

## **Ground-Spray Treatment with Deltamethrin against Tsetse Flies in NW Zimbabwe Has Little Short Term Effect on Lizards**

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Lizards abound in tropical habitats and make up an important component of savannah communities (Barbault 1983). They prey on insects and other small invertebrates and form a prominent link in food chains with raptorial birds (Broadley 1973) and other predators. They are also sensitive to many pesticides (Hall 1980; Lambert 1987), directly and through intake via their prey.

Insecticide ground-spraying against tsetse flies *Glossina* spp., vectors of trypanosomiasis in cattle, has been practiced in Zimbabwe since 1967. Residual deposits of DDT were applied to tsetse resting sites on tree trunks, holes and rock overhangs. Since 1988, deltamethrin, a synthetic pyrethroid of low mammalian toxicity, has been experimentally substituted for DDT. The insecticide is a soluble concentrate, which in a 0.05% aqueous solution has been applied selectively to trunk surfaces at up to 50 mg per sq m. In woodland, trunks of c. 15 cm diameter and more are treated on opposite sides up to a height of approximately 3 m. Tsetse control operations by teams of spraymen are carried out during the cool, dry season of the year (July to September).

The effects of using DDT against tsetse flies on native fauna, including lizards (Lambert 1993), have already been monitored in Zimbabwe. Fish and amphibians are known to be highly sensitive to synthetic pyrethroids, but birds and mammals are not (IPCS 1990). Lizards are ectothermic like fish and amphibians, but lack permeable skins or gill membranes. It is not known whether lizards are equally sensitive to this non-persistent insecticide, or whether they suffer little ill effect as in birds

and mammals. Grant and Crick (1987) could not detect any effects of deltamethrin aerosols, applied sequentially against tsetse flies, on the behaviour of a population of *Mabuya quinquetaeniata margaritifer* inhabiting rock outcrops in NE Zimbabwe. The objective of this work was to investigate the possible short-term effect of ground-spraying deltamethrin against tsetse flies on lizards in NW Zimbabwe. The study aimed to compare species richness and the relative abundance of lizard populations in woodland before and after treatment.

## MATERIALS AND METHODS

Northwest Zimbabwe is wooded, with occasional settlements and small-holder agriculture. Mopane *Colophospermum mopane* is a dominant leguminous tree colonizing soils poor in organic content (carbon and nitrogen) and often with impeded drainage. The trees sustain elephant and termite damage, and, becoming hollow as they mature, provide refuge for lizards and other wildlife.

Observations were made during the cool, dry season in NW Zimbabwe from 28 July to 27 August 1990. The work took place at sites of several hectares within woodland of a study zone of c. 73 sq km in the eastern part of the Omay Communal Area (Mashonaland West). The whole area had been ground-sprayed with DDT in 1988 and 1989, but in 1990 was treated for the first time with deltamethrin. A 1.4 ha woodland site not previously sprayed with any insecticide was also monitored in the Siabuwa Communal Area (Matabeleland North) before and after an experimental treatment with deltamethrin in July 1990. Further details on study areas are given in Lambert et al. (1991).

Lizard species and numbers were recorded in relation to maturity/age and, if possible, sex, and identified with the help of a field guide by Branch (1988) and key of Broadley (1989). The key formed the basis for the nomenclature, with a few amendments by Broadley (pers. comm.). Further details on the biology of the species observed are given in Branch (1988).

Trunk surveys were carried out in sites of mature mopane woodland. As described by Lambert (1993), searches by the specialist and technical assistant progressed from tree to tree in walked transects. Exposed surfaces were inspected with the sun behind or less than a right angle to the observers. Time spent at sites was influenced by tree density but corresponded approximately to area of coverage.

Sites 1-7 at Omay (see Fig. 1) were sprayed with one treatment of deltamethrin on 4, 18, 8, 8, 19, 6 and 12 July and at Siabuwa on 13 July 1990. Sighting rate was determined by counting lizards during trunk surveys at Sites 2, 5 and 7 before and after treatment had taken place. Based on preliminary observations on activity and air temperature, trunks were surveyed between 0845 and 1645 h (local mean time). Activity may have declined with full sunshine during the middle of the day when air temperature exceeded 30°C, but sighting rate with the prevalent <50% cloud cover between 0730 and 1730 h was not significantly correlated with air temperature at any site.

*Mabuya striata wahlbergii* was the predominant species and depended on trunks for basking sites and refuge in holes. Monitoring was standardised by density-independent surveying of all seven sites. The proportion of trees occupied was recorded in the morning from 0900 h until approximately 1145 h shortly before the lizards' basking period started to end. The two observers each counted 150 trees using a digitometer; the total of 300 was a compromise between finding mopane stands of adequate size and a sufficient number of trees yielding lizards. In practice, counts at the sites included the same trees since the same path was followed on each occasion. Basking lizards were first sighted from a distance of 10-20 m before reacting to the movement or other disturbance of the observer. Total cloud cover on one occasion reduced basking to zero and the count was ignored. The number of trees occupied by lizards before and after treatment was recorded in respectively seven and single sites in Omay and Siabuwa. Treatment took place at most sites on different dates and so counts during site visits took place a variable number of days after treatment.

Sighting rate reflected density, and provided relative density as a measure for comparing populations in this investigation. This obviated the need for a mark capture-recapture exercise. Furthermore, over a short term study the lizards could have been killed, damaged (some also losing tails), or simply put under stress through handling during the process of capture, resulting in corresponding adjustments in their behaviour. Marking lizards was not in any case considered necessary since it was possible to recognize the same lizards occupying trees when similar survey paths were traced. The possibility of immigration or reoccupation of territories by other lizards unexposed to treatment was precluded by the time scale of the investigation and the generally poor ability of lizards to traverse great distances, or

indeed by the need in low density populations with a large choice of trees in extensive areas of woodland for them to do so. Should the lizards have been affected by treatment, then recolonization would have taken place over a period of seasons or years (Massot et al. 1992), not days, or even weeks. The substantial areas that supported 300 trees in each of the seven sites selected also overcame variation between them.

## RESULTS AND DISCUSSION

Qualitative surveys yielded a characteristic array of mopane woodland lizards (Table 1). Most species are widespread in eastern and southern Africa, but *Lygodactylus chobiensis*, a larger species than *Lygodactylus capensis*, is typical of the Zambezi Valley, with a relatively restricted range from the Okavango Basin in Botswana to Tete in Mozambique, and spreading to the Zimbabwe Plateau and adjacent Zambia (Branch 1988).

There was no significant difference in species composition before and after treatment with deltamethrin (Table 1).

**Table 1.** Species composition (%) at seven study sites and treatment with deltamethrin. Numbers of lizards counted at sites before and after treatment ranged respectively from 4-72 and 5-171.

Species	Deltamethrin treatment			
	Before		After	
	Mean	Range	Mean	Range
<i>Mabuya striata wahlbergii</i>	89	78-100	87	69-100
<i>Lygodactylus chobiensis</i>	7	0- 17	8	0- 31
Others <sup>a</sup>	4	0- 11	5	0- 29

<sup>a</sup>*Lygodactylus capensis*, *Agama aculeata*, *Mabuya varia varia*, *Mabuya quinquetaeniata margaritifera* (on rocks at one site)

The relative density (abundance) of lizards was not influenced by treatment with deltamethrin. There was intersite variation, but cumulative sighting rates in Sites 2, 5 and 7 for all lizards before and after spraying were respectively 13.7 and 10.3, 11.4 and 8.5 and 5.8 and 10.5 per count-h; for *M. s. wahlbergii* 13.7 and 7.1, 11.4 and 6.9 and 3.9 and 7.5 per count-h, and for *L. chobiensis* 0 and 3.2, 0 and 1.7 and 1.9 and 0 per count-h.

Occupied trees invariably supported single lizards. Counts of those with *M. s. wahlbergii* in each of the

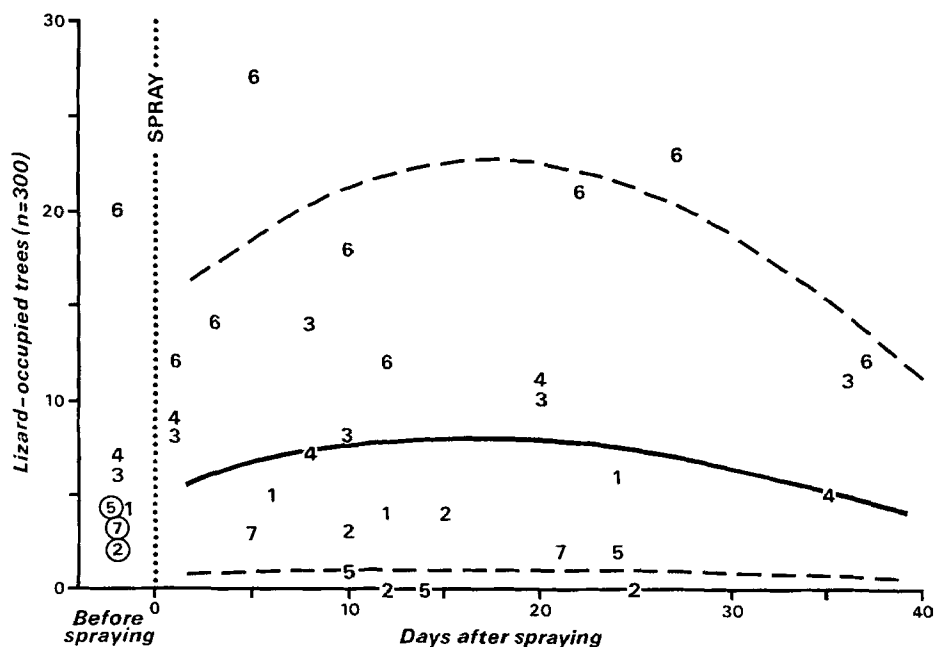


Figure 1. Trees ( $n = 300$ ) occupied by *Mabuya striata wahlbergii* and deltamethrin treatment in Omay. Sites (numbers correspond to site number) were treated between 4 and 19 July 1990. Mean values before spraying (encircled), and mean (solid line), minimum (Site 5) and maximum (Site 6) quadratic regressions (interrupted lines) after spraying are shown.

seven sites were made before deltamethrin spraying had taken place and for up to 39 days afterwards (Fig. 1).

Numbers did not decrease significantly after deltamethrin treatment. Regression slope intercepts indicated that site counts were significantly different from each other ( $\chi^2 = 188.9$ , 6 d.f.,  $P < 0.001$ ). In relation to time in days ( $x$ ), post-treatment counts ( $y$ ) at sites were found to best-fit a curvilinear (quadratic) relationship, which was significantly different from a linear one ( $\chi^2 = 4.25$ ,  $P < 0.05$ ). The quadratic regression for the site with the highest counts (Site 6) was  $y = -2.51 - 0.006x - 0.0011(x - 20)^2$  (Fig. 1). Intercept values in descending order for the remaining Sites 3, 4, 1, 7, 2 and 5, were respectively -3.08, -3.31, -3.35, -3.97, -4.99 and -5.55 (mean -3.82).

Further counts of 150 trees were made at the Siabuwa site in relation to deltamethrin ground-spraying. Two, and on one occasion three, pairs of consecutive counts were made during each visit one day and one hour before, and 1, 2, 14, 32 and 45 days after

treatment, but were not significantly different. The trend for trees with lizards to increase after spraying, from a mean of 1.75 (SD 0.96) at day one to 5.25 (SD 0.96) at day 45, was not significant, nor were within-day correlations between counts and air temperature.

Most of the lizard species observed in NW Zimbabwe are widespread in eastern and southern Africa and none is presently threatened with extinction. Only *L. chobiensis*, a species characteristic of the Zambezi Valley, has a relatively limited range, but is numerically abundant in largely undeveloped woodland habitat and is unlikely to be endangered by the selective ground-spraying of insecticides.

*Mabuya s. wahlbergii* is an adaptable lizard, frequently seen near human habitation within the vicinity of trees, and was the predominant species observed in mopane woodland during daylight hours. Populations were shown, however, to decline with DDT ground-spraying (Lambert 1993), but surveys in this work indicated that a single application of deltamethrin did not cause a decrease in the lizard's numbers for up to 45 days after treatment. The short term increase in counts of occupied trees over about a month following ground-spraying suggested that the behavior of the species may have been disturbed in some way. Parallel invertebrate surveys on deltamethrin-sprayed mopane trunks recorded a decline in the number of some species (Lambert et al. 1991), and the sighting of greater numbers of lizards basking may have been related to the need to warm-up before hunting actively for less readily available prey.

The half-life of deltamethrin is short and effects on invertebrates do not last. The decline in invertebrates fed upon by lizards is only short term (Lambert et al. 1991), and with rapid recovery lizard numbers (number of trees with lizards) decline again when probably the need to warm up preparatory to hunting for scarce prey is over. Deltamethrin is not persistent in food chains or the environment generally (IPCS 1990), and thus any long term effect on lizards directly, or indirectly through an effect on their invertebrate prey, was unlikely.

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