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# Seasonal Flight Activity and Seasonal Abundance of Selected Stored-Product Coleoptera Around Grain Storages in South Carolina[1]

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**ABSTRACT** In field studies on the ecology of *Sitophilus oryzae* (L.) and *S. zeamais* Motschulsky, an additional 19 species of Coleoptera that are stored-product pests were identified (*Ahasverus advena* [Waltl], *Araecerus fasciculatus* [DeGeer], *Cryptolestes ferrugineus* [Stephens], *Cryptolestes pusillus* [Schönherr]), *Cryptophagus cellaris* Scopoli, *Cryptophilus integer* [Heer], *Cynaeus angustus* [LeConte], *Gnatocerus cornutus* [F.], *Gnatocerus maxillosus* [F.], *Latheticus oryzae* Waterhouse, *Litargus balteatus* LeConte, *Oryzaephilus surinamensis* [L.], *Palorus subdepressus* [Wollaston], *Platydema ruficorne* Sturm, *Rhyzopertha dominica* [F.], *Stegobium paniceum* [L.], *Tenebroides mauritanicus* [L.], *Tribolium castaneum* [Herbst], and *Typhaea stercorea* [L.]). Sixteen of these species were caught on sticky traps placed at three grain storage sites in southern South Carolina over a 1-yr period. Seventeen species were present in packets baited with corn at the same storage sites over a 2-yr period. These species were most active during warmer parts of the year, except *Cryptophagus cellaris*. Sex ratio of the *Cryptolestes* spp. was skewed toward females in sticky traps and bait packets, except for *C. pusillus* in bait packets at one site. Sex ratio of *O. surinamensis* in bait packets was skewed toward females at one site, but did not differ from 1:1 at other sites. This study shows that many stored-product insects are active year-round in South Carolina, and that grain may be subject to infestation year-round.

**KEY WORDS** Bait packets, Coleoptera, flight traps, seasonal abundance, seasonal flight activity, stored grain, trapping

Seasonal flight activity and seasonal abundance of maize weevils, *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae), and rice weevils, *S. oryzae* (L.), at three grain storage sites in southern South Carolina were previously reported (Throne & Cline 1989, 1991). Although those studies were designed to study the

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ecology of *Sitophilus* spp., many other stored-product insects also were collected and have since been identified. The purposes of the studies was to determine at which times of the year the insects were flying using nonattractive sticky traps (seasonal flight activity) and to determine, using bait packets, whether the insects were active at times of the year when the insects were not flying (seasonal abundance). There are few previous reports on field activity of stored-product insects. Therefore, the seasonal flight activity and seasonal abundance of 19 species of beetles that are considered to be pests of stored-products was studied and is reported herein.

## Materials and Methods

Methods, including weather data and commodities (predominately corn and wheat) stored at three sites, were described in previous papers (Throne & Cline 1989, 1991). In general, flight was monitored continuously, using eight to ten unbaited sticky traps at each site, in Bamberg, Barnwell, and Hampton Counties in southern South Carolina from 18 March 1987 to 6 April 1988. Seasonal abundance was monitored continuously, using four bait packets containing whole corn and placed in shelters, at the same three sites from 20 August 1986 to 2 September 1987. Seasonal abundance was monitored for an additional year at the same sites for 1 wk of each month. Only adult insects were identified and counted.

Due to the large numbers of insects captured, only *Cryptolestes ferrugineus* (Stephens), *Cryptolestes pusillus* (Schönherr), and *Oryzaephilus surinamensis* (L.) were sexed. Binomial confidence limits were calculated to determine whether sex ratio for the study periods differed from 1:1. A runs test (Conover 1971) was used to determine whether the proportion of females in bait packets or sticky traps summed for each sampling period and for each site varied throughout the studies.

## Results

In addition to the *Sitophilus* spp., over 27,000 adult stored-product insect pests representing 16 species and eight families of Coleoptera were caught on sticky traps and over 24,000 representing 17 species and eight families of Coleoptera were collected in bait packets. Other insects that were in families that include stored-product pests were collected, but were not identified to species. These insects included over 9,000 *Carpophilus* spp. (Coleoptera: Nitidulidae) on sticky traps and over 91,000 in bait packets; numerous Lepidoptera on sticky traps (that were not identifiable because of the sticky material); 180 Anthicidae (Coleoptera); 18 Bruchidae (Coleoptera); and 16 Ptinidae (Coleoptera). In addition, there were 29 Angoumois grain moths, *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae) in bait packets. Many other arthropods were caught on traps or in bait packets, but are not considered to be stored-product pests (Araneida, Dermaptera, Diptera, Hemiptera, Homoptera, Hymenoptera, Orthoptera, Pseudoscorpionida).

Most species of stored-product beetles were both caught on sticky traps and present in bait packets (the foreign grain beetle, *Ahasverus advena* [Waltl] [Cucujidae]; the coffee bean weevil, *Araecerus fasciculatus* [De Geer]

[Anthribidae]; the rusty grain beetle, *Cryptolestes ferrugineus* [Cucujidae]; the flat grain beetle, *Cryptolestes pusillus* [Cucujidae]; *Cryptophagus cellaris* Scopoli [Cryptophagidae]; *Cryptophilus integer* [Heer] [Languriidae]; the larger black flour beetle, *Cynaeus angustus* [LeConte] [Tenebrionidae]; the broadhorned flour beetle, *Gnatocerus cornutus* [F.] [Tenebrionidae]; the slenderhorned flour beetle, *Gnatocerus maxillosus* [F.] [Tenebrionidae]; the longheaded flour beetle, *Latheticus oryzae* Waterhouse [Tenebrionidae]; *Litargus balteatus* LeConte [Mycetophagidae]; the sawtoothed grain beetle, *Oryzaephilus surinamensis* [Cucujidae]; the depressed flour beetle, *Palorus subdepressus* [Wollaston] [Tenebrionidae]; *Platydema ruficorne* Sturm [Tenebrionidae]; the lesser grain borer, *Rhyzopertha dominica* [F.] [Bostrichidae]; the drugstore beetle, *Stegobium paniceum* [L.] [Anobiidae]; the cadelle, *Tenebroides mauritanicus* [L.] [Trogositidae]; the red flour beetle, *Tribolium castaneum* [Herbst] [Tenebrionidae]; and the hairy fungus beetle, *Typhaea stercorea* [L.] [Mycetophagidae]). *Gnatocerus maxillosus, Platydema ruficorne,* and *Tenebroides mauritanicus* were never caught on sticky traps. There were no *G. cornutus* or *S. paniceum* in bait packets. Two of the species, *C. cellaris* and *C. angustus,* have not been reported previously in South Carolina (Kirk 1969, 1970, Horton 1982).

**Sticky traps.** Three species, *A. advena, C. pusillus,* and *T. stercorea,* accounted for 82% of stored-product insects on sticky traps (Table 1). Most species were caught on sticky traps when average weekly temperature and maximum temperature during the trapping period were at least 20° C. The lowest maximum temperature recorded during a sampling period was 12.8° C. *Cynaeus angustus, G. cornutus, L. oryzae,* and *S. paniceum* were caught only when maximum temperatures during trapping periods exceeded 30° C. However, these four species were caught in small numbers. *C. cellaris* and *T. castaneum* were caught when maximum temperatures during trapping periods were less than 20° C. Low numbers of most species were caught in winter (Fig. 1). *Cryptophagus cellaris* was the only species that was caught predominantly during winter.

Catches for five species are not shown in Figure 1 because few individuals of these species were caught. One *A. fasciculatus* was caught on a sticky trap in Barnwell Co. on 16 December 1987. Two *C. angustus* were caught on sticky traps, one on 17 June and one on 5 August 1987, in Hampton Co. One *G. cornutus* was caught in Hampton Co. on 5 August 1987. One *O. surinamensis* was caught on 29 July 1987, one on 19 August 1987, and one on 16 December 1987 in Bamberg Co., and two on 5 August 1987 and one on 23 March 1988 in Hampton Co. Five *Stegobium paniceum* were caught in 1987, one in Barnwell Co. and two in Hampton Co. on 29 April, one in Barnwell Co. on 27 May, and one in Hampton Co. on 18 November.

**Bait packets.** Three species, *C. ferrugineus, T. castaneum,* and *T. stercorea,* accounted for 62% of stored-product insects in bait packets (Table 2). Most of the insects were present in bait packets when average weekly temperatures and maximum temperature during sampling periods were greater than 10° C. *Cryptophagus cellaris* was the only species that was present predominantly during cooler weeks. Except for *C. cellaris,* most species were present in bait packets in lower numbers in winter (Fig. 2).

**Table 1. Lowest maximum temperature during trapping periods when a species was caught on sticky traps, percentage of total number of each stored-product pest on sticky traps at various average weekly temperatures, number of weeks (out of 55) when the species was caught on sticky traps, and the total number of each species caught on sticky traps at three grain storage sites in South Carolina.**

| Species | Lowest maximum temp. when present (°C) | % of total caught at average weekly temperature of (°C): | | | No. weeks caught | Total no. caught |
|---|---|---|---|---|---|---|
| | | ≤ 10 | > 10 & ≤ 20 | > 20 & ≤ 30 | | |
| *Ahasverus advena* | 23.3 [a] | 0 [a] | 32 [a] | 68 [a] | 45 | 8,757 |
| *Araecerus fasciculatus* | 24.4 | 0 | 100 | 0 | 1 | 1 |
| *Cryptolestes ferrugineus* | 23.3 | 0 | 16 | 85 | 39 | 1,103 |
| *Cryptolestes pusillus* | 23.3 [a] | 0 [a] | 9 [a] | 91 [a] | 39 | 7,543 |
| *Cryptophagus cellaris* | 16.7 [a] | 24 [a] | 76 [a] | 0 [a] | 26 | 66 |
| *Cryptophilus integer* | 21.1 [a] | 0 [a] | 17 [a] | 83 [a] | 40 | 353 |
| *Cynaeus angustus* | 35.0 | 0 | 0 | 100 | 2 | 2 |
| *Gnatocerus cornutus* | 35.6 | 0 | 0 | 100 | 1 | 1 |
| *Latheticus oryzae* | 30.6 | 0 | 0 | 100 | 12 | 35 |
| *Litargus balteatus* | 21.1 [a] | 0 [a] | 23 [a] | 77 [a] | 30 | 143 |
| *Oryzaephilus surinamensis* | 26.7 | 0 | 33 | 67 | 5 | 6 |
| *Palorus subdepressus* | 23.9 | 0 | 4 | 96 | 23 | 532 |
| *Rhyzopertha dominica* | 20.6 | 0 | 39 | 61 | 43 | 787 |
| *Stegobium paniceum* | 30.6 [a] | 0 [a] | 25 [a] | 75 [a] | 3 | 5 |
| *Tribolium castaneum* | 17.2 [a] | 0 [a] | 24 [a] | 76 [a] | 42 | 2,125 |
| *Typhaea stercorea* | 21.1 [a] | 0 [a] | 12 [a] | 88 [a] | 42 | 5,948 |

[a] These percentages do not include data for this species caught at Hampton Co. from 28 October 1987 through 2 December 1987 because weather data for that period were missing. Average weekly temperatures during sampling periods for Bamberg and Barnwell Counties during that period ranged from 23.8° to 26.8°C, and lowest maximum temperature for those counties was 24.4°C.

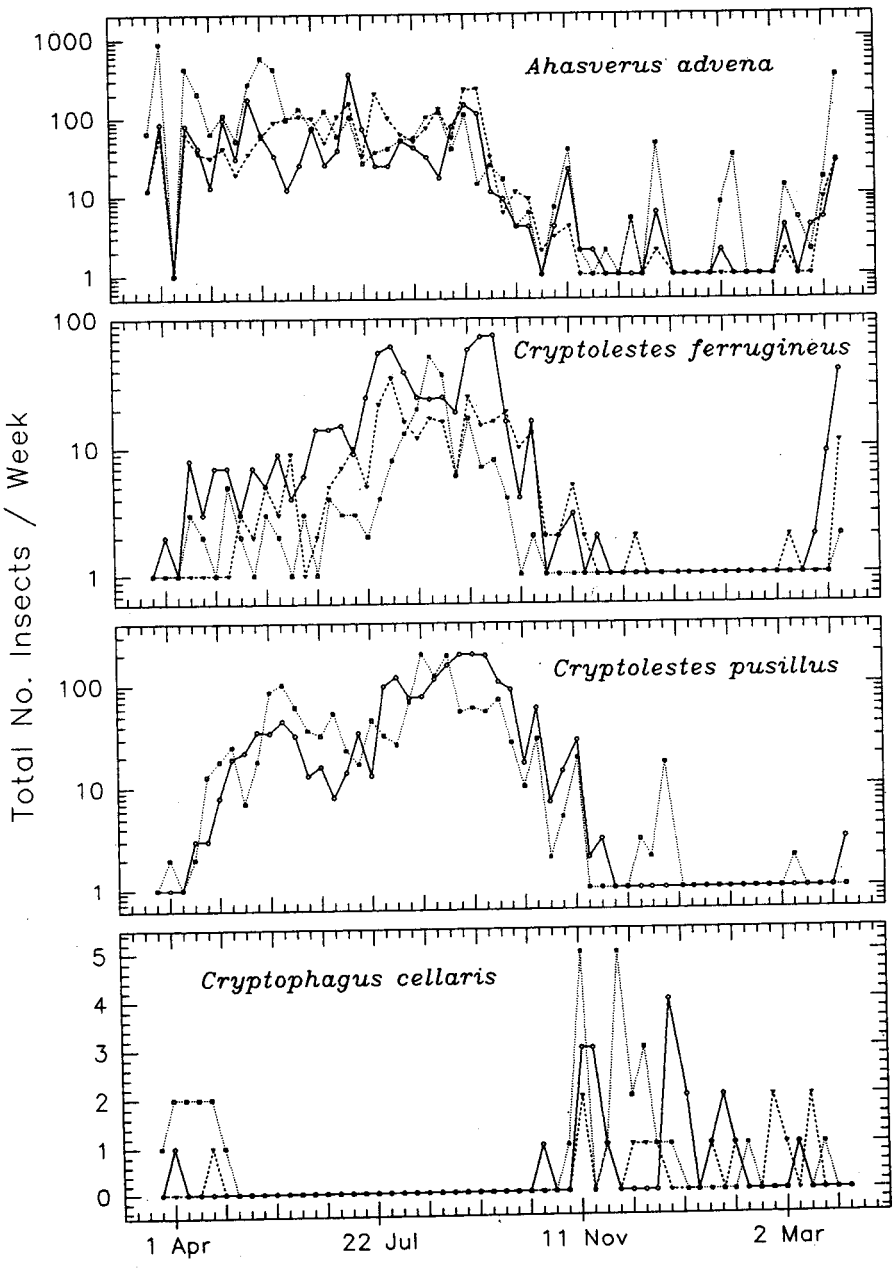



**Fig. 1.** Number of stored-grain beetles caught on sticky traps at three grain storage sites in southern South Carolina during 1987 to 1988 (solid line and circle, Bamberg Co.; dashed line and triangle, Barnwell Co.; dotted line and square, Hampton Co.). Note that graphs plotted on a log scale report number of insects plus one.

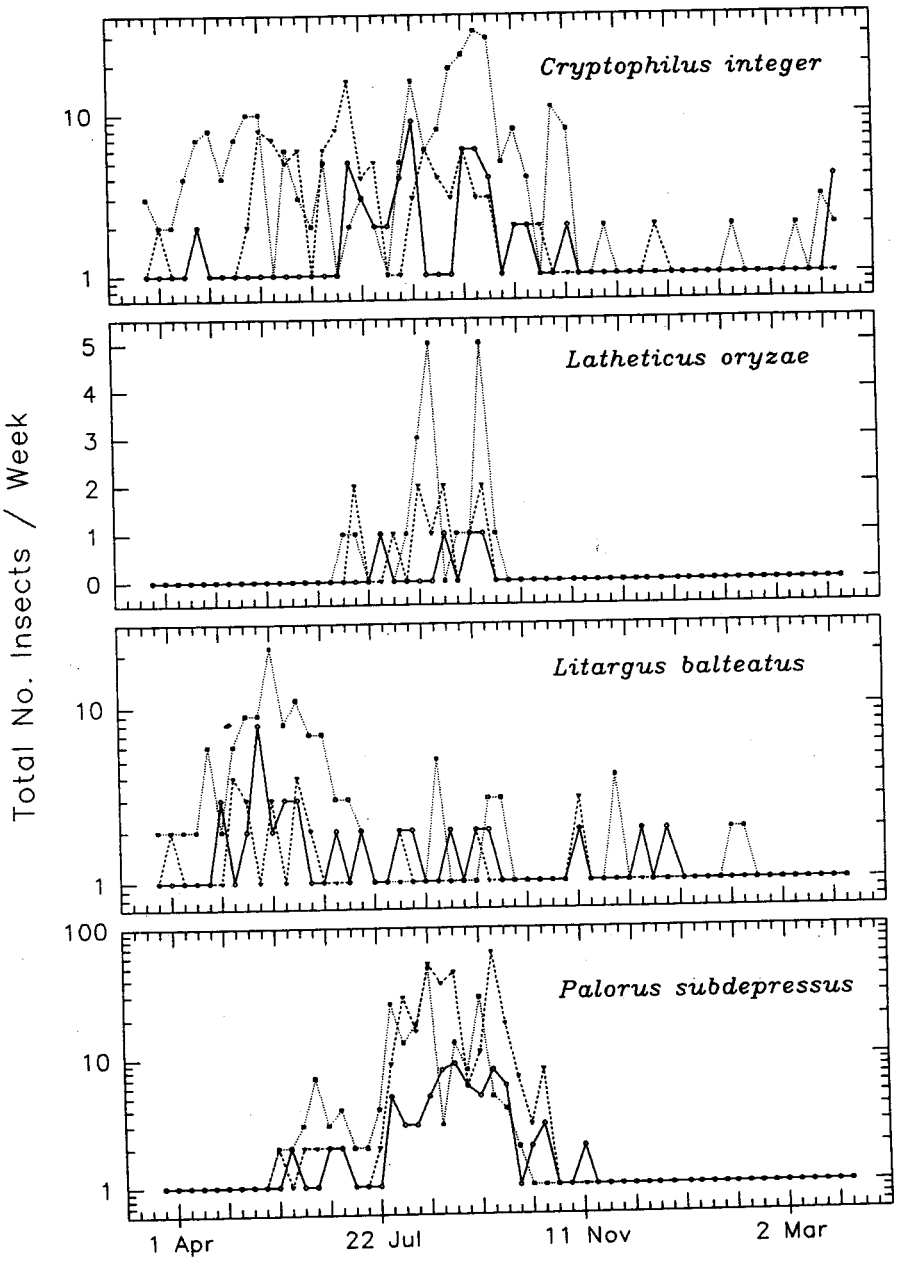



**Fig. 1.** Continued.

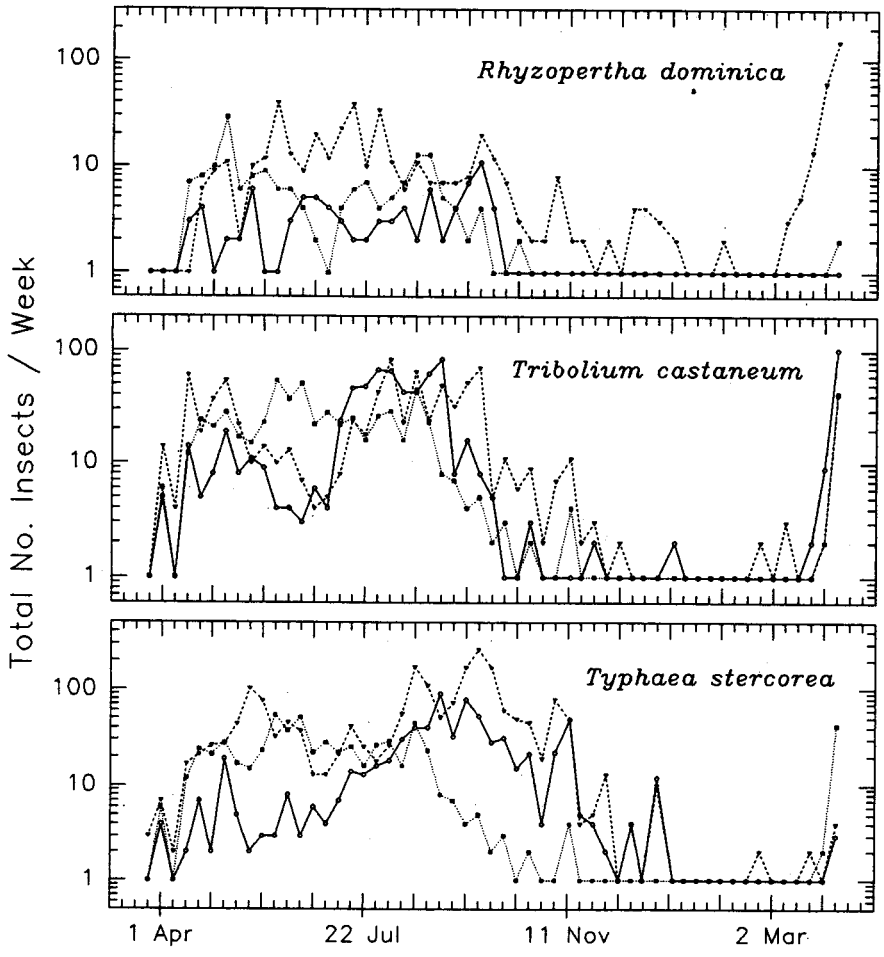



**Fig. 1.** Continued.

**Table 2. Lowest maximum temperature during sampling periods when a species was present in bait packets, percentage of total number of each stored-product pest in bait packets at various average weekly temperatures, number of weeks (out of 69) when the species was present in bait packets, and the total number of each species present in bait packets at three grain storage sites in South Carolina.**

| Species | Lowest maximum temp. when present (°C) | % of total present at average weekly temperature of (°C): | | | No. weeks present | Total no. caught |
|---|---|---|---|---|---|---|
| | | ≤ 10 | > 10 & ≤ 20 | > 20 & ≤ 30 | | |
| *Ahasverus advena* | 12.8 [a] | 5 [a] | 35 [a] | 61 [a] | 64 | 1,807 |
| *Araecerus fasciculatus* | 24.4 [a] | 0 [a] | 40 [a] | 60 [a] | 10 | 17 |
| *Cryptolestes ferrugineus* | 12.8 [a] | 2 [a] | 33 [a] | 64 [a] | 67 | 3,110 |
| *Cryptolestes pusillus* | 13.3 [a] | 1 [a] | 20 [a] | 78 [a] | 59 | 1,086 |
| *Cryptophagus cellaris* | 17.8 [a] | 18 [a] | 73 [a] | 8 [a] | 29 | 75 |
| *Cryptophilus integer* | 18.9 | 2 | 46 | 53 | 46 | 455 |
| *Cynaeus angustus* | 12.8 [a] | 9 [a] | 11 [a] | 80 [a] | 26 | 45 |
| *Gnatocerus maxillosus* | 32.2 [a] | 0 | 0 | 100 | 1 | 1 |
| *Latheticus oryzae* | 30.6 [a] | 0 | 0 | 100 | 11 | 1,089 |
| *Litargus balteatus* | 12.8 [a] | 7 [a] | 48 [a] | 44 [a] | 49 | 773 |
| *Oryzaephilus surinamensis* | 18.9 [a] | 1 [a] | 7 [a] | 92 [a] | 54 | 2,138 |
| *Palorus subdepressus* | 21.1 | 0 | 51 | 49 | 41 | 741 |
| *Platydema ruficorne* | 28.3 | 0 | 14 | 86 | 3 | 7 |
| *Rhyzopertha dominica* | 15.6 [a] | 1 [a] | 7 [a] | 92 [a] | 39 | 756 |
| *Tenebroides mauritanicus* | 21.1 [a] | 0 [a] | 12 [a] | 88 [a] | 24 | 443 |
| *Tribolium castaneum* | 12.8 [a] | 2 [a] | 22 [a] | 76 [a] | 69 | 3,556 |
| *Typhaea stercorea* | 12.8 [a] | 2 [a] | 41 [a] | 57 [a] | 69 | 8,560 |

[a] These percentages do not include data for this species in bait packets at Hampton Co. from 28 October 1987 through 2 December 1987 because weather data for that period were missing. Average weekly temperatures during sampling periods for Bamberg and Barnwell Counties during that period ranged from 23.8° to 26.8°C, and lowest maximum temperature for those counties was 24.4°C.

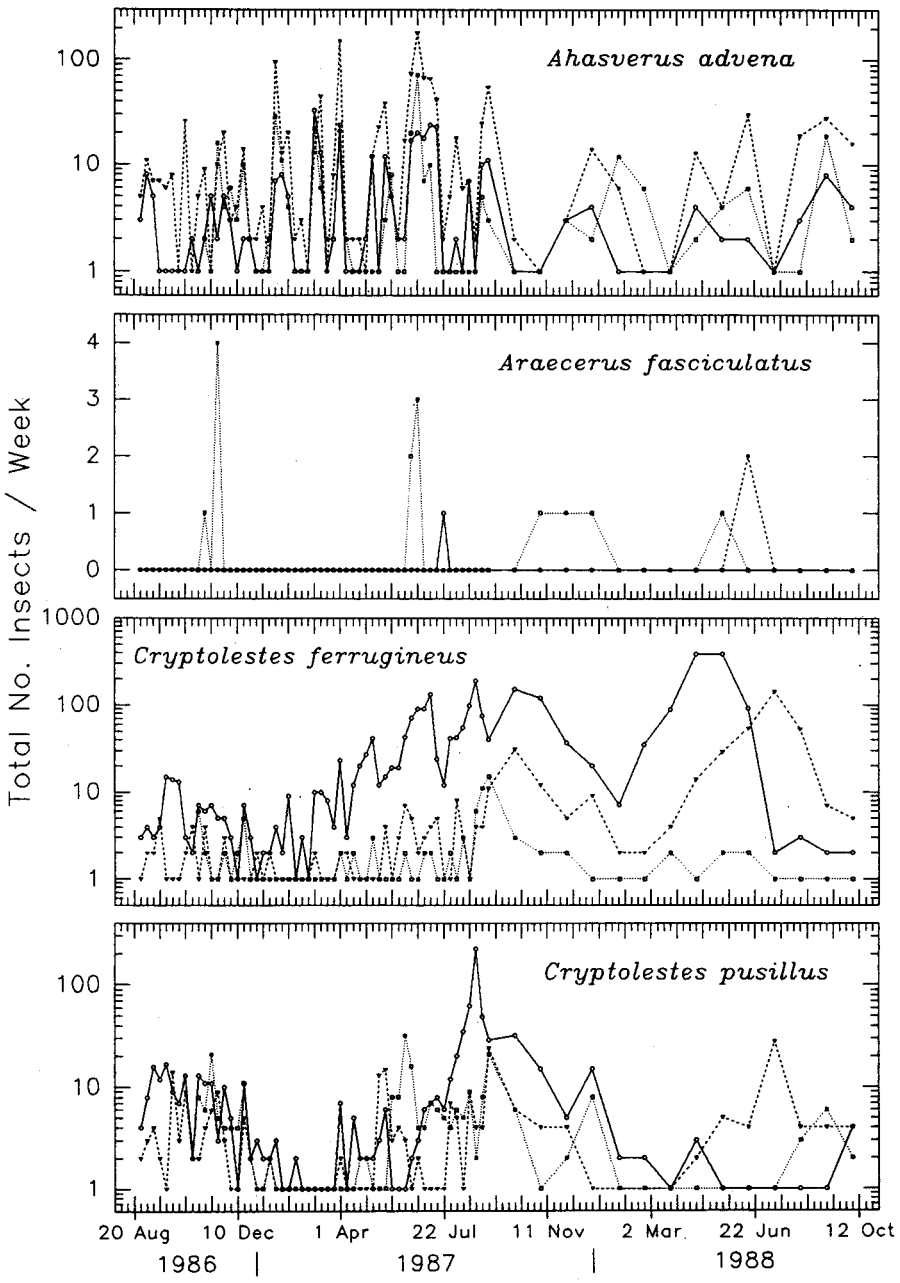
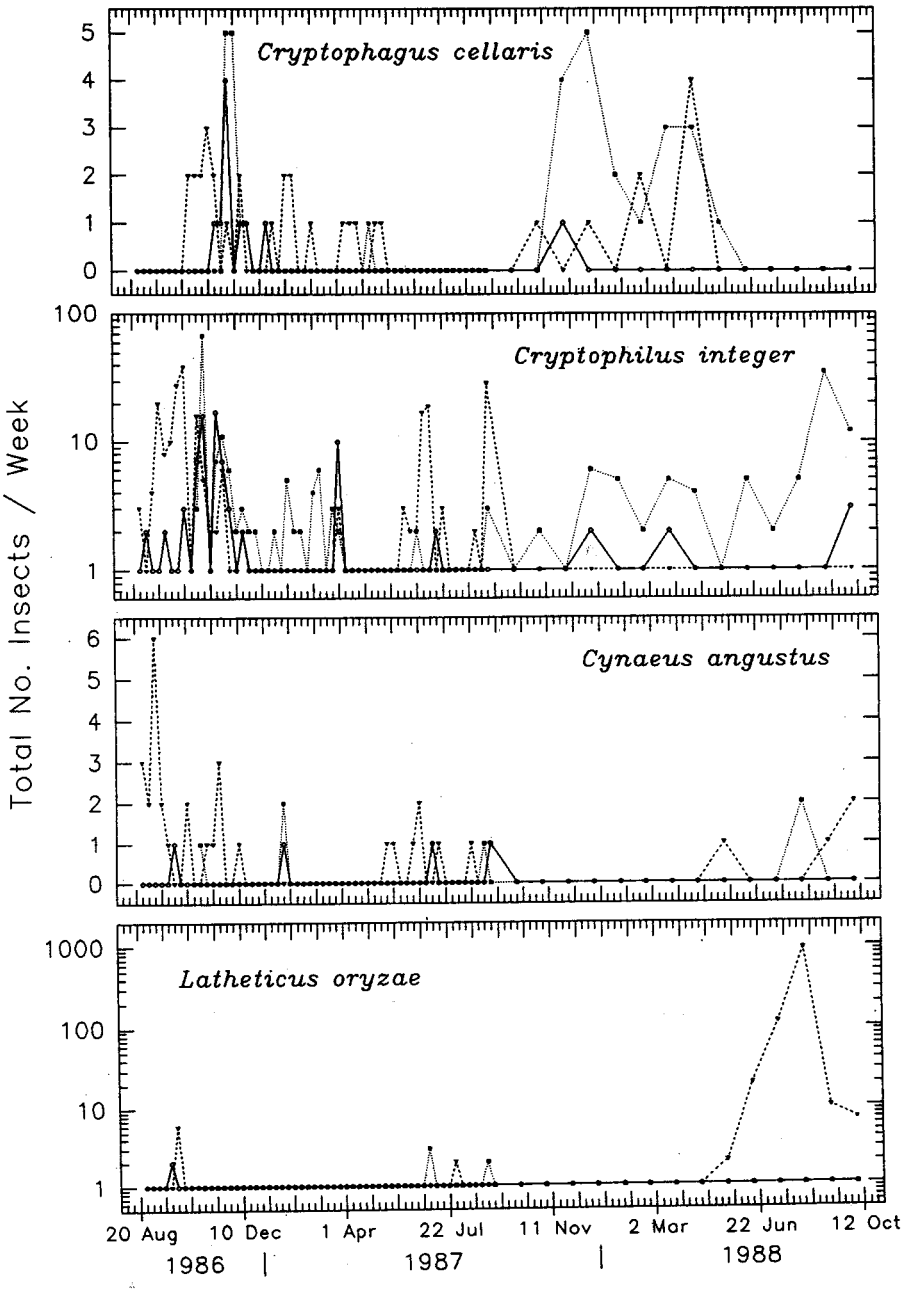



**Fig. 2.** Number of stored-grain beetles in bait packets containing corn at three grain storage sites in southern South Carolina during 1986 to 1988 (solid line and circle, Bamberg Co.; dashed line and triangle, Barnwell Co.; dotted line and square, Hampton Co.). Note that graphs plotted on a log scale report number of insects plus one.

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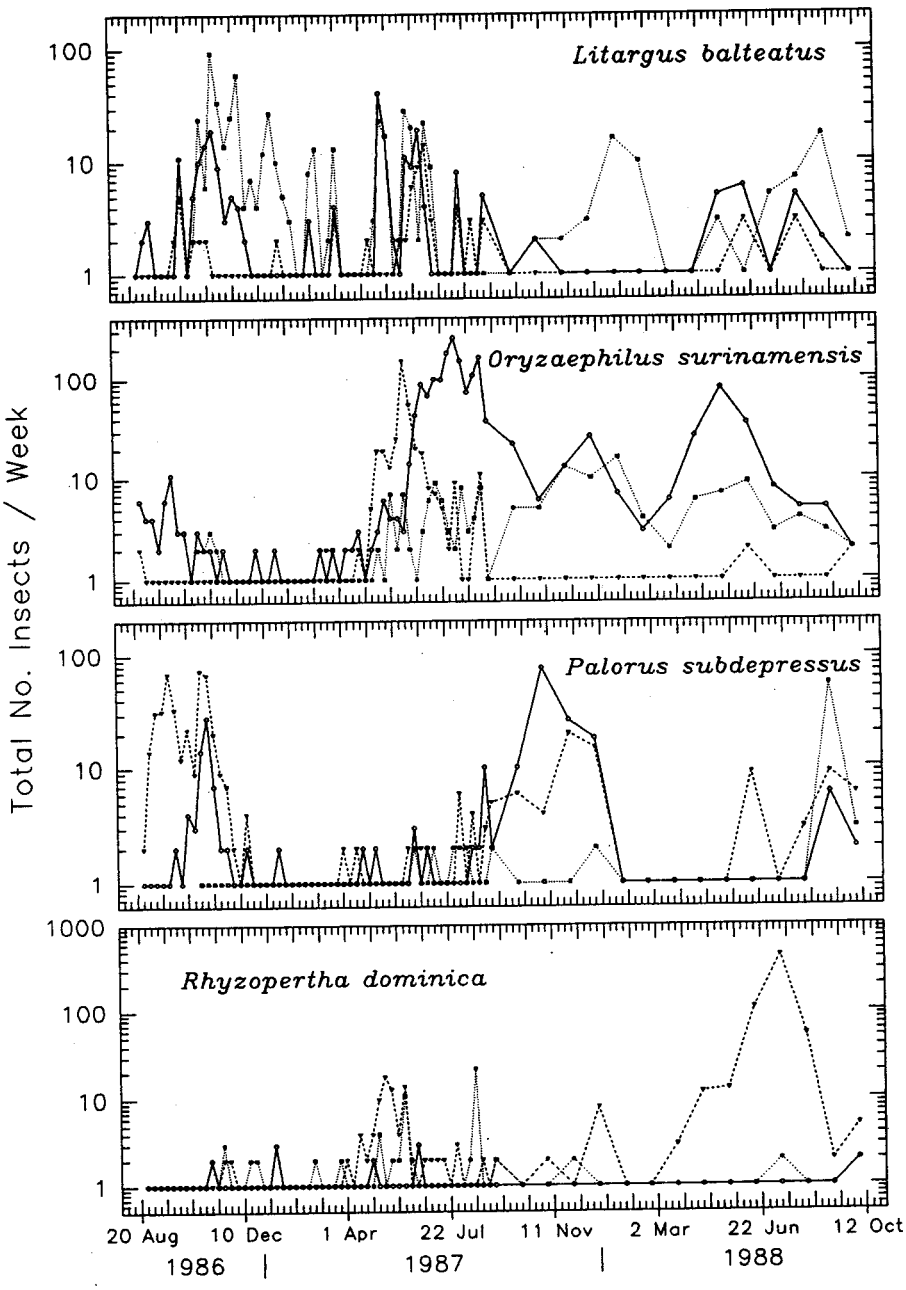


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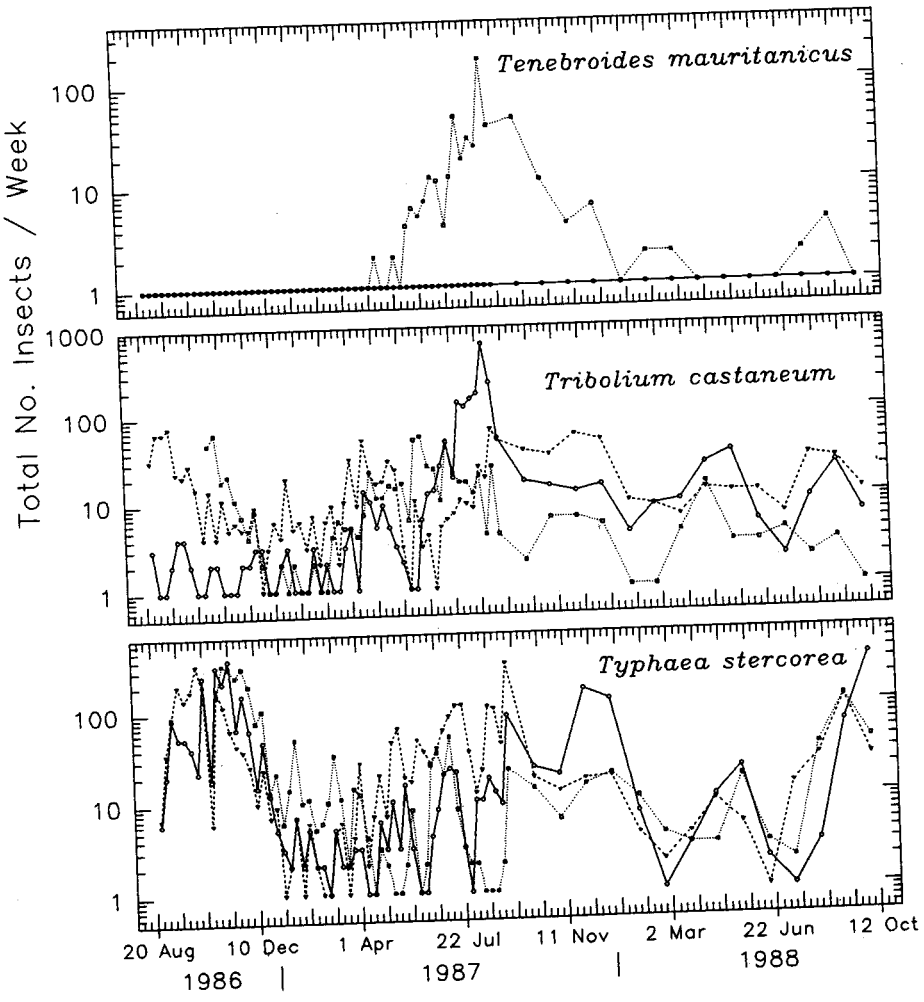


**Fig. 2.** Continued.

Data for two species present in bait packets in low numbers are not shown in Figure 2. There was one *G. maxillosus* in a bait packet in Hampton Co. on 9 September 1987, and one *P. ruficorne* in a bait packet on 8 October 1986 and three on 9 September 1987 in Bamberg Co., and one on 13 May and one on 9 September 1987 in Blackwell Co.

**Sex ratio.** The sex ratio of *C. ferrugineus* was skewed toward females at all sites in both bait packets and sticky traps (Table 3). The sex ratio of *C. pusillus* was skewed toward females in both bait packets and sticky traps, except in Bamberg Co. bait packets (Table 3). The sex ratio of *O. surinamensis* in bait packets was not different from 1:1 in Barnwell and Hampton Counties, but was skewed toward females in Bamberg Co. (Table 3). Not enough *O. surinamensis* were caught on sticky traps to make meaningful analyses of sex ratio. The proportion of females did not vary significantly throughout the year for any of the species tested, as indicated by the runs tests (Table 3).

## Discussion

The sticky traps used were passive traps; there was no intended stimulus to attract insects to the traps. Anything flying into the trap would presumably stick to the material. After some individuals are stuck on the trap, the passiveness of the trap may change. The trap is no longer clear because of insects stuck to it and possibly moving on the trap. Insects stuck on the traps may emit chemical signals that attract or repel other insects.

Most of the insects captured on sticky traps were flying during weeks when maximum temperatures were at least 20° C. These data do not necessarily indicate the minimum temperatures at which these insects are capable of flight. We do not know during which part of the trapping period flight occurred, so the trapped insects may have been flying when air temperatures were lower than the maximum recorded during the week. The insects also may be capable of flight at lower temperatures but may not have been present at the sites or flying during trapping periods when maximum temperatures were lower than 20° C. Temperature is one factor that may limit insect flight because body temperature must be high enough for muscles and enzymes to work efficiently (Chapman 1971). Thus, there is a minimum body temperature below which an insect is incapable of flight. However, many insects may raise their body temperature above ambient air temperature by basking in sunlight. Although our data give an indication of minimum temperatures for flight of these stored-product insects, only more carefully controlled experiments can definitively determine minimum body temperature for flight and whether a species will bask in sunlight to raise its body temperature.

The bait packets work by providing a food source that may be attractive to some of the species. There is no mechanism for keeping insects in the bait packet; thus, it is not a trap. Insects may walk or fly to the bait packets. Thus, bait packets may indicate that a species is active even when temperatures are too low for flight. The lowest maximum temperature at which a species was recorded in bait packets generally was lower than that

**Table 3. Proportion females of *Cryptolestes ferrugineus, Cryptolestes pusillus,* and *Oryzaephilus surinamensis* on sticky traps and in bait packets at three grain storage sites in South Carolina and test statistics for runs test[a].**

| | Sticky traps | | | | Bait packets | | | |
|---|---|---|---|---|---|---|---|---|
| Location | % females (95% CI) | $w_{.025}$ | No. runs | $w_{.975}$ | % females (95% CI) | $w_{.025}$ | No. runs | $w_{.975}$ |
| | | | | *Cryptolestes ferrugineus* | | | | |
| Bamberg Co. | 66 (62 - 69)* | 11 | 15 | 22 | 58 (57 - 60)* | 22 | 23 | 37 |
| Barnwell Co. | 59 (54 - 65)* | 7 | 13 | 15 | 67 (62 - 71)* | 8 | 11 | 16 |
| Hampton Co. | 90 (87 - 95)* | 5 | 7 | >10 | 74 (64 - 88)* | 3 | 5 | 9 |
| | | | | *Cryptolestes pusillus* | | | | |
| Bamberg Co. | 69 (68 - 71)* | 14 | 16 | 25 | 53 (50 - 57) | 13 | 18 | 23 |
| Barnwell Co. | 75 (73 - 77)* | 12 | 15 | 23 | 59 (52 - 66)* | 11 | 11 | 22 |
| Hampton Co. | 69 (67 - 72)* | 11 | 13 | 22 | 63 (57 - 70)* | 9 | 10 | 18 |
| | | | | *Oryzaephilus surinamensis*[b] | | | | |
| Bamberg Co. | -- | -- | -- | -- | 57 (55 - 59)* | 15 | 22 | 27 |
| Barnwell Co. | -- | -- | -- | -- | 51 (46 - 56) | 4 | 6 | 10 |
| Hampton Co. | -- | -- | -- | -- | 59 (50 - 67) | < 9 | 9 | 18 |

* Sex ratio differs statistically from 1:1 at $\alpha = 0.05$ level.

[a] Runs are random (without any pattern) if $w_{.025} \leq$ no. runs $\leq w_{.975}$. All runs were random, indicating sex ratio was consistent throughout each study.

[b] Only six *O. surinamensis* were caught on sticky traps, so sex ratio data are not presented.

for sticky traps, indicating that the bait packets do sample insects during periods when none were caught on sticky traps.

Many of the species in the bait packets produce aggregation pheromones which probably attract other individuals to a suitable food source (Faustini et al. 1981, Cogburn et al. 1984, Millar et al. 1985, Oehlschlager et al. 1988, Pierce et al. 1989, 1991b). Thus, the large numbers of some species in the bait packets may have been a result of attraction of other members of the species by aggregation pheromones. In addition, at least the cucujids are known to be attracted to fungal volatiles (Pierce et al. 1991a) which may have been present in the baits.

The source of the insects in the bait packets and on the sticky traps is not known, but most of these species are ubiquitous (Linsley 1944). Many have been found under bark and in decomposing wood (*A. advena, C. ferrugineus, Cryptophagus* spp., *C. angustus, G. cornutus, G. maxillosus, L. oryzae, L. balteatus, O. surinamensis, P. subdepressus, P. ruficorne, R. dominica, S. paniceum, T. mauritanicus, T. castaneum,* and *T. stercorea*), and in insect nests or food caches (*C. ferrugineus, C. cellaris, C. angustus, O. surinamensis, S. paniceum,* and *T. castaneum*). Thus, wooded areas around grain storage sites would provide natural reservoirs for most of the species collected. The species collected may be divided into primary pests, those that can damage sound grain (*A. fasciculatus, R. dominica, S. paniceum,* and *T. mauritanicus*); secondary pests, those that cannot damage sound grain (*C. ferrugineus, C. pusillus, C. integer, C. angustus, G. cornutus, G. maxillosus, L. oryzae, O. surinamensis, P. subdepressus, P. ruficorne, and T. castaneum*); and fungus feeders (*A. advena, C. cellaris, L. balteatus,* and *T. stercorea*) (Hill 1990). Pest category also may indicate habitats in which these species may occur in nature.

There have been few previous reports on seasonal activity of these species outside of grain storages. Barnes & Kaloostian (1940) used a rotary insect trap to monitor flight of stored-product insects from 14 April to 31 October in a raisin storage yard in Fresno, California. *A. advena* was present in large numbers in all months, with peak catch in May. Peak catches of *O. surinamensis* were in August, with few caught during other months. Peak catches of *T. castaneum* were in September, with moderate catches in August and October. *Typhaea stercorea* were caught in large numbers during all months, with peak catch in May. They indicated that no flight occurred during periods when temperatures were below 18.3° C for *A. advena*, 23.9° C for *T. castaneum*, and 17.8° C for *T. stercorea.*

Schwitzgebel & Walkden (1944) used sticky traps to monitor flight of insects around bins of wheat in July in Kansas. They caught mostly *C. pusillus* and *T. stercorea,* and a few *A. advena, S. oryzae,* and *R. dominica.* They also ran a rotary insect trap from 1 April through October of the same year at the same site. The first insect captured was one *T. castaneum* on 26 May. Except for one *S. oryzae* on 11 June and one *R. dominica* on 12 June, no stored-product insects were caught until July. Large numbers of stored-product insects then were caught until the end of September. Additional species captured were *A. advena, Cryptolestes* spp., *L. oryzae,* and *T. stercorea.* They also placed traps in ventilator openings at the tops of bins from 2 April to 1 November to

determine when insects entered the bins. *Cryptolestes* spp. were captured for the first time on 2 April, *R. dominica* on 13-15 May, *A. advena* on 10-16 June, *T. stercorea* on 24-30 June, and *S. oryzae* on 1-7 July. Catches were highest from July through September.

*Araecerus fasciculatus* has been recorded from at least 136 species of plants and plant products (Childers 1982). In a survey of seasonal activity on wild and cultivated plants in Florida, adults were found throughout the year (Childers 1982). Cogburn et al. (1984) trapped *R. dominica* using pheromone traps around grain bins in Texas from 16 June to 12 July. They caught some each week that they trapped, and they caught as many as 2,300 per week per trap. Sinclair and Haddrell (1985) found that *Cryptolestes* spp., *R. dominica, S. oryzae,* and *T. castaneum* were most active during the warmest parts of the year in a study conducted in Queensland, Australia, in which bait packets and sticky traps were placed in empty farm buildings. These previous reports, like ours, generally indicate increased activity during warmer months. Specific patterns of activity presumably would be related to local weather conditions and commodities stored.

Sinclair & Haddrell (1985) reported that *Cryptolestes* spp. and *T. castaneum* did not differ from a 1:1 sex ratio (no statistics provided) on sticky traps placed around fields of grain. *Rhyzopertha dominica* captured around fields of grain were predominantly female, but those captured around grain storage sites did not differ from a 1:1 sex ratio. Sinclair and Alder (1984) showed that as an insect population increased in a grain storage, the sex ratio in the bulk became skewed toward males of *C. pusillus, R. dominica,* and *S. oryzae*. Sex ratio in *C. ferrugineus* and *T. castaneum* did not differ from 1:1. The migrant population was consistently skewed toward females for *C. pusillus, R. dominica,* and *S. oryzae.*

Individuals of both sexes of *A. advena* produce an aggregation pheromone that is attractive to both sexes (Pierce et al. 1991b). *C. ferrugineus, C. pusillus, O. surinamensis, R. dominica,* and *T. castaneum* males produce aggregation pheromones that are attractive to both sexes (Cogburn et al. 1984, Faustini et al. 1981, Millar et al. 1985, Oehlschlager et al. 1988, Pierce et al. 1989). These aggregation pheromones probably attract conspecifics to a suitable food source. However, there are no data to indicate that females should be caught in flight traps more than males or should be retained in bait packets more readily than males.

This study shows that large numbers of stored-product insects are present around grain storages in South Carolina throughout the year. Flight is generally limited to warmer parts of the year. However, there is no part of the year when grain is not subject to infestation.

## Acknowledgment

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