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RABBIT BEHAVIOUR RESEARCH IN AUSTRALIA AND ITS RELEVANCE IN CONTROL OPERATIONS

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ABSTRACT: Research in Australia on the behaviour of wild rabbits has provided a basis for improvements in the tactics and strategy of control.

As the warren is a central focus for growth and survival of a population, a program for effective control or eradication should aim at making the warren unavailable to rabbits.

Enclosure studies of behaviour suggested that poisoning would be much more effective when carried out in the non-breeding season. This has been confirmed in field trials.

The behavioural importance of the odour-producing inguinal, submandibular, and anal glands is emphasized. It is suggested that further studies of these glands may provide insights for the development of repellents or attractants.

The European rabbit, Oryctolagus cuniculus, a burrowing lagomorph, has been well established in Australia as a major pest species for about 100 years (Ratcliffe 1959). It has spread throughout much of the southern third of the continent and has caused great financial loss by competing with livestock for pasture, by damaging agricultural crops, and by permanent destruction of pasture, particularly in arid rangelands. Conversely on holdings where effective control or eradication has been achieved there have been large increases in productivity (Fennessy 1966).

In this paper we draw attention to some research findings about wild rabbits, particularly on behaviour, which have direct relevance to control of populations. These results have come from a major program of investigation into the biology of wild rabbits started in 1949 by the Division of Wildlife Research of the Australian Government's research organization, the CSIRO (Commonwealth Scientific and Industrial Research Organization). Some of the findings have formed the basis for changes in the tactics and strategy of rabbit control and have led to substantially better control.

A most important but often unexploited value of this information on the biology of rabbits is that it may be used to counter folk-lore and misconceptions which have often frustrated attempts by governmental pest control organizations to encourage higher standards of rabbit control. The availability of soundly based biological information can give greater confidence to these organizations in the training of their staff, and subsequently to the field staff in their extension work with landholders.

In the late 1940's despite the expenditure of much money in attempted eradication through the use of poison, traps, and the destruction of warrens, rabbit numbers were very high on many holdings. In 1950 the introduction of the insect-borne disease myxomatosis started a new era in control (Fenner and Ratcliffe 1965). After the disease developed an epidemic spread there was a dramatic decline in the rabbit population over much of the infested area, and as a consequence major increases occurred in agricultural production, especially in the wool industry (Reid 1953).

However, it soon became obvious that although the disease had become endemic it would not provide a complete answer to the rabbit problem. This was because biological adjustments were occurring between the virus and the rabbit host upon which, in Australia, it was impinging for the first time. It became necessary to learn a lot more about the biology and ecology of the rabbit to pave the way for the improvement of other methods of control to supplement the results obtained through myxomatosis.

Studies of populations in a wide range of environments have provided data about the effects on the size of populations of factors ranging from climate to disease (Myers 1970). Hence there is a better basis for integrating man-imposed controls, such as poisoning, with those operating naturally. There is also a better basis for consideration of deliberate manipulation of natural factors, e.g., by introduction into rabbit populations in Australia of internal parasites which do not occur there at present.

In some arid areas the major importance of definable refuge areas has been shown (Myers and Parker 1965). During major droughts they harbour the remnant population from which resurgency occurs when the drought breaks. The strategic, concentrated application of control measures in these refuge areas during drought when populations are low could lead to long-term effective control, at realistic cost, over wide areas of country.

The field studies have highlighted the importance of the residual populations which survive after some control procedures. It is now clear that much control work in the past has been a poor investment because the level of control was not high enough or because insufficient follow-up work was done to deal with those rabbits which survived the initial attack on a population (Rowley 1968).

The prime importance of the warren as a shelter and as a focus for population growth has been demonstrated. In addition it has been found that rabbits are less nomadic than was thought previously, and are strongly gregarious, associating closely around their warrens. This behaviour is now much better understood as a result of long-term studies of tagged populations (Mykytowycz and Fullagar 1973). These findings point to the value of destruction of warrens in control operations as emphasized by Bromell (1973).

The information on the rabbits' relatively sedentary way of living has provided an incentive to government departments which supervise control efforts by landholders, to promote and implement projects designed to make large conglomerations of holdings completely free of rabbits. Where such projects have been successfully carried out, e.g., in parts of the Bathurst and Wagga Wagga districts in New South Wales, there has been a dramatic decline in the long-term cost of control effort, and in the risk of damage being caused by rabbits to individual properties (Bruce 1969).

The efficiency of the technique of poisoning has been improved as the result of studies of behaviour of rabbits in large enclosures under quasi-natural conditions. It has been found that, generally speaking, each community of rabbits does all its breeding, feeding, and foraging within boundaries that are recognized by neighbouring social entities (Mykytowycz 1960; Myers and Poole 1961). Unless a ground furrow in which poison bait is laid traverses each group's territory, entire communities will not have a chance of eating poisoned bait.

However, it is only during the breeding season that territories are strictly maintained. During summer, when breeding stops, the territorial boundaries are much less rigid, and rabbits roam and reconnoitre more, and so there is a much greater likelihood that they will chance upon a poison furrow.

If poisoning is done while the rabbits are breeding, kitten rabbits which are still too young to feed on poison baits may survive (Poole 1963) and they will provide nuclei for resurgence of the population.

All this leads to the practical recommendation that poisoning should be carried out at a time when rabbits are not breeding. Where this suggestion has been followed, substantially better results have been obtained, and consequently in the long-term there is less need for repetitive poisoning, and its associated hazards are thus reduced.

A technique of poisoning called "Tarbaby" was developed as a result of detailed observations on the grooming behaviour of rabbits. Poison 1080 (sodium fluoroacetate) is mixed with a sticky material and the mixture is placed on the floor of the opening to a rabbit burrow. The rabbits are poisoned as a consequence of licking the sticky poison material from their feet.

Although the technique is useful under some conditions (Hale and Myers 1970) various factors were found to militate against its general application (Ryan and Murray 1973). For example, in densely populated warrens the first rabbits to use the treated entrances sometimes removed all the poison mixture, and hence rabbits which came later were not poisoned. In sandy soils the passage of only one rabbit through a burrow opening was often sufficient to cause the poison mixture to be buried. Some warrens remained undetected and hence untreated. In warrens where treatment of one or more openings was accidentally omitted, rabbits used the untreated openings to avoid stepping in the poison mixture in the treated openings. As the warrens are not destroyed when this technique is used they remain available for reinfestation by rabbits which survive the poisoning or move in from adjacent untreated warrens.

A proposal for another technique of poisoning has been based on the appetite of rabbits for salt in some areas of Australia. In the subalpine areas during spring and early summer pastures have a very low sodium content. If rabbits are presented at this time with soft, sooden pegs impregnated with salts, particularly sodium chloride and sodium bicarbonate, they chew them avidly (Myers 1967). The incorporation of poison into the pegs may provide a control method. The practical application of this technique has not been fully assessed as yet.

We have referred several times to the behaviour of rabbits in relation to their warrens. In our work we have been especially interested in the way in which this warren-centred behaviour is affected by secretions from odour-producing glands.

The role of odour in the life of animals has recently attracted a lot of attention amongst biologists (Mykytowycz 1970; Schultz and Tapp 1973). An example of its importance is the blocking of pregnancy in a mouse exposed to the smell of a strange male (Bruce 1960).

It seems that rabbits, and indeed other species, live and reproduce successfully only within a space where their own or a familiar odour prevails (Mykytowycz 1973). The deposition of their own odour is the first action of animals entering new ground. This is usually referred to as territorial-marking, although space-marking would be a more appropriate term.

The main sources of odour in the rabbit are the inguinal, submandibular (or chin), and anal glands. The secretory activity of these glands varies, and is significantly correlated with the behavioural status of the animal within its social entity.

The chin and anal glands are definitely involved in space marking. The anal gland is the source of the characteristic rabbitty odour of the dung pellets. Dung hills, which are commonly found in the space occupied by rabbits, are equivalent to marking posts or communication centres characteristic of many species.

Within the space where a rabbit's own or a familiar odour prevails, the animal moves and feeds freely and dominates an individual for which the same odour is novel. This has been demonstrated repeatedly in laboratory experiments. In each test two rabbits, strangers to one another, were introduced into a neutral pen. At the same time an odour familiar to only one of them was also placed in the pen. The source of the odour was urine or the secretion from the anal, chin, or inguinal gland from that rabbit or members of its own group. If the odour was from the chin or anal gland the rabbit dominated in its behaviour the one for which these smells were foreign. Odour from inguinal glands and urine did not produce this result (Mykytowycz 1973).

If we knew a lot more about the effect of odour on the behaviour of rabbits we might be in a better position to develop repellents so that the space which rabbits occupy could be made less attractive to them. Conversely we would have a better background for the development of attractants to make poisoning more effective by increasing the numbers of rabbits which find and feed from poisoned bait.

The task is complicated by the fact that in a given rabbit population, as indeed in those of other higher animals, there is a range of behaviourally different individuals. Hence a particular stimulus in a given situation will not stimulate all individuals equally. Moreover, the same stimulus will not always influence the same individual in the same way. Reaction to a stimulus in a higher animal depends on may factors, such as age, sex, reproductive state, seasonal needs, nutritional state, social state, and presence or absence of other individuals.

A better understanding of the role of olfaction in rabbits should enable us to come to closer grips with the pest in some situations.

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