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Short communication

Flight behaviour of *Prostephanus truncatus* and *Teretrius nigrescens* demonstrated by a cheap and simple pheromone-baited trap designed to segregate catches with time

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Abstract

The storage pest *Prostephanus truncatus* (Horn) (Coleoptera: Histeridae) and its predator *Teretrius nigrescens* (Lewis) (Coleoptera: Histeridae) are both known to disperse by flight. The pattern of flight activity of the two beetles in Ghana, across 11 months of the year, was investigated using a novel flight trap that separates catch at 3-h intervals. *Prostephanus truncatus* showed most flight activity around dusk with a smaller peak around dawn. *Teretrius nigrescens* had a strong diurnal peak. There were considerable differences in catch of both species during the year and when catch was low the peaks in activity were also less distinct.

Keywords: Flight trapping; Flight behaviour; Pheromone trap

1. Introduction

It is well known that insects favour particular times of day for flight. Several insect pests of stored products, e.g. *Rhyzopertha dominica* (F.) (Barrer et al., 1993), *Sitophilus zeamais* Motschulsky and *Ephestia cautella* (Walker) (Giles, 1969), show mid- to late afternoon peaks in flight activity. This behaviour can be studied using traps such as the Johnson–Taylor suction trap (Burkard Ltd, UK) that separate catch according to time of day. Such traps are relatively expensive, so in view of this a simple, cheap pheromone-baited flight trap was constructed to observe the flight activities of the larger grain borer, *Prostephanus truncatus* (Horn)

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(Coleoptera: Bostrichidae) and its predator *Teretrius* (formerly *Teretriosoma*) *nigrescens* (Lewis) (Coleoptera: Histeridae). The latter is known to be attracted to the male-produced aggregation pheromone of *P. truncatus* (Rees et al., 1990; Boeye et al., 1992).

It is known that the flight activity of *P. truncatus* peaks at dawn and dusk. In Mexico (Tigar et al., 1994) and Kenya (Giles et al., 1995) the peaks of flight activity at dusk were much larger than at dawn while in Honduras the scale of the peaks was reversed, with about 30% greater catch at dawn (Novillo Rameix, 1991). The aims of the current study were to confirm unpublished observations that *T. nigrescens* has a diurnal peak of flight activity (G. Key, personal communication) and to determine whether the scale of the peaks for the two species might change during the course of the year. This study was undertaken in Ho in the Volta Region of Ghana.

2. Materials and methods

The trap (Figs. 1 and 2) was constructed of materials that were conveniently to hand and consisted of a 12-compartment carousel designed to store drying cutlery (UK Das. App. No. 1010346, made in China), an automatic cat-feeder powered by clockwork (Staywell, Freedom Feeder, Reilor Ltd, Preston PR2 5AP, UK), a piece of plastic drainpipe and a funnel trap. The opening in the cat-feeder from which pets would feed was covered over using a piece of vinyl flooring fixed in place with silicon sealant. The funnel trap used was the upper portion of the Japanese beetle trap (Trécé Inc., Salinas, CA., USA). This consists of a yellow plastic funnel (diameter 15 cm, height 11 cm) with four vertical vanes in the form of a cross, extending 10 cm up from the funnel to form a baffle. The baffle was baited with a standard *P. truncatus* aggregation-pheromone lure consisting of a polythene capsule impregnated with 1 mg each of Trunc-call 1 and

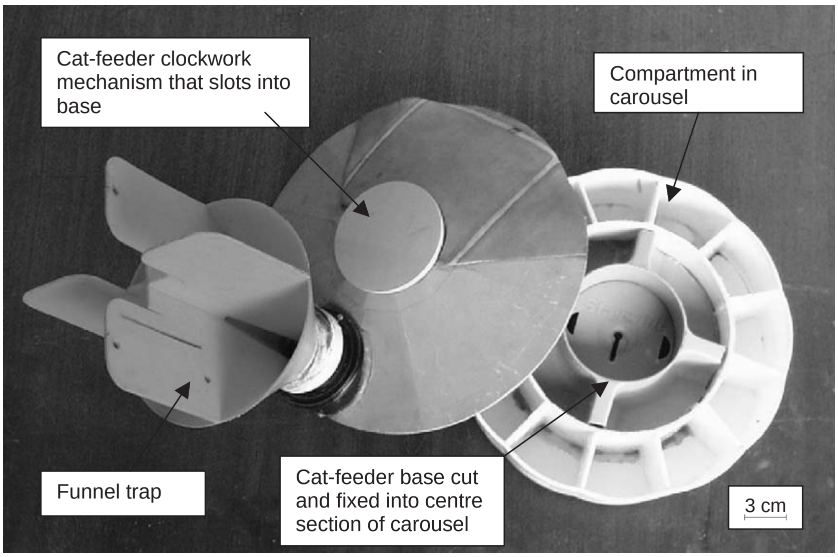

Fig. 1. Exploded view of the pheromone-baited flight trap for segregating catch with time.

Fig. 2. Assembled pheromone-baited flight trap for segregating catch with time.

Trunc-call 2 (Dendy et al., 1989; Cork et al., 1991). The funnel trap was fitted into the piece of drain pipe, held in place with adhesive tape, and the pipe was bolted to the top of the cat-feeder where a hole had been cut so that insects could fall through the top of the cat-feeder. The base portion of the cat-feeder was cut to shape so that it would fit tightly into the centre section of the carousel (Fig. 1). Insects caught in the funnel trap were directed, by the drain piping, into one of the compartments of the carousel. The base of each compartment was covered with a piece of filter paper impregnated with 0.1 cm^3 of a 25% emulsion of the insecticide Actellic Super, so that the captured beetles were killed. The cat-feeder top, with its funnel trap, rotated across eight compartments in 24 h so that each contained the catch from a 3 h period.

The trap was operated for between 16 and 26 days (Table 1) during each month from November 1999 to October 2000, except in April when there was no trapping due to other commitments. Fresh pheromone capsules were inserted into the trap every seventh day and the trap catch was emptied between 12.00 and 13.00 h on trapping days. The trap was conveniently placed on the covered porch of a house.

3. Results and discussion

The trap worked reliably and was effective in demonstrating the daily flight activity of the two beetles (Figs. 3 and 4; Table 1). Construction cost was estimated at about US$25. There was no

Table 1
Mean (±sem) trap catches per h at peak times of the day for *P. truncatus* and *T. nigrescens* during eleven months of the year

Months	No. days trapping	*P. truncatus*		*T. nigrescens*
		05.30–08.30 h	17.30–20.30 h	14.30–17.30 h
Jan.	23	0.43 ± 0.10	1.00 ± 0.35	0.80 ± 0.22
Feb.	23	0.28 ± 0.05	0.78 ± 0.16	0.62 ± 0.14
March	16	0.11 ± 0.05	0.22 ± 0.08	0.49 ± 0.13
May	16	0.52 ± 0.11	2.31 ± 0.48	0.44 ± 0.10
June	23	0.28 ± 0.09	1.71 ± 0.60	0.23 ± 0.06
July	25	0.14 ± 0.05	0.86 ± 0.22	0.15 ± 0.05
August	23	0.20 ± 0.07	0.39 ± 0.09	0.01 ± 0.01
Sept.	25	0.04 ± 0.02	0.24 ± 0.08	0.08 ± 0.04
Oct.	26	0.03 ± 0.02	0.01 ± 0.01	0.04 ± 0.02
Nov.	25	0.19 ± 0.06	1.13 ± 0.31	0.06 ± 0.03
Dec.	25	0.39 ± 0.12	1.23 ± 0.25	0.07 ± 0.03

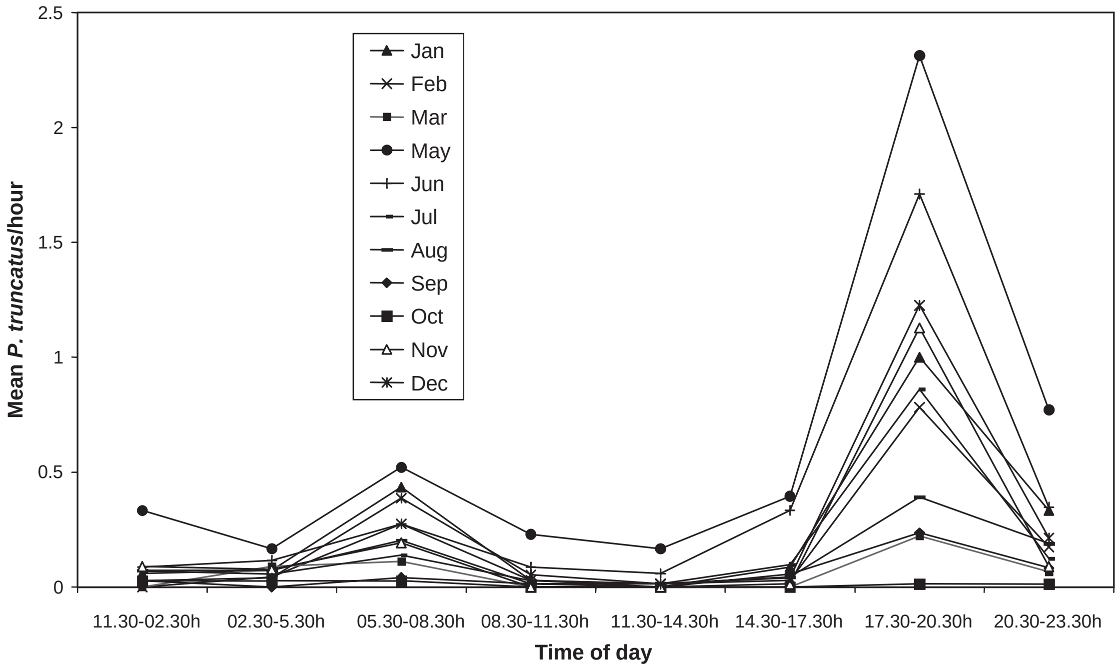

Fig. 3. Mean hourly trap catch of *P. truncatus* by month (except April) over the course of a year segregated by intervals of 3 h.

discernible effect of age of lure on the size of daily catch so the data were pooled by month without correcting for this. The flight pattern of *P. truncatus* showed the expected dawn and dusk peaks, except in October when catches were so low that no peaks were discernible (Fig. 3). The numbers of beetles caught varied considerably over the course of the year with particularly high

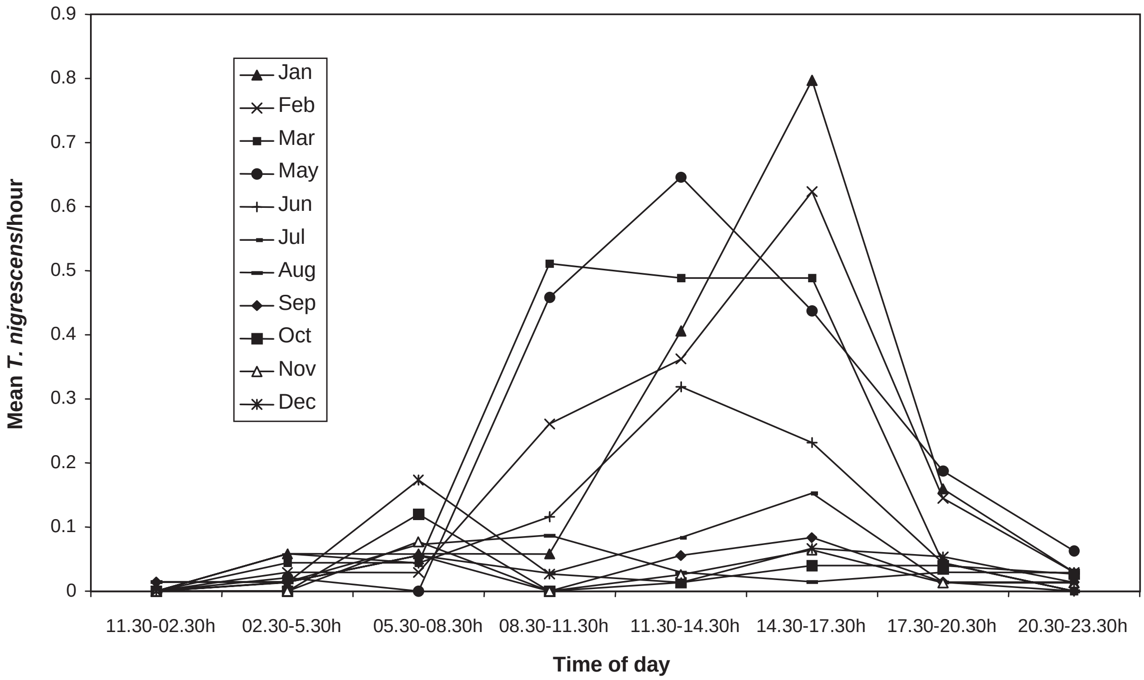

Fig. 4. Mean hourly trap catch of *T. nigrescens* by month (except April) over the course of a year segregated by intervals of 3 h.

catches in May, June and December. The relative proportion of the catch in the two peaks also varied, with the peaks of more similar size when overall catches tended to be low, in September, August and March. There was no evidence of peak reversal as in Honduras, although no data were collected in April. The observed seasonal variation in the size of *P. truncatus* catch is already well known and is strongly related to prevailing conditions of temperature and relative humidity (Borgemeister et al., 1997; Nansen et al., 2001).

Teretrius nigrescens shows a strong diurnal peak of flight activity although the peak was much diminished in those months where catch was very low; July, September and October and altogether absent in August (Fig. 4). *Teretrius nigrescens* and *P. truncatus* do not have synchronized flight activity. This is a little surprising as *T. nigrescens* uses the aggregation pheromone of *P. truncatus* as an element in locating its prey. It might therefore be possible for *P. truncatus* to limit predation by only releasing pheromone when its own flight activity is at a peak. The daily rhythm of pheromone release in individuals or groups of male *P. truncatus* has not been investigated although in the related bostrichid, *Rhyzopertha dominica* (F.), pheromone release does appear to be somewhat greater at the time of maximal flight activity (Bashir et al., 2003). Details of pheromone release in *P. truncatus* may prove to be an interesting area for behavioural study since the length of time over which release occurs could be a trade-off between maximising reproductive success and minimising predation by *T. nigrescens*. This subject has apparently received little or no attention in other species.

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References

Barrer, P.M., Starick, N.T., Morton, R., Wright, E.J., 1993. Factors influencing initiation of flight by *Rhyzopertha dominica* (F). (Coleoptera: Bostrichidae). Journal of Stored Products Research 29, 1–5.

Bashir, T., Birkinshaw, L.A., Farman, D., Hall, D.R., Hodges, R.J., 2003. Pheromone release by Rhyzopertha dominica (F.) (Coleoptera: Bostrichidae) in the laboratory: daily rhythm, inter-male variation and association with body weight and/or boring activity. Journal of Stored Products Research 39, 159–169.

Boeye, J., Laborius, G.A., Schulz, F.A., 1992. The response of *Teretriosoma nigrescens* Lewis (Col., Histeridae) to the pheromone of *Prostephanus truncatus* (Horn) (Col., Bostrichidae). Angewandte Schaedlingskunde Pflanzenschutz Umweltschutz 65, 153–157.

Borgemeister, C., Meikle, W.G., Scholz, D., Adda, C., Degbey, P., Markham, R.H., 1997. Seasonal and weather factors influencing the annual flight cycle of *Prostephanus truncatus* (Coleoptera: Bostrichidae) and its predator *Teretriosoma nigrescens* (Coleoptera: Histeridae) in Benin. Bulletin of Entomological Research 87, 239–246.

Cork, A., Hall, D.R., Hodges, R.J., Pickett, J.A., 1991. Identification of major component of the male produced aggregation pheromone of the larger grain borer, *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae). Journal of Chemical Ecology 17, 789–803.

Dendy, J., Dobie, P., Saidi, J.A., Smith, J., Urono, B., 1989. Trapping the larger grain borer, *Prostephanus truncatus* in maize fields using synthetic pheromones. Entomologia Experimentalis et Applicata 50, 241–244.

Giles, P.H., 1969. Observations in Kenya on the flight activity of stored products insects, particularly *Sitophilus zeamais* Motsch. Journal of Stored Products Research 4, 317–329.

Giles, P.H., Hill, G., Nang'ayo, F., Farrell, G., Stabrawa, A., Wekesa, P., 1995. Entomological and socio-economic investigations for the development of integrated pest management strategies against *Prostephanus truncatus*. UK/Kenya Larger Grain Borer Research Project Report. Natural Resources Institute, Chatham Maritime, Kent, ME4 4TB, UK, p. 273.

Nansen, C., Korie, S., Meikle, W.G., Holst, N., 2001. Sensitivity of *Prostephanus truncatus* (Coleoptera: Bostrichidae) flight activity to environmental variables in Benin, West Africa. Environmental Entomology 30, 1135–1143.

Novillo Rameix, P., 1991. *Prostephanus truncatus* (Horn)(Coleoptera: Bostrichidae) en el ambiente de almacenamiento traditional de maiz en el Valle de el Zamorano Honduras, C.A. Tesis de Ingeniero Agronomo, Escuela Agricola Panamericana, Honduras, viii + p. 129.

Rees, D.P., Rodriguez, R., Herrera, F.L., 1990. Observations on the ecology of *Teretriosoma nigrescens* Lewis (Col Histeridae) and its prey *Prostephanus truncatus* (Col.: Bostrichidae). Tropical Science 30, 153–165.

Tigar, B.J., Key, G.E., Flores-S, M.E., Vazquez-A, M., 1994. Flight periodicity of *Prostephanus truncatus* and longevity of attraction to synthetic pheromone. Entomologia Experimentalis et Applicata 66, 91–97.