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PITFALL TRAP COLLECTIONS OF GROUND BEETLE LARVAE (COLEOPTERA: CARABIDAE) IN KENTUCKY ALFALFA FIELDS [1]

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ABSTRACT

Pitfall traps were installed in alfalfa fields to monitor the seasonality and abundance of immature ground beetles. Head capsule widths were determined by instar for *Evarthrus sodalis*, *Harpalus pennsylvanicus*, *Chlaenius tricolor*, *Scarites subterraneus*, *Amara cupreolata*, and *A. impuncticollis*. Seasonality of larval and adult catches indicated that *E. sodalis*, *H. pennsylvanicus* and *A. impuncticollis* overwinter in a larval diapause while *A. cupreolata* and *S. subterraneus* overwinter in the adult stage.

The ground beetle community has been investigated for many agroecosystems: corn (Dritschilo and Wanner 1980), soybeans (Bechinski and Pedigo 1981, House and All 1981), apple orchards (Holliday and Hagley 1978), and alfalfa (Barney et al. 1979, Los and Allen 1983). Although our understanding of the importance of the adult carabid community in these crops has increased, research on immatures has been restricted because larvae, unlike adults, rarely venture far from their burrows in the soil. When larvae have been collected with adults, the best method to associate these morphologically different life stages is through the rearing of larvae to the adult stage. This is difficult because many species are cannibalistic. Difficulty in collecting, handling, and identifying immatures suggests that many specimens remain untrapped, overlooked, or unidentified. There has been a lack of adequate identification aids since van Emden's (1942) key to 165 genera. A few updated, carabid-larvae identification aids have been published (Dogger and Olson 1966, Kirk 1972a, Thompson and Allen 1974, Goulet 1979, Thompson 1979), and Goulet (1976) and Thompson (1979) described methods for obtaining and rearing larvae.

Our study was done to determine the seasonality and abundance of the most common species in alfalfa fields and to determine limits for head capsule width by instar.

MATERIALS AND METHODS

Pitfall traps were installed in two alfalfa fields in the spring of 1983 at the Spindletop Research Farm, Kentucky Agricultural Experiment Station, Lexington, to monitor ground beetle activity. A trap consisted of a plastic cup (7 cm diam) containing a dilute ethylene glycol preservative solution within a larger plastic cup (10 cm diam) positioned at ground level (Morrill 1975). Each trap was equipped with a plastic rain cover (23.5 cm diam) suspended 10 cm above the soil surface by wooden stakes. The 64 traps were checked weekly from 25 April to 2 November 1983, 14 March to 6 November 1984, and 13 May

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to 27 September 1985. A representative sample of larvae from the 1983 collections was sent to Dr. Yves Bousquet, Biosystematics Research Institute, Agriculture Canada, for identification so that those individuals could be used to compile a more complete accounting of the 1984 and 1985 larval catches.

Adults were collected from dry pitfall traps placed in an alfalfa border strip surrounding one field and held in 27.0 by 19.0 by 9.0 cm plastic food crispers containing soil. Crispers were kept in a chamber at 21 ± 3°C under a 15:9 h (LD) photoperiod. Several species mated in the crispers and eggs recovered from the soil were individually placed in 4.0-diam by 6.0-cm-high plastic vials containing 3.0 cm of soil. Vials were checked every 2–3 days for exuviae and the soil changed when needed. Larvae were offered pieces of caterpillar and foxtail seeds. Head capsule widths for each stadium were measured with an ocular micrometer.

RESULTS AND DISCUSSION

Over 12,000 adults representing 40 species were trapped, indicating a large and diverse population of carabids. However, fewer than 300 carabid larvae were recovered from the traps. Genera such as *Evarthrus* and *Harpalus* that were well represented as adults were less abundant in the larval collections. Larvae of these genera may not be very mobile or active on the soil surface and therefore not subject to capture by pitfall traps.

Head capsule width measurements for each genus were grouped into three size categories, one for each instar. These data were then analyzed to determine conformity to Dyar's rule (Dyar 1890) that growth of successive instars is represented by a geometric progression, assuming that no head capsule expansion occurs during each stadium. Dyar's ratio is calculated for a species by dividing the mean head capsule width of each instar by that of the successive instar. In this study we found a mean ratio of 0.72 with a range of 0.68–0.74 (Table 1), which compares favorably to those of Dyar.

Larvae were identified to genus. Those of *Evarthrus* were considered to be *E. sodalis* LeConte because of the abundance of adults captured during the study. While this was the most abundant species in the adult samples, very few larvae were collected. Although only one third instar was caught, its width was almost identical to van Emden's (1942) reported mean of 2.27 mm (n = 2). We believe this species overwinters as second and third instars because adults and first instars were found in the summer, second instars in the fall, and the lone third instar in the spring.

Mating of *E. sodalis* was observed in the crispers but only four eggs were recovered. First instars were offered pieces of caterpillar and seeds but never fed. Mandibles of the larvae are sickle-like, indicating that the larvae are probably fluid-feeders and predaceous.

The majority of *Harpalus* larvae were probably *H. pennsylvanicus (= pensylvanicus)* De Geer, on the basis of the overwhelming abundance of this species in the adult catches. Chu (1945) reported a head capsule width of 3.2 mm, which must have been a third instar. Apparently this species also overwinters in the larval stage because only first instars were captured in the fall. Kirk (1973) believed that this species overwintered in a larval diapause in South Dakota.

H. pennsylvanicus readily oviposited in the crispers during October and eggs were found individually throughout the soil. This same observation was made by Kirk (1973) and Tomlin (1975). A total of 56 eggs was isolated in vials. Mean egg size before eclosion was 1.73 by 2.56 mm, a size increase of 18% over the size at oviposition (1.44 by 2.20 mm). Tomlin (1975) measured the eggs to be 1.6 by 2.5 mm at oviposition. Larvae were provided foxtail seeds which were often later found in tunnels the larvae constructed. Kirk (1972b) also found foxtail seeds in tunnels, but none showed feeding damage. Head capsule widths of the surviving larvae were recorded and added to the field-collected information in Table 1.

Although the larvae of *Amara* were not separated to species by Dr. Bousquet, we believe the larvae of *Amara* can be divided into two species based on the field from which

Table 1. Head-capsule width measurements, limits, and ratios of successive instars for selected carabid larvae found in pitfall traps in alfalfa, Lexington, KY.

Species	Instar	N	x̄ ± SE (mm)	Limits (mm)	Ratio
Amara	1st	32	0.53 ± 0.01	0.34–0.56	—
cupreolata	2nd	36	0.75 ± 0.01	0.64–0.83	0.70
	3rd	8	0.95 ± 0.02	0.90–1.05	0.79
Evarthrus[a]	1st	9	1.07 ± 0.04	0.90–1.36	—
sodalis	2nd	7	1.63 ± 0.03	1.51–1.70	0.66
	3rd	1	2.26 ± —	—	0.72
Harpalus[b]	1st	75	1.73 ± 0.01	1.36–1.92	—
pennsylvanicus	2nd	15	2.34 ± 0.04	2.11–2.56	0.74
	3rd	12	2.84 ± 0.05	2.64–3.17	0.82
Chlaenius	1st	31	0.69 ± 0.02	0.41–0.87	—
tricolor	2nd	8	1.00 ± 0.03	0.90–1.13	0.69
	3rd	8	1.38 ± 0.03	1.28–1.54	0.72
Scarites	1st	37	1.55 ± 0.04	1.17–1.88	—
subterraneus	2nd	20	2.39 ± 0.04	2.03–2.64	0.65
	3rd	12	3.17 ± 0.05	2.94–3.43	0.75
Amara impuncticollis	3rd	22	1.21 ± 0.01	1.13–1.32	

[a]Contains four head capsule measurements of 1st instars from laboratory-reared in addition to field-collected specimens.
[b]Contains 42 head capsule measurements of 1st instars from laboratory-reared in addition to field-collected specimens.

they were trapped and the species of adults found there. All the larvae designated as *A. impuncticollis* Say were collected during June in a field where only adults of that species were represented in pitfall catches. Larvae of *Amara cupreolata* Putzeys were collected from a different field that had very few adult *Amara* belonging to other species.

Larvae of *A. cupreolata* were present from late May through July. This species overwinters as adults because adults were active very early in the spring. However, *A. impuncticollis* adults were not active until July, which was after the collection of larvae in June. This species probably overwinters in an immature stage. The molar-like shape of the mandibles suggests that larvae of *Amara* are omnivorous, as are the adults.

The *Chlaenius* larvae were probably *C. tricolor* Dejean. These larvae have sickle-like mandibles adapted for piercing soft-bodied prey, as do other known members of this genus (Kirk 1972a). Larochelle (1974) surveyed the *Chlaenius* literature and believed *C. tricolor* adults to be omnivorous. These larvae must be very active foragers on the soil surface because large numbers of larvae were trapped in comparison to numbers of adults. First instars were active in June and July, second instars in July through September, and third instars in August and September.

Some confusion exists as to the *Scarites* larvae. Blatchley (1910) recognized two North American species, *S. subterraneus* Fabricius and *S. quadriceps* Chaudoir, that he separated solely on the basis of size. Lindroth (1961) considered *S. quadriceps* to be a subspecies of *S. subterraneus* and we have followed his interpretation. Emden (1942) reported the mean second instar head capsule width of *S. quadriceps* as 2.39 mm; that corresponds exactly to our measurement (Table 1). First instars were found in June and July, but second instars were active from June through September. Most third instars were caught in August.

The seasonality, abundance, and head capsule widths of the most abundant carabid larvae in Kentucky alfalfa presented here should aid future researchers in characterizing immature carabids found in many agroecosystems in the eastern United States. Additional studies are needed to characterize the abundance, seasonality, and feeding behavior of carabid larvae because these immatures remain a relatively unknown entity in most agroecosystems.

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LITERATURE CITED

Barney, R. J., S. J. Roberts, R. D. Pausch, and E. J. Armbrust. 1979. Insect predators of the alfalfa weevil and clover root curculio (Coleoptera: Curculionidae) during fall field reentry. Great Lakes Entomol. 12:153–155.

Bechinski, E. J., and L. P. Pedigo. 1981. Ecology of predaceous arthropods in Iowa soybean agroecosystems. Environ. Entomol. 10:771–778.

Blatchley, W. S. 1910. An illustrated and descriptive catalogue of the Coleoptera or beetles (exclusive of the Rhynchophora) known to occur in Indiana. Nature, Indianapolis.

Chu, H. 1945. The larvae of the Harpalinae unisetosae (Coleoptera, Carabidae). Entomol. Amer. 25:1–71.

Dogger, J. R., and C. A. Olson. 1966. Larval characteristics of some North Dakota carabids (Coleoptera: Carabidae). Coleopt. Bull. 20:91–96.

Dritschilo, W., and D. Wanner. 1980. Ground beetle abundance in organic and conventional corn fields. Environ. Entomol. 9:629–631.

Dyar, H. G. 1890. The number of molts of lepidopterous larvae. Psyche 5:420–422.

Emden, F. I. van. 1942. A key to the genera of larval Carabidae (Col.). Trans. Royal Entomol. Soc. London 92:1–100.

Goulet, H. 1976. A method for rearing ground beetles (Coleoptera: Carabidae). Coleopt. Bull. 30:33–36.

______. 1979. Contributions of characters of larvae to systematics of Carabidae. pp. 205–208 *in* T. L. Erwin, G. E. Ball, and D. R. Whitehead (eds.). Carabid beetles: Their evolution, natural history, and classification. Junk Publ., The Hague.

Holliday, N. J., and E. A. C. Hagley. 1978. Occurrence and activity of ground beetles (Coleoptera: Carabidae) in a pest management apple orchard. Canadian Entomol. 110:113–119.

House, G. J., and J. N. All. 1981. Carabid beetles in soybean agroecosystems. Environ. Entomol. 10:194–196.

Kirk, V. M. 1972a. Identification of ground beetle larvae found in cropland in South Dakota. Ann. Entomol. Soc. Amer. 65:1349–1356.

______. 1972b. Seed-catching by larvae of two ground beetles, *Harpalus pensylvanicus* and *H. erraticus*. Ann. Entomol. Soc. Amer. 65:1426–1428.

______. 1973. Biology of a ground beetle, *Harpalus pensylvanicus*. Ann. Entomol. Soc. Amer. 65:513–518.

Larochelle, A. 1974. A world list of prey of *Chlaenius* (Coleoptera; Carabidae). Great Lakes Entomol. 7:137–142.

Lindroth, C. H. 1961. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Part 2. Opusc. Entomol. (Suppl.) 20:1–200.

Los, L. M., and W. A. Allen. 1983. Abundance and diversity of adult carabidae in insecticide-treated and untreated alfalfa fields. Environ. Entomol. 12:1068–1072.

Morrill, W. L. 1975. Plastic pitfall trap. Environ. Entomol. 4:596.

Thompson, R. G. 1979. Larvae of North American Carabidae with a key to the tribes. pp. 209–291 *in* T. L. Erwin, G. E. Ball, and D. R. Whitehead (eds.). Carabid beetles: Their evolution, natural history, and classification. Junk Publ., The Hague.

Thompson, R. G., and R. T. Allen. 1974. Descriptions of larval Carabidae. I. Coleopt. Bull. 28:185–201.

Tomlin, A. D. 1975. Notes on the biology and rearing of two species of ground beetles, *Pterostichus melanarius* and *Harpalus pensylvanicus* (Coleoptera: Carabidae). Canadian Entomol. 107:67–74.