CONSERVATION
TE PAPA ATAWHAI

CONSERVATION ADVISORY SCIENCE NOTES

No. 33

A REVIEW OF THE EFFECTS OF PESTICIDES ON LIZARDS

(Short Answers in Conservation Science)

This report is published by Head Office, Department of Conservation, and presents the results of scientific services or advice purchased from a consultant outside the Department or provided by Departmental scientific staff. All enquiries should be addressed to the CAS Coordinator, S&R Division.

Department of Conservation, P 0 Box 10-420, Wellington, New Zealand

ISSN 1171-9834

Reference to material in this report should be cited thus:

Spurr, E.B., 1993.
A review of the effects of pesticides on lizards.
Conservation Advisory Science Notes No. 33, Department of Conservation, Wellington. 4p.

Commissioned by: Otago Conservancy.
Location: NZMS

A REVIEW OF THE EFFECTS OF PESTICIDES ON LIZARDS

E.B. Spurr
Manaaki Whenua - Landcare Research, P.O. Box 31-011, Christchurch, New Zealand

INTRODUCTION

It has been suggested that rabbit control operations using sodium monofluoroacetate (1080) may be implicated, directly or indirectly, in the decline of the "giant" skinks, *Leiolopisma otagense* and *L. grande,* in Central Otago (Whitaker 1984, 1985, Whitaker & Loh 1991). Possible impacts on lizards include direct poisoning from eating (or licking) poisoned bait and secondary poisoning from eating dead, dying, or disorientated insects containing 1080. Poisoning could impair movement making lizards more vulnerable to death from other causes such as heat stress or predation. Sub-lethal doses could detrimentally affect reproductive performance. Other possible indirect effects include starvation, if large numbers of invertebrates are killed by poisoning, and increased predation if ferrets and feral cats switch diet after the removal of rabbits. Older poisons such as strychnine, and newer poisons such as the anticoagulant brodifacoum, may affect lizards in the same way as 1080.

OBJECTIVE

To review existing knowledge on the palatability of baits to lizards and on the effects of poisons on lizard survival.

METHODS

The literature cited in BIOSIS Previews from 1969-1993 was searched by a computer data retrieval system using codes for pest control, toxicology, and reptiles. Whitaker & Thomas (1989) and reference lists in the back of identified references were also checked.

RESULTS

The computer search identified literature on the effects of 1080, strychnine, anticoagulants, and insecticides on reptiles. Insecticides are included in this review because they may have an impact on lizards in some parts of New Zealand if not in Central Otago.

Baits

Whitaker (1984, 1985) stated that New Zealand lizards are unlikely to eat carrot, pollard, or grain baits containing pesticides. However, several species of lizards in Australia have been observed eating carrot bait intended for rabbits (McIlroy *et al.* 1985). Telfair's skinks on Round Island, Mauritius, picked up and carried away pieces of raw carrot bait, and were attracted to small insects that were eating raw oat baits (Merton 1987). They showed only a passing interest in fresh pollard/bran pellet baits but ate rain-softened ones.

New Zealand geckos and skinks naturally eat soft fruit, and geckos also eat nectar and honeydew (Whitaker 1987). Several species also eat canned fruit, especially pear (Whitaker 1967, Patterson 1992). Captive geckos and skinks eat soft fruit and other sweet foods such as honey and syrups (Whitaker 1967). Whitaker (1985) considered that jam-based baits (or pastes) used for some rabbit poisoning operations would be eaten by both geckos and skinks.

Sodium monofluoroacetate (1080)

The acute LD_{50}'s for five species of Australian lizards range from 43.6 to 543.2 mg1kg (McIlroy et al. 1985, McIlroy 1986, 1992). The lizards tested were generally more tolerant to 1080 than were most other animals tested, took a long time to show signs of poisoning, a long time to die, and would need to eat vast quantities of poisoned bait to receive a lethal dose of 1080. McIlroy et al. concluded that lizards are unlikely to face any direct risk from pest-poisoning operations using 1080, although they may be more vulnerable to physiological stress and predation if they ate sub-lethal quantities of 1080.

Insectivorous and predatory lizards are potentially at risk from secondary poisoning if they eat insects that have eaten poisoned baits. However, McIlroy (1992) calculated that even if lizards fed entirely on insects or other animals poisoned with 1080 they could never ingest enough poison to receive a lethal dose. The only data on (failed) secondary poisoning in reptiles relate to snakes. Gopher snakes fed rodents poisoned with 1080 often regurgitated the rodents but showed no other response (Brock 1965). Also, three species of snakes showed no signs of secondary poisoning after eating rodents poisoned with fluoroacetamide (1081), a poison related to 1080 (Braverman 1979).

Strychnine

There are no published LD_{50} data on acute toxicity of strychnine to reptiles. However, bullfrogs are much more sensitive to strychnine than to 1080 (LD_{50} 2.21 cf. 54.4; Tucker & Crabtree 1970). The only reference on secondary poisoning in reptiles reports that five out of 12 gopher snakes died after being fed rodents poisoned with strychnine (Brock 1965).

Anticoagulants

There are no published LD_{50} data on acute toxicity of anticoagulants to reptiles. However, during the eradication of rabbits from Round Island, Mauritius, skinks were observed eating rain-softened Talon® 20P pellet baits and those later found dead contained residues of brodifacoum, the active ingredient in Talon® 20P (Merton 1987). Despite the death of more than 100 individuals, skinks remained abundant on the island. Aerially sown Talon® 20P for the eradication of rats and rabbits did not appear to reduce lizard numbers on Stanley Island (Towns & McFadden 1991).

Insectivorous and predatory lizards are potentially at risk of secondary poisoning from use of anticoagulants (Merton 1987). However, there are no known reports of secondary poisoning in lizards. The only report on secondary poisoning in reptiles concerns gopher snakes, which showed no reaction to consuming rodents poisoned with three first generation anticoagulants, Warfarin, Diphacin, or Prolin (Brock 1965).

Reptiles have a distinct blood coagulation chemistry to that of mammals (Merton 1987). Most of the skinks containing brodifacoum residues on Round Island did not have internal haemorrhaging, prompting Merton to suggest that brodifacoum inhibited regulation of body temperature rather than blood coagulation in these animals, causing them to die from over-heating when exposed to high ambient temperatures.

Insecticides

Hall (1980) reviewed several studies showing deaths of lizards and other reptiles following use of organochlorine pesticides, especially DDT, Dieldrin, Endrin, and Heptachlor. Reptiles have been reported to be more sensitive to the effects of these pesticides than are birds and mammals. However, although dying on lower doses reptiles generally took longer to die than other animals. There is one report of widespread mortality in two lizard populations following application of Heptachlor (Hall 1980).

Reports not reviewed by Hall (1980) include the finding of residues of DDT and other organochlorines in Australian lizards (Best 1973, Birks & Olsen 1987) and the death of

Australian lizards following the spraying of chlordane for termite control (Henle 1988). DDT and other insecticide residues have been found in many New Zealand birds and mammals but lizards have not been tested (Lock & Solly 1976). House-dwelling lizards in Ivory Coast were found to contain residues of endosulfan after a spraying campaign against human sleeping sickness but no measurable changes in populations were observed (Evert *et al.* 1983). Hall & Clark (1982) reported the deaths of iguanid lizards in the USA from four organophosphate pesticides, parathion, methyl parathion, azinphos-methyl, and malathion, and calculated that the LD_{50}'s were similar to those of birds and mammals. Aminocarb, a carbamate used to control spruce budworm in Canada, reduced the activity of snakes, probably as a consequence of reduced invertebrate prey availability (Bracher & Bider 1982).

CONCLUSIONS

There is little information available on the susceptibility of lizards or other reptiles to pesticides. However, Hall (1980) noted that reports of reptilian mortality following pesticide applications are numerous enough to establish the sensitivity of reptiles to these chemicals.

Lizards in some countries eat carrot and pollard baits similar to those used in pest control operations in New Zealand. However, no information is available on the palatability or acceptability of these baits to New Zealand lizards.

Lizards are among the animals most tolerant to 1080, and are unlikely to be directly or secondarily killed by 1080 in pest control operations. However, there is no information on the potential sub-lethal effects of 1080 on lizards, on the effects of 1080 on the invertebrate food supply of lizards, or on the effects of 1080 on predators of lizards.

Insufficient is known about the toxicity of strychnine or anticoagulants to lizards.

Lizards and other reptiles have been reported to be more sensitive to the effects of persistent insecticides than are birds and mammals. This apparent sensitivity may result from their low metabolic rate and resultant inability to quickly detoxify contaminants (Hall 1980).

Insecticides used for pasture and forest pest control may be a more serious direct threat to New Zealand lizards than are vertebrate pesticides.

REFERENCES

Best, S.M. 1973: Some organochlorine pesticide residues in wildlife of the Northern Territory, Australia, 1970-71. *Australian journal of biological sciences 26:* 1161-1170.

Birks, P.R.; Olsen, A.M. 1987: Pesticide concentrations in some South Australian birds and other fauna. *Transactions of the Royal Society of South Australia 111:* 67-77.

Bracher, G.A.; Bider, J.R. 1982: Changes in terrestrial animal activity of a forest community after application of aminocarb (Matacil®). *Canadian journal of zoology 60:* 1981-1997.

Braverman, Y. 1977: Experiments on direct and secondary poisoning by fluoroacetamide (1081) in wildlife and domestic carnivores. *Journal of wildlife diseases 15:* 319-325.

Brock, E.M. 1965: Toxicological feeding trials to evaluate the hazard of secondary poisoning to gopher snakes, *Pituophis catenifer. Copeia 1965 (2):* 244-245.

Everts, J.W.; van Frankenhuyzen, K.; Roman, B.; Cullen, J.; Copplestone, J.; Koeman, J.H. 1983: Observations on side effects of endosulfan used to control tsetse in a settlement area in connection with a campaign against human sleeping sickness in Ivory Coast. *Tropical Pest Management 29:* 177-182.

Hall, R.J. 1980: Effects of environmental contaminants on reptiles: a review. United States Department of the Interior, Fish and Wildlife Service, special scientific report - wildlife no. 228. Washington D.C., USA. 12 p.

Hall, R.J.; Clark, D.R. Jr 1982: Responses of the iguanid lizard *Anolis carolinensis* to four organophosphorus pesticides. *Environmental Pollution (Series A) 28:* 45-52.

Henle, K. 1988: Amphibian and reptile fatalities caused by chlordane spraying? *Victorian Naturalist 105:* 216-217.

Lock, J.W.; Solly, S.R.B. 1976: Organochlorine residues in New Zealand birds and mammals. 1. Pesticides. *New Zealand journal of science 19:* 43-51.

McIlroy, J.C. 1986: The sensitivity of Australian animals to 1080 poison. IX. Comparisons between the major groups of animals, and the potential danger non-target species face from 1080-poisoning campaigns. *Australian wildlife research 13:* 39-48.

McIlroy, J.C. 1992: Secondary poisoning hazards associated with 1080-treated carrot-baiting campaigns against rabbits, *Oryctolagus cuniculus. Wildlife research 19:* 629-641.

McIlroy, J.C.; King, D.R.; Oliver, A.J. 1985: The sensitivity of Australian animals to 1080 poison. VIII. Amphibians and reptiles. *Australian wildlife research 12:* 113-118.

Merton, D. 1987: Eradication of rabbits from Round Island, Mauritius: a conservation success story. *Dodo, journal of the Jersey wildlife preservation trust 24:* 19-44.

Patterson, G.B. 1992: Development of Otago skink and grand skink population census and monitoring techniques. Department of Conservation, Science & Research internal report no. 133. 23 p.

Towns, D.R.; McFadden, I. 1991: The use of Talon 20P and Talon 50WB against kiore (*Rattus exulans*) and rabbits on Stanley Island, Mercury Islands. Department of Conservation, contract report (unpublished). 6 p.

Tucker, R.K.; Crabtree, D.G. 1970: Handbook of toxicity of pesticides to wildlife. United States Department of the Interior, Fish and Wildlife Service, Resource Publication No. 84. 131 p.

Whitaker, A.H. 1967: Baiting pitfall traps for small lizards. *Herpetologica 23:* 309-310.

Whitaker, A.H. 1984: A survey of the lizards of the Lindis Pass area, Otago, 9-19 April 1984. New Zealand Wildlife Service report (unpublished). 26 p.

Whitaker, A.H. 1985: A survey of the lizards of the Mt Ida area, Otago, 12-22 March 1985. Otago 'giant' skink survey, no. 2. New Zealand Wildlife Service report (unpublished). 36 p.

Whitaker, A.H. 1987: The roles of lizards in New Zealand plant reproductive strategies. *New Zealand journal of botany 25:* 315-328.

Whitaker, A.H.; Loh, G. 1991: Species recovery plan for the Otago skink (*Leiolopisma otagense*) and the grand skink (*Leiolopisma grande*) 1991-1996. Department of Conservation, Wellington (unpublished draft). 36 p.

Whitaker, T.; Thomas, B. 1989: *New Zealand lizards: an annotated bibliography*. Department of Scientific and Industrial Research, Lower Hutt. 215 p.