BREEDING SEASON AND FERTILITY OF THE WILD RABBIT, *ORYCTOLAGUS CUNICULUS* (L) IN NORTH CANTERBURY, NEW ZEALAND

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SUMMARY: Breeding season and fertility of *Oryctolagus cuniculus* (L) in North Canterbury, New Zealand, were determined from the dissection of 6692 rabbits between 1968 and 1970. The breeding season lasted for 243 days during spring, summer and early autumn. The seasonal fertility of the population was 29 young per female per season. This was higher than that found for rabbits in Hawke's Bay but no different from populations studied in Great Britain or Australia. The higher rate recorded in North Canterbury compared with Hawke's Bay is due to the longer breeding season and not to any change in litter size.

INTRODUCTION

The reproduction of the wild rabbit, *Oryctolagus cuniculus* (L), has been studied in Great Britain, Australia and New Zealand.

In New Zealand, rabbits in Hawke's Bay have shown greater fertility than the same species in Wales (Watson, 1957), a difference attributed to the near optimal conditions of climate and grass growth in Hawke's Bay. Watson (op. cit.) commented that in other areas of New Zealand, reproduction patterns could vary and suggested that more studies were needed to elucidate this aspect. Wodzicki and Darwin (1962) examined the reproductive differences between populations from different latitudes in New Zealand and found that they were not statistically significant. However, they intuitively believed that probably there was a difference in the length of the breeding season between North and South Island rabbit populations.

In Britain, several workers (Brambell, 1944, Lloyd, 1970, Mead-Briggs *et. al.*, 1975), described the varied seasonal pattern of reproduction and fertility at different geographic locations. Their studies indicated that variation was as great as in Australia.

In Australia, Poole (1960), Myers and Poole (1962) and Hughes and Rowley (1966) have shown that regional patterns of reproduction vary significantly both in magnitude and seasonal distribution. The net result of these differences is that populations in some areas produce 20-30 young per female per annum whereas populations in other areas produce about half as many. Myers and Poole (1962) were able to show conclusively that some areas of Australia had a potentially "explosive" rabbit problem and consequently an annual high mortality was required if population growth was to be suppressed. In other areas, characterized by populations with a low rate of increase, infrequent control efforts based on sound biological principles should be sufficient to maintain rabbit numbers at a low level.

Studies in Australia have shown that the onset and duration of the breeding season was important in the timing of control operations because, in order to gain maximum effect, poisoning operations had to be carried out during the non-breeding season. The aim of this study was to describe the breeding season in North Canterbury and compare it with other published data. If major regional differences existed in the length of the breeding season and fertility of the rabbit, the information would be useful in planning future appropriate control strategies.

STUDY AREA

Rabbits were collected from four Pest Destruction Boards (Fig. 1) located to the East of the Southern Alps (42°S, 172°E) of New Zealand. Collection sites were scattered throughout the 328 000 ha of well grazed pastoral land which comprised the Pahau, Waiau, Culverden and Amuri Boards. The study area received 360-790 mm rain per year and had monthly temperature minima and maxima of -7°C in July to 31°C in January and February. The rainfall during the study was approximately 30 percent below the average for the region.

METHODS

A total of 6692 rabbits was collected by pest board staff during routine control operations from 1968-

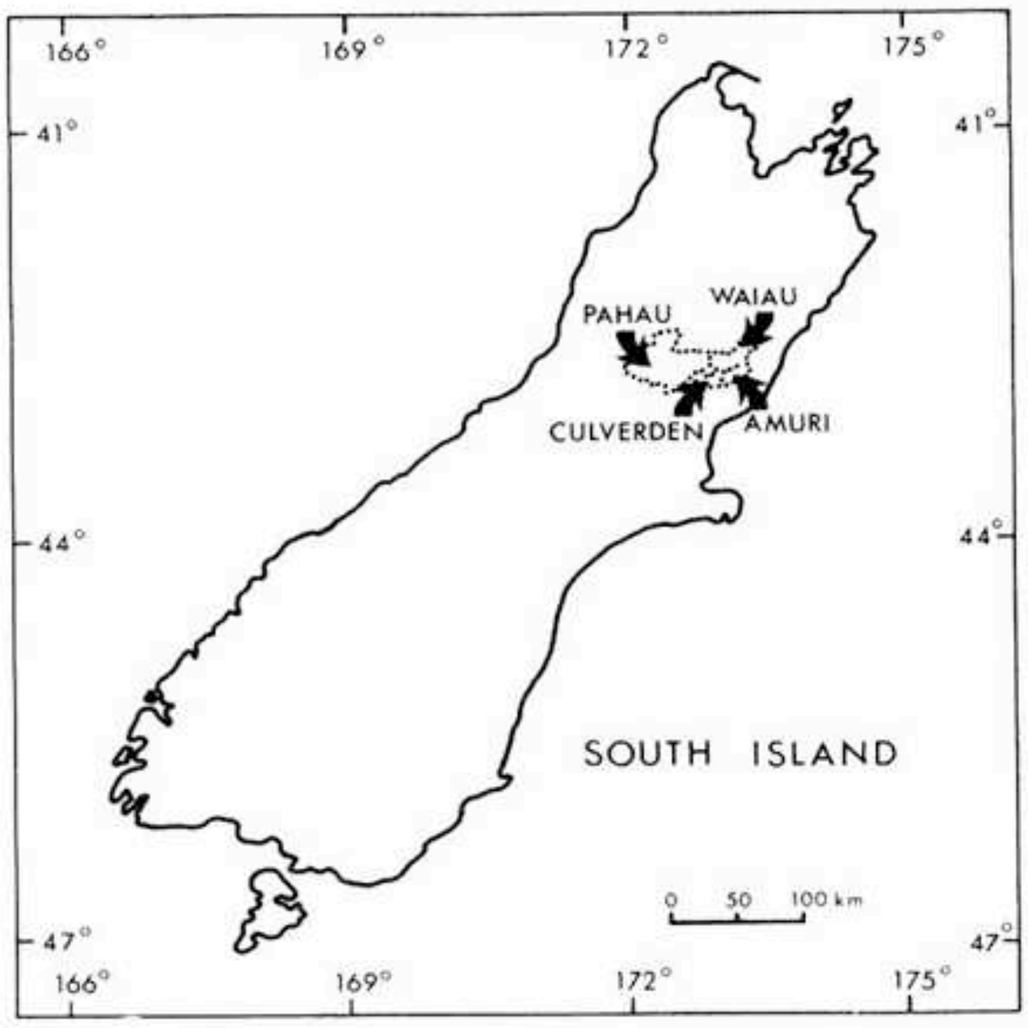

FIGURE 1. *The location of Pest Boards which provided rabbits for the survey.*

1970. The Amuri and Culverden Boards collected rabbits by both shooting at night and "gun and dog" operations. The Waiau and Pahau Boards used only night shooting to obtain their samples.

Rabbits were taken from areas of differing control history but all came from fairly light infestations. The infrequent and irregular nature of board control operations (one or two visits per location per annum) precluded obtaining regular samples of sufficient size from well-defined habitats.

Rabbit autopsies were carried out by board personnel. The reproductive condition of the males was assessed from the position of the testes VIZ either scrotal or abdominal and for females, the mammary glands were examined to see if milk could be expressed. Litter size was determined from the number of swellings in the uterine horns and the mean litter size for the monthly sample estimated. This was probably an overestimate because no allowance was made for foetal loss through the resorption of embryos.

The breeding season was defined as that period in which 50 percent of the females in the population were pregnant (Lloyd, 1963). The mean number of litters born to each female in any one season was calculated from the formula:— Mean number of litters = Average monthly proportion of females pregnant $\times$ total duration of season (days) / total duration of pregnancy (30 days).

The mean number of young born per female was calculated by multiplying the mean number of young per litter by the mean number of litters per season.

As the board boundaries are man-made rather than ecologically delineated, the material has been treated as one large sample. However, on occasions it has been necessary to extract data from individual boards for comparison with published data.

RESULTS

Breeding Season—Males

The testes of the male undergo a seasonal change in inguinal position (Fig. 2). Males with scrotally-

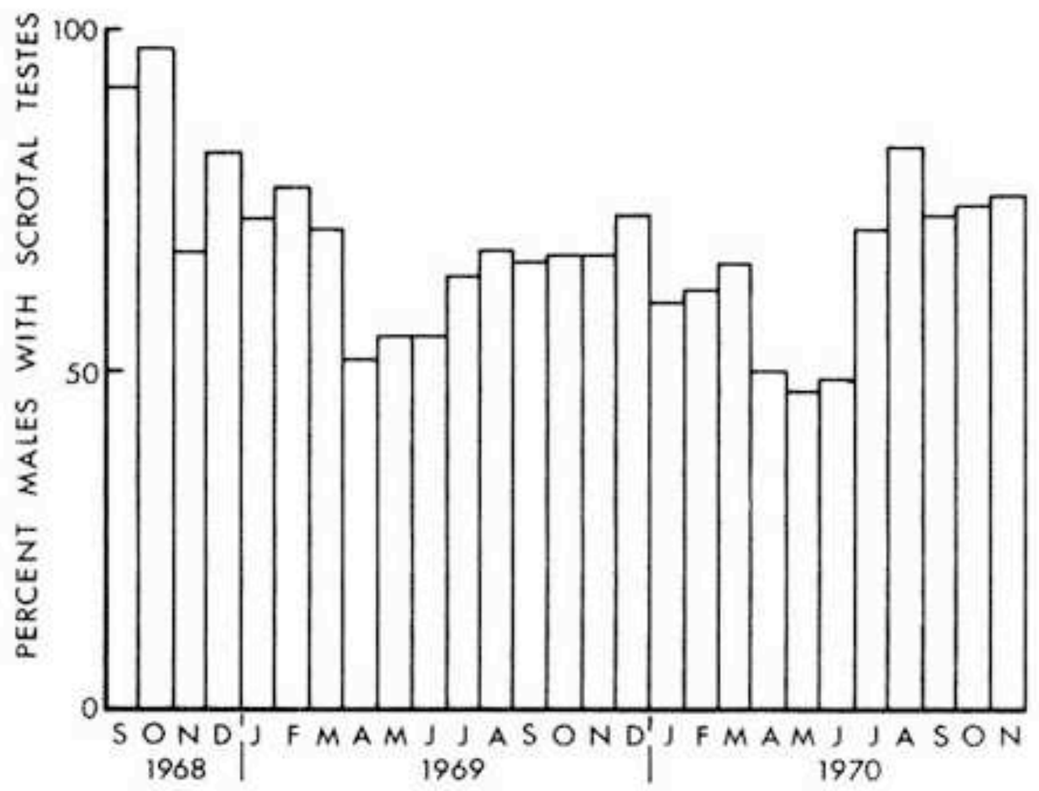

FIGURE 2. *The monthly percentages of males with scrotal testes caught between 1968-1970.*

located testes were fewest during the early winter (April, May, June) and peaked during the warmer months (October, November). However, it was rare to find less than 50% of the males in any sample with abdominal testes.

Breeding Season—Females

Collection of samples began after the breeding season started in 1968 and finished before the season finished in 1971. Therefore, only the animals collected between May 1969 and April 1970 have been used for fertility calculations viz. the one complete breeding year. During this year 1412 females were examined and 756 found to be pregnant. The overall incidence of pregnancy was 53.5% but within the limits of the breeding season, the mean proportion pregnant was 66.0%. Pregnant females were found throughout the year, but the first month in which over 50% were pregnant was August and the last, March (Fig. 3). In general, these conclusions were

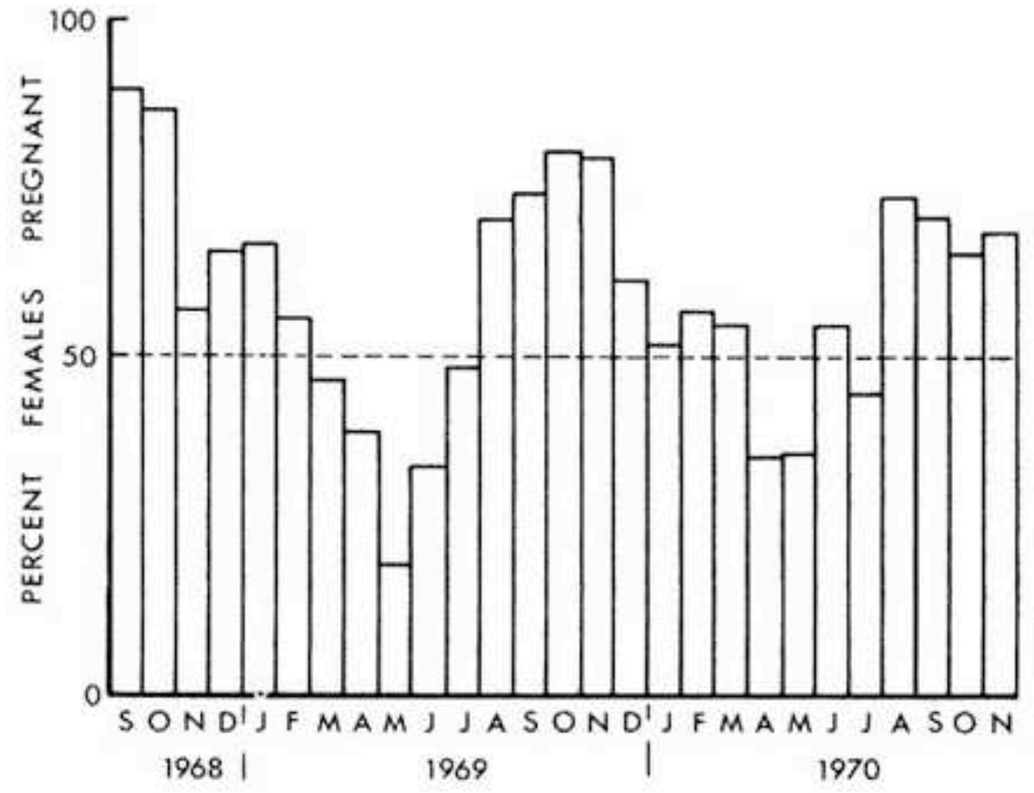

FIGURE 3. *The monthly percentages of pregnant rabbits caught between 1968-1970.*

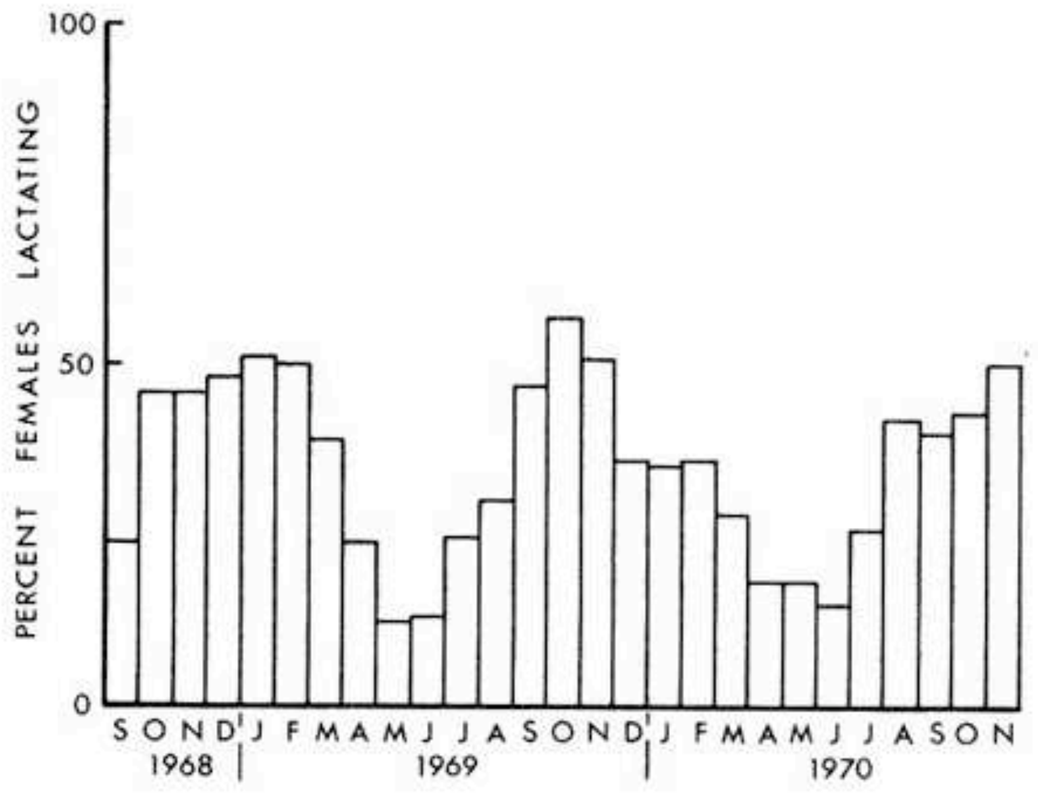

FIGURE 4. *The monthly percentages of lactating rabbits caught between 1968-1970.*

supported by data from the years with incomplete breeding data. A similar pattern was obtained from the percentage of females lactating (Fig. 4).

Litter Size and Fertility

The mean number of embryos per female per month showed a seasonal bimodal form (Fig. 5). Females were least fecund in June-July (4.7 embryos per female) and most fecund in October (6.4 per female). There was a breeding season mean of 5.5 ± 0.19 (S.E.), N=587.

The mean number of litters per female per year, calculated from a 30 day duration of pregnancy and a 243 day breeding season, was 5.35. This gives a calculated seasonal fertility of 29.4 young per female.

DISCUSSION

The population parameters described for the rabbits of North Canterbury have some characteristics similar to those of rabbits in the North Island and Great Britain.

The seasonal pattern of the inguinal position of rabbit testes (Fig. 2) is similar to the seasonal changes in mean testes weight described by Watson (1957). His study showed that the weight of the testes increased in the winter and early spring and reached a maximum in September, thereafter they decreased in size. The presence of spermatozoa also followed this curve (Brambell, 1944) and Watson deduced by comparison that the weight of the testes is a sensitive indicator of fertility of the animals. The similarities of the patterns in New Zealand, and the observations by Myers and Poole (1962) of a correlation between scrotal testes and breeding, suggests that testes position is a valid indicator of fertility. However, smears, with viable spermatozoa, are necessary to confirm this.

Watson (1957) described a well marked breeding season in Northern Hawke's Bay from about June through until November. He postulated for *Oryctolagus cuniculus* and demonstrated for other lagomorphs a direct relationship between latitude and the onset of the breeding season. That is, the closer to the equator populations exist, the earlier they commence breeding. The breeding season in North

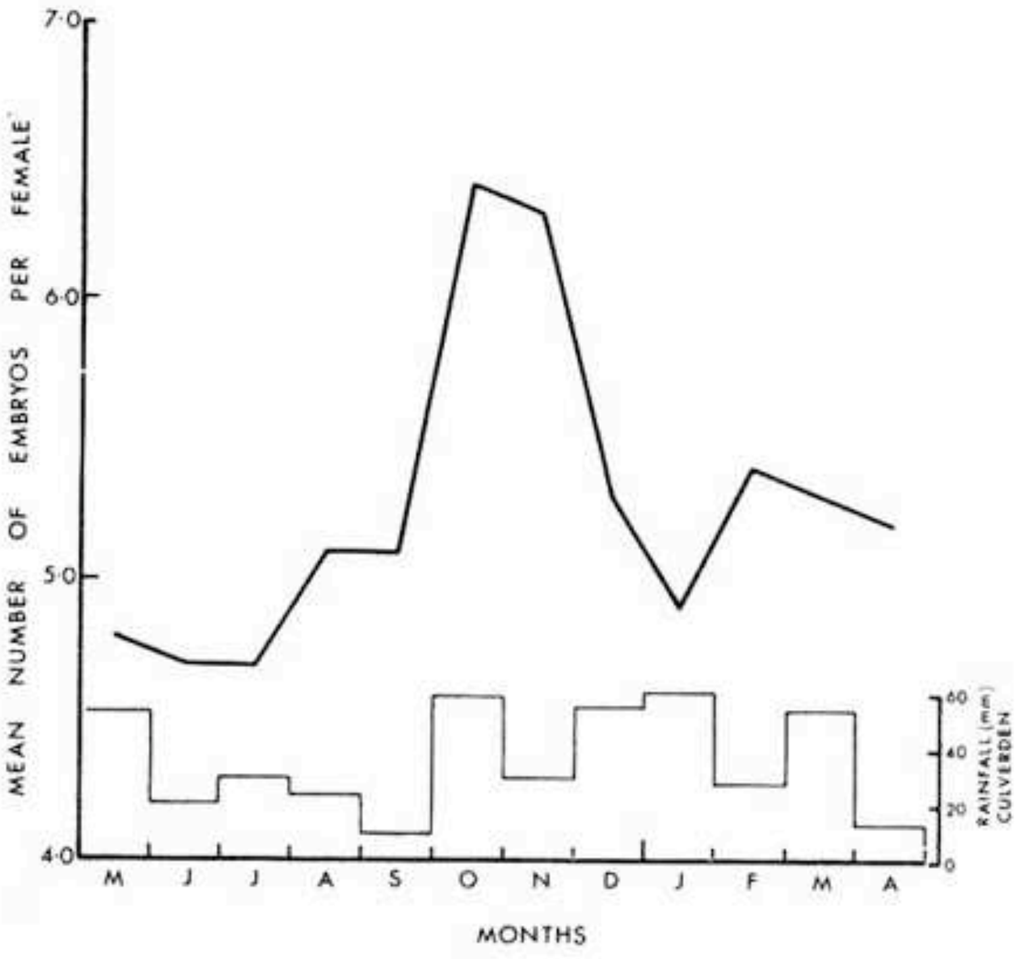

FIGURE 5. *Seasonal variation in the litter size of rabbits in North Canterbury.*

TABLE 1. *Variation of reproductive productivity of rabbits within different regions of New Zealand, Great Britain and Australia.*

Country	Region	Young/ female	Source
New Zealand	North Canterbury	29.4	Present study
	Hawke's Bay	26.0 }	Watson 1957
		20.9 }	
Great Britain	Wales	11.7	Brambell 1944
		30.0	Lloyd 1970
	England	18–28	Mead-Briggs *et al.* 1975
Australia	Subtropical	18.5	Myers 1970
	Subalpine	13.1	Myers 1970
	Arid	13.4	Myers 1970
	Mediterranean	29.4	Myers 1970
	Coastal	16.7	Myers 1970

Canterbury, during the two years it was studied, began in August, a month later than Watson's study and this supports his hypothesis.

Wodzicki and Darwin (1962) examined animals collected by night shooting in October. Their determination of the start of the breeding season was based on the age structure of young animals estimated from body weight. They concluded that there was no statistical difference in the onset of breeding between the North and South Island populations or not sufficient difference to alter the timing of control operations.

Myers (1970) has since shown that there is a high natural mortality of young rabbits. Also they are under-represented in samples collected by shooting due to differences in behaviour. Because of this information and the wide confidence limits in ageing by body weight, I believe Wodzicki and Darwin were unable to make an accurate assessment of the latitudinal effect on the commencement of the breeding season from their data.

The pattern of seasonal breeding in Canterbury, is similar to that found at Hawke's Bay (Watson, 1957) but, as in other countries (Table 1), the estimated number of young born per female varies with the sample collection point. The greater fertility of females in Canterbury is undoubtedly due to the extended autumnal breeding season (Fig. 3), as the

TABLE 2. *Variation in mean litter size of rabbits within regions of New Zealand, Great Britain and Australia.*

Country	Region	Mean Litter Size	Source
New Zealand	North Canterbury	5.54	Present study
	Hawke's Bay	4.84	Watson 1957
Great Britain	Wales	4.87)	Brambell 1944
		5.36)	
		5.95 }	Lloyd 1963
		6.78)	
	England	4.36	Stephens 1952
		5.03	Mead-Briggs *et al.* 1975
Australia	Subtropical	4.80	Myers 1970
	Subalpine	4.53	Myers 1970
	Arid	4.49	Myers 1970
	Mediterranean	5.65	Myers 1970
	Coastal	5.23	Myers 1970

mean number of embryos varies little between sample points (Table 2).

There is a seasonal variation in litter size with the maximum occurring in October (Fig. 5). The peak litter size in North Canterbury (6.4) is similar to that of rabbits in Hawke's Bay (6.36) and both peaks are in October. Again there is a difference between North Canterbury and Hawke's Bay with an autumnal increase in litter size in the former region.

Watson (1957) reiterates that the ultimate factor determining the timing of breeding is generally considered to be an adequate food supply. Although no pasture figures were collected, the rainfall figures for the year (Fig. 5) show increased rain early in the year which probably induced fresh grass growth. The presence of a new flush of pasture and apparently increased breeding rate of the rabbit during this period reinforces the postulate that rabbit productivity is determined by the carrying capacity of their environment.

Therefore, potentially, North Canterbury rabbit populations could increase rapidly under favourable conditions unless a high mortality occurs either naturally or artificially. If control is required, poisoning operations should take place outside the described breeding season of August to March for maximum control.

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The final collation of the record cards was carried out by W. D. Ross.

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