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ABSTRACT: Control of rabbits, Oryctolagus cuniculus, by poisoned bait has been widely practiced in Australia and New Zealand for many years. Since the 1950s, Compound 1080 has been the active ingredient and yielded good results (ca 90% kills) when first used. Recent trails (1973-74) in New Zealand showed that the main reason for poor results obtained nowadays is the failure of many rabbits to eat bait. Recent trials in Western Australia showed that there has been a significant decline in effectiveness of rabbit control by baiting during the period 1958-1975. Shortcomings in operational technique and increased resistance to the poison 1080 were eliminated as being major possible causes of recent poor results. An increased incidence of neophobic behavior in rabbit populations as a result of artificial selection by poison baiting is suggested as the most likely explanation of our findings.

INTRODUCTION

Control of rabbits, Oryctolagus cuniculus, by bait poisoned with 1080 has been widely and continuously practiced in Australia and New Zealand from the 1950s to the present time. When this method was first introduced, the level of control was regarded as acceptable as population reductions were of the order of 90%. The capacity of the European rabbit for resurgence following control is such that reductions of substantially less than this are of marginal economic and practical value.

In the 1970s, complaints of failure of rabbit-poisoning operations in the Central Otago district of New Zealand prompted investigations into the various possible causes of failure. The main cause was identified and is reported in this paper.

Concurrently, in Western Australia the effectiveness of bait poisoned with 1080 was being compared with an alternate toxin. In the course of this study, it became apparent that 1080 baiting was less successful than it had been when it was first used.

Results from the relevant parts of these New Zealand and Australian studies are the basis of this paper and are presented here as they suggest the development of an important problem common to both countries. It is a problem which is likely to have general relevance to the field of vertebrate pest control.

METHODS

In Central Otago, New Zealand, rabbits have traditionally been controlled by aerial distribution of several unpoisoned prefeeds of chopped carrot followed by a distribution of the same material poisoned with 1080. In the investigation of poor bait acceptance as a possible cause of failure, other likely causes of failure such as inadequate quantity and distribution of bait were actively eliminated. Bait was spread evenly and in excessive quantities.

The trials were also carried out under conditions favorable to success when natural foods were in short supply and rabbits were including bark in their diet, an item of very low preference. The unpoisoned prefeeds were treated with Rhodamine B at 0.025% which is sufficient to stain the mouth parts of rabbits feeding upon it without affecting the acceptability of the carrot. The poisoned bait was not treated with rhodamine. Following each of the two poisoning operations carried out in this way, a sample of carcasses of poisoned rabbits was collected and a sample of unpoisoned survivors was shot. The mouth parts of all rabbits were examined under ultraviolet light for traces of fluorescing rhodamine to determine which animals had consumed prefed carrot.

In southwestern Australia, the bait under test was that known as "one shot" 1080 oats which has been in use since 1958. This bait is a combination of 99% unpoisoned oats with 1% of oats which have been vacuum-impregnated with 1080 solution and dried. Each poisoned oat contains about 4.5 mg 1080, about three times the lethal dose for an adult rabbit. The mixture is laid in one operation and was originally developed to reduce the operational costs of rabbit control without sacrificing effectiveness. It has performed well in the dry summer conditions of Western Australia for which it was developed.

During the period 1958-62, 170 trails were carried out to measure the effectiveness of "one shot." In the period 1971-75, 25 trials of "one shot" were carried out. The results of these two sets of trials were compared. Each trial was a field control operation in which indices of rabbit population size were determined in a standard manner before and after the baiting operation (Oliver, Wheeler and Gooding, 1982, in press). The data used in making comparisons are the percentage change in population index from each trial. These are termed for convenience "% kills" and arcsine transformed to allow statistical comparison between sets of trials. Twenty-five null trials in which the bait contained no poison were carried out in association with treatments.

RESULTS

The results from the New Zealand trials are shown in Table 1. It is clear from these data that nearly all rabbits which survived baiting operations did not consume carrot at all, while very few individuals which took poisoned carrot had not accepted carrot at some time during the feeding period.

Table 1. Consumption of prefed carrot bait by rabbits: Central Otago, New Zealand.

	Poisoned Rabbits		Survivors		
Trial	R+	R-	R+	R-	% Kill
SJ6	242	0	3	60	75
SJ7	276	9	0	99	33-49*

Legend: R+ = rhodamine stained mouth parts, R- = unstained.
*Range of kills from parts of trial area.

Figure 1 compares results of rabbit-poisoning trials carried out in Western Australia around 1973 with those from around 1960. The decrease in effectiveness over this period is clearly significant. The most rigorous comparison is lc as it includes only those trials carried out in February and March by the only operator (LAH) who was common to both the earlier and later sets of trials. The season February-March is optimal for rabbit control using "one shot" 1080 oats and is the time of year when variability in results is at its lowest. This comparison (lc) reflects the differences between the two sets of trials as a whole.

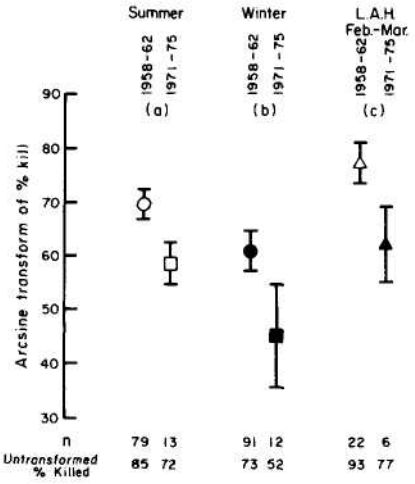

Fig. 1. Comparison of results of field trials of "One shot" 1080 oats for rabbit control in W. Australia: 1958-62 versus 1971-75.

The mean change in index of abundance for the 25 null trials was -6.4% which is not significantly different from zero.

DISCUSSION

There are several likely explanations for the major decline in overall effectiveness observed in our results: a change in operational technique leading to inadequate bait quantity and placement, a decline in bait toxicity at the preparation stage, an increase in tolerance of rabbits to 1080, an increasing reluctance to accept a specific bait material or a more general shift in the behavioral response of rabbits to unfamiliar material in their environment.

Of these possibilities, shortcomings arising from technique and bait formulation were deliberately eliminated (as described under METHODS) and by measured quality control. Increase in genetic resistance to 1080 over the period 1958-75 can be rejected as the results of Gooding (unpubl. 1955), Lazarus (1956) and Meldrum et al. (1957) for Australian wild rabbits show LD values marginally higher than those obtained by Wheeler and Hart in 1977 using rabbits from an area where 1080 bait has been regularly used for over 20 years (Wheeler and Hart 1979). The possibility of a minor change in susceptibility of rabbits to 1080 has not been eliminated; but, if any such change has occurred, it has not been of sufficient magnitude to account for our results.

The possibility of specific rejection of carrot as bait material was investigated by testing acceptance of a range of alternatives in the field in New Zealand. Failure to accept bait was found to be general and was not confined to rejection of carrot.

Studies of the European rabbit in enclosures by earlier workers in Australia (Carrick 1957; Rowley 1957, 1958, 1963; Poole 1963) showed that rabbits varied greatly in their readiness to accept bait placed in their territories. Some individual rabbits were observed to persistently avoid bait and thus survive poisoning.

These early observations suggested to us that there is a basis upon which selection for bait avoidance by rabbits may operate. The persistent application of a high level of selection pressure has been provided by control programs for over 20 years.

We believe there has been an increase in the level of neophobic response in rabbit populations in Australia and New Zealand and that this is the most likely explanation of our results. We use the term "neophobic" in the sense of Barnett (1958): the avoidance of an unfamiliar object in a familiar place. Whereas we recognize that levels of neophobia per se have not been quantitatively measured in rabbit populations at any time, we feel that our evidence is sufficiently weighty to be brought to the attention of those concerned with the science and practice of vertebrate pest control.

Selection for behavioral traits which diminish the effectiveness of control methods may not be conspicuous or easy to measure. It is a less well-recognized problem than selection for genetic resistance to pesticides but may deserve greater attention than it has hitherto received.

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