Effects of DDT treatments applied for tsetse fly control on White-headed Black Chat (Thamnolaea arnoti) populations in Zimbabwe. Part II: cause of decline

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Food supply, breeding success and DDT residue accumulation were investigated as possible causes for the decline of White-headed Black Chat populations in woodland sprayed for tsetse fly control. Gut contents from 21 birds were examined. A variety of invertebrates had been eaten, but ants, especially Camponotus spp. (Formicidae: Formicinae), Pheidole spp. (Myrmicinae), and termites, especially Odontotermes spp. (Isoptera: Termitidae), predominated in the dry season. In the early rains, more beetles (Coleoptera (predominantly Curculionidae)) and fewer termites were eaten. Ant and termite activity at sprayed sites in the study area was as great as or greater than that at unsprayed sites. Ants (Camponotus spp.) from sprayed sites held mean residue levels of 8.71 μg g⁻¹ dry weight (max. 218 μg g⁻¹ dry weight) total DDT, of which 67% was unaltered DDT. Termites and beetles had mean residue levels of 3.32 μg g⁻¹ dry weight (max. 14 μg g⁻¹ dry weight) and 0.92 μg g⁻¹ dry weight (max. 8 μg g⁻¹ dry weight) total DDT, of which 44% and 37% was unaltered DDT, respectively. Fledging success of White-headed Black Chats in adjacent sprayed and unsprayed areas was similar. Residues of DDT, DDD and DDE were found in all 23 chat carcasses examined. Birds collected in the dry season (July) from an area sprayed one month before contained up to 2206 μg DDT, 367 μg DDD and 578 μg DDE, g⁻¹ extractable lipid (86, 17 and 27 μg g⁻¹ dry weight, respectively). On average, residue levels were 50 times higher than in birds from the unsprayed area, and 4 times higher than in birds taken from another, recently sprayed area in the early rains (November). It is concluded that DDT spraying did not reduce availability of prey or fledging success. Initial population decline in sprayed areas was due to a lethal accumulation of DDT residues from prey, especially Camponotus spp. ants. Possible reasons for continued decline for 2–3 years after spraying, are discussed.

Keywords: DDT; Thamnolaea arnoti; population decline; prey contamination; residue burdens

Introduction

Ground-spraying operations to control tsetse flies (Glossina spp.) with residual deposits of DDT in NW Zimbabwe were followed by decline of White-headed Black Chat (Thamnolaea arnoti) populations. No dead birds were found during the study, but

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numbers fell gradually for 2–3 years after a single spray treatment. Emigration alone could not explain these changes (Douthwaite, 1992).

Local population decline in the American Robin, *Turdus migratorius*, following control of Dutch Elm disease was attributed to lethal accumulation of DDT residues from contaminated earthworms (Barker, 1958; Mehner and Wallace, 1959). Over 90 bird species, including ground feeders, bark foragers, foliage gleaners, bud eaters and predatory birds were killed by these operations, suggesting widespread environmental contamination, but dead birds rarely contain food items and the critical food chains were not identified (Wallace *et al.*, 1961). Direct exposure was discounted as the source of residues found in birds from orchards treated with DDT, and the death of Blackbirds *Turdus merula* and Song Thrushes *T. philomelos* was again attributed to contaminated earthworm prey (Bailey *et al.*, 1970; 1974). Eggshell thinning and behavioural changes due to residues of DDT and its metabolites (Risebrough, 1986) have not been detected by field studies in songbirds.

This paper reports investigations into the effects of DDT on arthropod prey, breeding success and adult survival of White-Headed Black Chat in northwestern Zimbabwe, aimed at determining the cause of the population decline.

**The study area**

The study was located in 400 km² of the Siabuwa Communal Area, Binga District, NW Zimbabwe, at an altitude of 600–800 m above mean sea level (see Fig. 2 of Douthwaite, 1992). Soils in the study area are derived from Karroo sandstones and are generally shallow, tending to be deeper and sandier on the topslopes, shallow and rocky on the midslopes and clayey on the bottomslopes. Botanically, the area is characterized by a patchy cover of grasses, herbaceous and shrubby plants in low, often open woodland dominated by mopane, *Colophospermum mopane* (Kirk ex Benth.) Kirk ex J. Leonard, *Julbernardia globiflora* (Benth.) Troupin, *Combretum* spp., or a mixture of these trees. The vegetation is broadly similar across the whole area, but varies locally, with soil depth and texture. *Julbernardia* woodland is more extensive, and combretaceous-mopane woodland less, at the northern, sprayed end of the study area than in the south.

The summer rains are short and erratic (November/December to March/April), averaging around 660 mm per annum. Temperatures are in the range 20–40 °C daily in the hottest months (November and December), and in the range 10–32 °C daily in the coolest (June and July).

**Methods**

**Diet**

The diet of birds collected in the dry, winter season and warm, early, wet season was examined. Thirteen birds were shot at Siabuwa in July 1987 and another ten in Omay in November 1989. The first batch included eight birds from an unsprayed area and five birds from areas treated three or four times with DDT, most recently a month before. The second batch, collected in the breeding season, included five birds from an area treated twice, 14 and two months earlier, and five birds from an area treated once, 14 months before.