The dispersion pattern of *Teretriosoma nigrescens* Lewis (Col., Histeridae) after its release and monitoring of the occurrence of its host *Prostephanus truncatus* (Horn) (Col., Bostrichidae) in the natural environment in Togo

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Abstract

In a program of classic biological pest control, *Teretriosoma nigrescens*, imported from Central America, was released for the first time at the end of January 1991 in southern Togo. *T. nigrescens* is a predator of *Prostephanus truncatus*, a storage pest non-native to Africa. The dispersion of this useful insect was monitored by means of pheromone-baited traps (trunc-call [I+II]; kairomone effect). One day before, the pheromone traps were installed at a radius of 1 km around the point where the insect was to be released, and after making two catches of *T. nigrescens*, these were moved to distances of 2, 3, 5, 10 and 20 km. Due to the influence of the main wind direction, blowing from SSW to NNE, the predator had spread 10 km to the north, 5 km to the east and south and 2 km to the west during the course of 11 months (end of January to the end of December 1991). An evaluation of the catches of larger grain borer, caught simultaneously with *T. nigrescens*, provided details on population fluctuations and seasonal occurrence of the pest outside the closed settlement area. Weekly counting and resetting of the traps produced total figures of 300805 *P. truncatus* and 111 *T. nigrescens*.

Introduction

The spread of the storage pest *Prostephanus truncatus* (Horn) (Col., Bostrichidae) from its Central American home to East Africa (Dunstan and Magazine 1981), and later to West Africa (Harnisch and Krall 1984), posed a considerable risk to maize and dried cassava chips, extensively stored in traditional structures. Damage and losses, in this dimension unknown prior to this time, now threaten the staple foods of large groups of the population in the affected countries. In East and also in West Africa, there have, since its discovery, been endeavours to effectively combat this pest using synthetic means of storage protection (Golob et al. 1983; Golob et al. 1985). As alternative to chemical control, *P. truncatus* as a non-native species in the new habitat, seemed ideal as target organism for a program of classic biological pest control (Schulz and Laborius 1987; Böye 1988). In detailed preliminary studies carried out in Costa Rica, *Teretriosoma nigrescens* Lewis (Col., Histeridae) could be identified as the most promising antagonist (Böye et al. 1992). After concluding a series of initial investigations and breeding under quarantine conditions, *T. nigrescens* was taken to Togo (Helbig 1993) in the course of Togo–German technical cooperation (Service de la Protection des Végétaux/Deutsche Gesellschaft für Technische Zusammenarbeit, GTZ GmbH) in November 1989. At the end of January 1991, the first specimens were released in the southern part of the country. Since this was the first release of its kind, special attention was paid to the methods (Biliwa et al. 1992).

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Materials and Methods

The village of Tsagba (Région des Plateaux, approx. 85 km north of Lomé and 20 km east of the town of Notsé) was selected as the location for the first release of *T. nigrescens*. In this area, local maize varieties and cassava are cultivated in the long rainy season (April–July), whilst the short rainy season (September–October) is used for the cultivation of cotton.

The centrally-located village square was chosen as the site for release (Helbig 1993). Ten traditionally built trial stores, containing maize of a uniform and infested with *P. truncatus*, were erected around this in a distance up to 200 m (Fig. 1). The monitoring stores were covered with fine gauze (Fig. 2.) which was searched at half-hour intervals during the day and once during the night for any *T. nigrescens* which had landed, to determine how the insect spread over short distances within the first few hours of being released.

To determine the spread of *T. nigrescens* over more extensive regions, 12 pheromone-baited traps (trunc-call [I+II], 1:1, Biological Control Systems Ltd, U.K.) were installed at distances of 1 km encircling the release point with the aid of an aerial photograph. The distance of 1 km was thought to be sufficient to avoid an influence to the traps on the spread because of the known attracting distance of 450 m on the predator (Helbig et al. 1992). 'Bark beetle traps' (self-made imitation of a Theyson-bark-beetle slit trap, W × D × H: 500 mm × 140 mm × 600 mm) were used for all four directions. Between each two bark beetle traps, there were two delta flight traps (AgriSense-BCS Ltd, U.K.). The individual traps were hung up on bushes, trees or on wooden constructions especially made for this purpose, and evaluated and renewed every week from February to December 1991. After two consecutive catches of *T. nigrescens*, the bark beetle traps were moved to distances of 2, 3, 5, 10 15 km etc. Due to inaccessible terrain, the delta traps were left at the same spots and, as soon as *T. nigrescens* had been caught several times, were removed.

Results and Discussion

Spreading over shorter distances

After approximately 20 minutes of free flight from on open dish, the first beetles of the 4000 adult *T. nigrescens* arrived at stores 9 and 4, which were set up 100 m away from the release point. Later, the monitoring stores near the release point were the flight targets preferred, too. On the first day, the highest

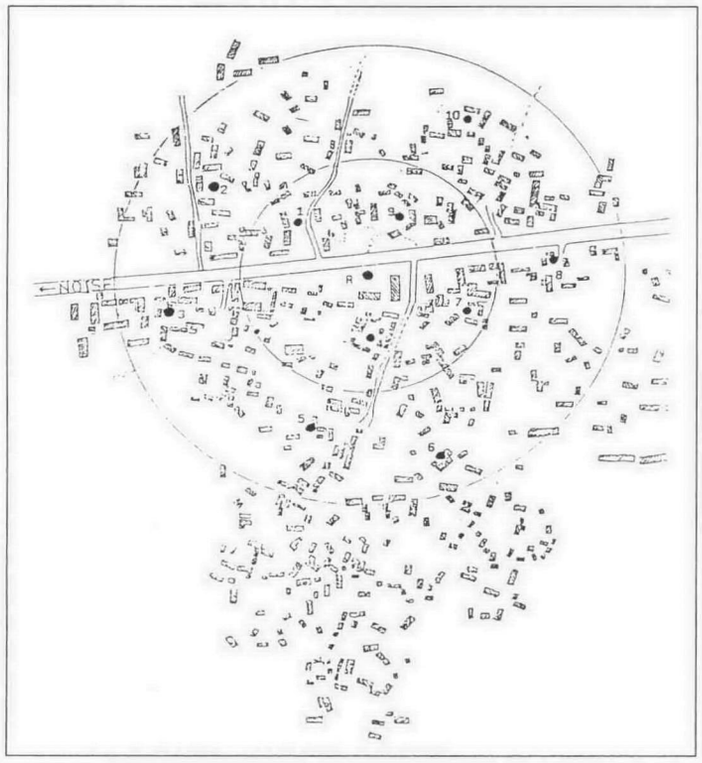

Fig. 1. Map of the release village with monitoring stores and release point.

catches were observed on store 1 with 10 beetles and on store 9 with 24 beetles (Table 1). Due to the changing wind direction, which was NE at the release time, but S two hours later, a dependence on the wind direction is not detectable. After four days, a total of 78 *T. nigrescens* had settled on the 10 monitoring stores, producing a catch rate of 1.95% of the beetles released. After having been counted, they were put into the appropriate stores. Nocturnal flying activity of the useful insects could not be observed.

Spreading over longer distances

The spreading of *T. nigrescens* to the area around the village was observed for the first time 3 months after its release. Considering the time interval here, these were possibly F_1 progeny of the population released.

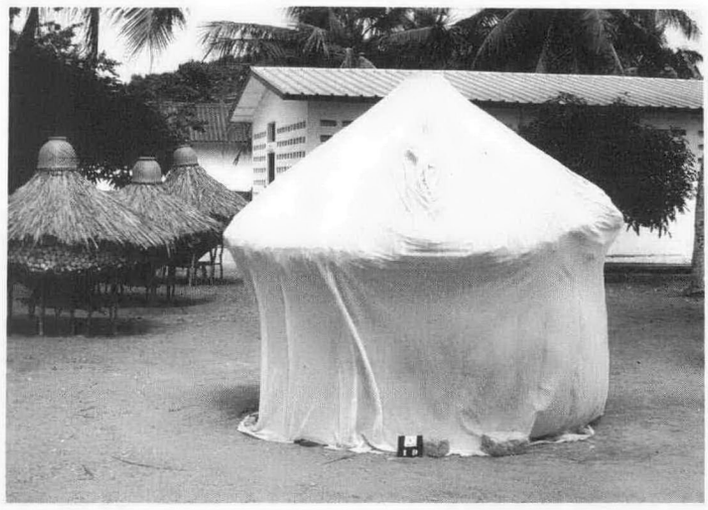

Fig. 2. Maize store under a gauze tent.

T. nigrescens preferred to disperse over long distances in the main wind direction. This dispersion is supposed to be partly caused by passive spreading. With a predominant local air stream from SSW to W in the direction of NNE, the beetle reached a distance of 25 km to the north within 14 months of being released.

The trap set up to the west, 1 km from the village where the beetles were set free, was on the outskirts of a neighbouring village. *T. nigrescens* was discovered there for the first time during the 29th week after its release (Fig. 3). The relatively late arrival at this point, as compared to the traps to the north and east where the first specimens of *T. nigrescens* were caught after 12 and 15 weeks, could be the result of the predominant air stream, but also of the attraction exerted by maize stores infested by *P. truncatus* in the near vicinity.

Simultaneously, *P. truncatus* was caught in the pheromone traps. This provides a picture of the frequency and flying activity of the pest throughout the year outside village settlements (Fig. 4). When evaluating this over the year, the distances of the traps from the point of release, which steadily increased, have to be taken into consideration. Maximum rates caught in the traps were reached towards the end of the main storage season which corresponds to the end of the long rainy season. During this period, the farmers empty their stores and

Table 1. Catches of *Teretriosoma nigrescens* on the monitoring stores after its release on 29 January 1994 in Tsagba

Store	Day of observation					Distance from release point	Direction from release point
	29/1	30/1	31/1	1/2	Total days		
1	10	3	0	1	14	75 m	North-west
2	3	0	0	0	3	145 m	North-west
3	3	0	0	0	3	160 m	West
4	4	2	1	1	8	55 m	South
5	0	0	1	0	1	140 m	South
6	1	2	0	0	3	170 m	South
7	3	1	0	0	4	85 m	South-east
8	1	1	0	0	2	145 m	East
9	24	7	1	4	36	55 m	North-east
10	4	0	0	0	4	155 m	North-east
Total	53	16	3	6	78		
Per cent	1.3	0.4	0.075	0.15	1.95		

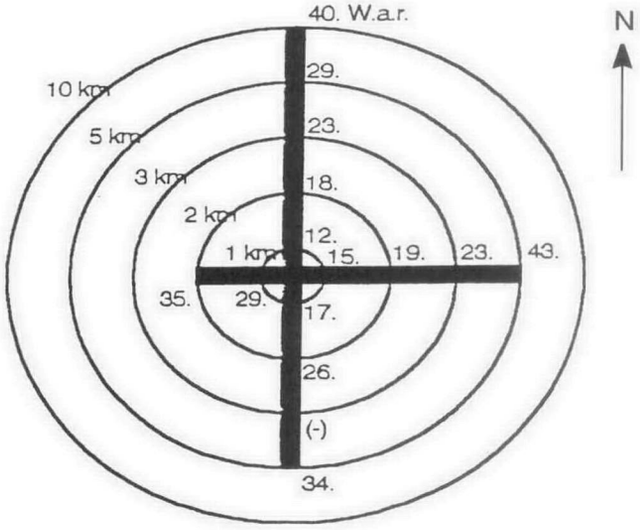

Fig. 3. First occurence of *Teretriosoma nigrescens* at different distances from the release point and maximum spreading after 11 months (W.a.r. = week after release).

sell their remaining stock of maize. Many insects are freed when the maize cobs are husked and stripped, which could possibly explain the high numbers of insects caught in the pheromone traps.

Another reason for this trend could be the development of food supply in relation to the population dynamics of the pest. Simultaneous with the increasing density of the pest in store, there is a removal of maize by the farmer. This leads to a deficiency in food supply for the pest. Therefore, a part of the population density might migrate. The later the storage season, the higher the population density of the pest due to the ongoing multiplication. However, a certain part of the population migrates in order to avoid an extremely high density.

Table 2 clearly shows how the number of *P. truncatus* and *T. nigrescens* caught in each trap at a particular location does not primarily depend on the period of time the traps were at this location. Far more important were the circumstances created by season and weather, but also the reasons already mentioned above. The rate of *T. nigrescens* caught, at 1–3 beetles per trap and week, was too low to provide a clear picture. Figure 4 indicates a slight correlation of *P. truncatus* and *T. nigrescens* in an open environment: where the activity of larger borer was high, relatively high numbers of the predator were caught. Since the same reasons could be true for the high catches of *T. nigrescens* as for larger grain borer, which are emptying the stores, regulation of the density and migration due to food deficiency, the two observations are possibly related in this way. A validated statement on the interaction of the two species in an open environment, however, can only be given after a biological equilibrium has been reached.

According to the experience gained with the method of release described, free flight can be recommended to ensure rapid, extensive dispersion of the useful insect. The disadvantage of this method could be an extreme dispersion of the population. Therefore, expectations as regards efficiency of the predator should not be too high early after release.

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Table 2. Catches of *Teretriosoma nigrescens* and *Prostephanus truncatus* at different sites with weekly change of the traps

Trap position	Distance between trap and release point (km)	Length of stay of the trap at the site (weeks)	Number of *P. truncatus* caught	Number of *T. nigrescens* caught
North	1	17	20719	14
	2	5	26817	9
	3	5	6916	5
	5	4	6166	8
	10	14	2660	3
East	1	17	18095	3
	2	5	22891	3
	3	5	4215	6
	5	18	1584	7
South	1	22	25095	2
	2	7	1945	3
	3	-	-	-
	5	8	550	4
West	1	33	42409	4
	2	12	325	2

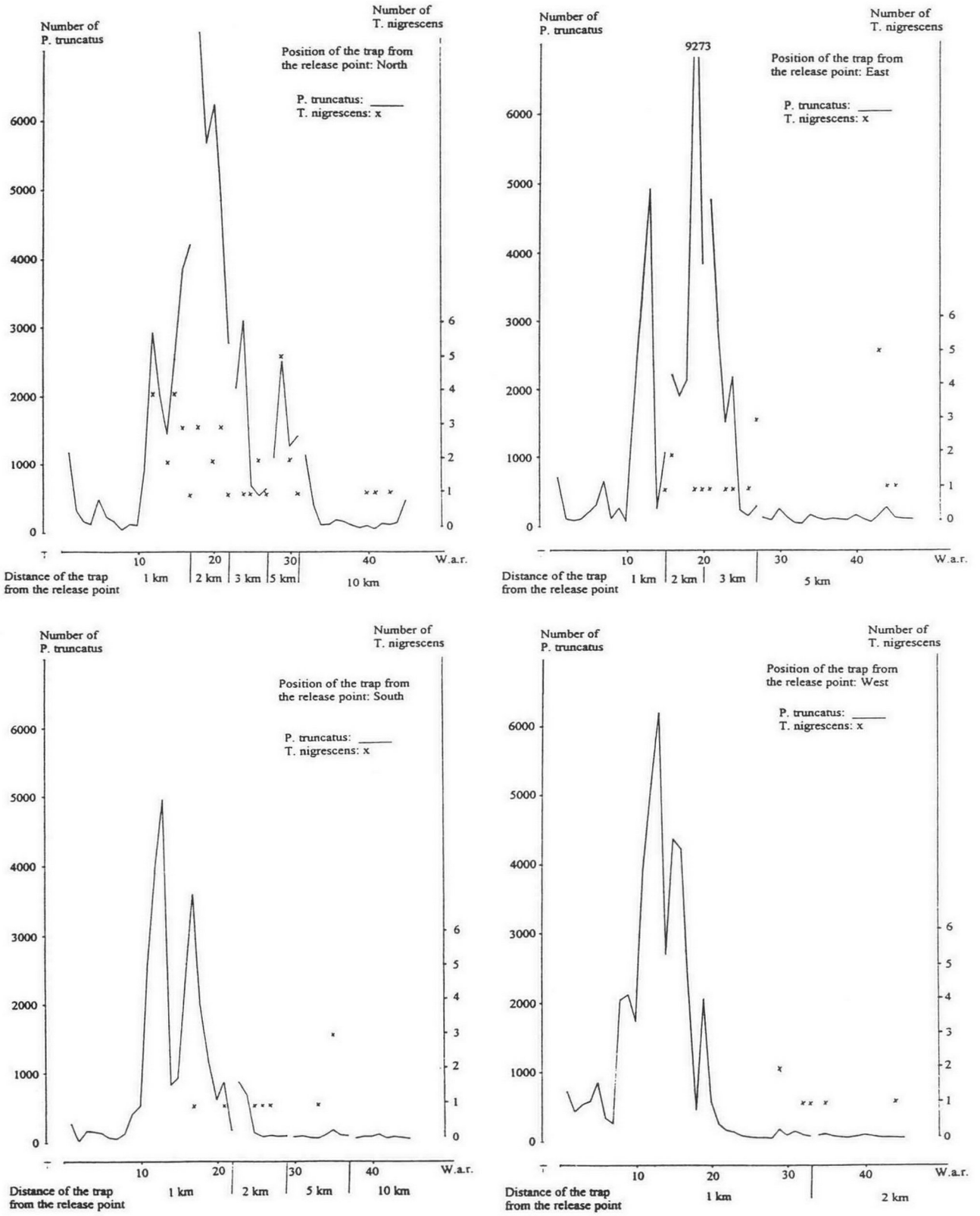

Fig. 4. Weekly catches of *Teretriosoma nigrescens* after its release in Tsagba and of *Prostephanus truncatus* in pheromone-baited traps (W.a.r. = week after release).

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