apparent beginning of a late summer population peak in August.

Certain carrion beetle species are nocturnal (Milne and Milne 1944, Abbott 1927, Scott et al. 1987), and this may have affected our results as some beetles may have escaped from the traps during the night before they were counted. Ants (Hymenoptera: Formicidae) were occasionally found in the pitfall traps, and can have a significant negative impact on carrion beetle reproductive ecology, although greater in the southern U.S. than further north (Scott et al. 1987). Therefore, when possible, traps were moved to avoid ants, but this still may have had an effect on our results. However, no carrion beetle mortality was observed as the result of ant activity or large vertebrate disturbance to the traps.

Although Wilson and Knollenberg (1984) suggest that baited pitfall traps may give a biased sample, they are still one of the better sampling procedures for this type of species survey. The type of bait used in our traps influenced the beetles collected. Four baits that have commonly been used for monitoring carrion beetles include chicken drumsticks or baby chicks (Shubeck 1968, Shubeck 1971, Shubeck 1975, Lomolino and Creighton 1996, Shubeck 1976, Kozol et al. 1988, Scott et al. 1987, Newton and Peck 1975), beef kidney (Scott et al. 1987, Kozol et al. 1988, Newton and Peck 1975), fish (Shubeck 1976, Wilson and Knollenberg 1984, Walker 1957, Newton and Peck 1975), and piglets (Shubeck 1970, Newton and Peck 1975).

This study directly compared these four bait types for their effectiveness in attracting carrion beetles. Shubeck (1976) observed that there appeared to be a preference in carrion beetles for bait such as fish. This may be supported by the results of our initial survey, as more beetles were captured over a shorter period than during the second bait comparison survey. However, this may also simply be an artifact of the peak numbers of carrion beetles which are normally present in June (Kozol et al. 1988), although *Nicrophorus* have been

collected in Nebraska throughout June, July, and August (J. Bedick, pers. comm.). Fish did attract a relatively diverse beetle assemblage, and along with chicken, attracted the highest number of carrion beetle species, although chicken attracted the most diverse carrion beetle assemblage.

In conclusion, our results gave us an indication of the diversity and abundance of common carrion beetle fauna of Northeastern Iowa, and also provided a good comparison of four commonly used carrion beetle baits. While fish was an effective bait, we highly recommend chicken as the most useful bait for surveys of carrion beetles if only one bait choice is available for sampling.

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