Changing Incidence of Parasites in a Declining Rabbit Population

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The present paper is a progress report on work undertaken in Hawke's Bay to determine the extent to which changes in the population density of the wild rabbit, *Oryctolagus cuniculus* (L.), are accompanied by changes in the abundance of certain endoparasites. The results are of interest in relation to the suggestion of Whittle (1955) that a host-parasite interaction is the underlying cause of the fluctuations in rabbit abundance which seem to have occurred fairly regularly, with periodicities of 11.5 and 14 years, since at least the year 1900.

Rabbits at Gwavas Forest, some 30 miles south-west of Napier, increased greatly during and immediately after the war, reaching peak numbers about 1948–49. A vigorous control programme was then instituted and the number of rabbits gradually declined; from 1954 onwards the rabbit population was light except for occasional pockets of medium density. Some idea of the magnitude of the decline may be obtained from the fact that 43,000 rabbits were killed in 1948 but only 1,720 in 1955. Samples of rabbits for parasitological examination were collected in the Gwavas district every month from March, 1950, to March, 1952, and at irregular intervals thereafter. The abundance of the protozoan parasite *Eimeria stiedae* was assessed on the frequency and severity of lesions in the liver, and *E. perforans* (an intestinal species) on the number of oocysts recovered from rectal fæces; the size of nematode infestations was determined by counting the worms in aliquot samples of stomach or intestinal contents. Some 5,000 rabbits were examined for *E. stiedae* and about 1,000 for each of the other parasites.

The results of this work show that there have been marked changes in the level of parasitism during the period 1950–57 and that the direction of these changes is constant for each of the four parasites studied (Fig. 1). The incidence of substantial infections of *E. stiedae* in young rabbits increased from 49 per cent. in 1950–51 to 60 per cent. in 1951–52 and then declined to 43 per cent. in 1953–54 and 6 per cent. in 1955–56; very small samples available in 1949–50 and in 1956–57 suggest even lower values in those years (4 per cent. and zero respectively). Substantial infections of *E. perforans* in older rabbits rose from zero in March, 1950, to 32 per cent. in July, 1950, and 46 per cent. in March, 1951; no more rabbits were examined for *E. perforans* until July, 1956, when an incidence of only 4 per cent. was recorded. The mean number of the nematode *Trichostrongylus retortaeformis* rose from 730 worms per host in the first half of 1950 to 1,887 worms a year later, and then gradually declined to reach a record low level of 379 in December, 1955; a rather higher value, 672 worms per host, was recorded during the winter of 1956. Figures for *Graphidium strigosum*, a nematode occurring in the stomach, followed a similar trend to those of *T. retortaeformis* in the intestine, the values varying from 511 worms per host in the second half of 1951 to 128 in 1956.

The samples of rabbits examined during the early part of the work showed that the incidence of the parasites was only slightly affected by the month or the locality in which the samples were collected; host age was a much more important factor, but this source of bias has been eliminated from Fig. 1 by ensuring that the samples have similar age structures. The curves shown in Fig. 1 are therefore thought to reflect real changes in the level of parasitism in the rabbit population of the Gwavas area. These changes could be due to differences in the availability of the parasites' infective stages, in the density of the host population or in the resistance of the host animals to infection. With regard to the first of these possibilities, it is well known that the free-living stages of many parasites are susceptible to desiccation. However, preliminary attempts to correlate the incidence of parasites at Gwavas with changes in the rainfall or in the amount of protecting vegetation were unrewarding.

The recent decline in the rabbit population at Gwavas might be expected to affect the level of parasitism because transmission of parasites must be more difficult when the host population is sparse. However, there are difficulties in

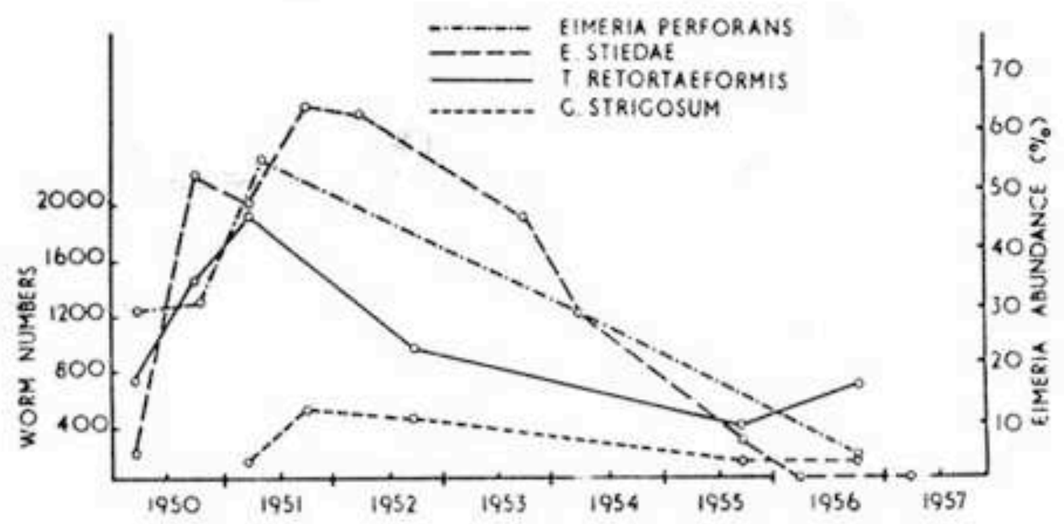

FIGURE 1.—*Variation in numbers of rabbit parasites from 1950 to 1957.*

accepting this as an explanation for the results shown in Fig. 1. To obtain samples of sufficient size, the rabbits examined for parasites were all drawn from local populations which had not fully experienced the decline characteristic of the rabbit population as a whole. Indeed, some of the more recent samples of rabbits, with a very low incidence of parasites, were obtained in restricted areas where rabbits remained quite numerous. A further difficulty is that parasitism actually *increased* during 1950–52 when the rabbit population was already declining.

Host resistance is known to be important in regulating the size of *T. retortaeformis* infestations in wild rabbits (Bull, 1955), and this factor is probably of significance in the other parasites also. It is therefore of interest to consider how the strength of host resistance might change. Recent work on vole (field-mouse) cycles in Europe (Chitty, 1952) has indicated that animals in crowded populations are subject to stresses which ultimately lead to physiological derangements and the birth of individuals with reduced viability. If this phenomenon occurs in rabbits, one might expect that reduced resistance to parasites would result from a period of crowding such as that experienced by rabbits at Gwavas prior to 1950. The local populations of medium density which provided samples of rabbits in 1955 and 1956 had developed from recent successful breeding, and any crowding that existed was of such recent origin that a decline in resistance to parasites was not to be expected.

REFERENCES

BULL, P. C., 1955: Population Regulation in Rabbit Nematodes. *Nature*. 175: 218.

CHITTY, D., 1952: Mortality among Voles (*Microtus agrestis*) at Lake Vyrnwy, Montgomeryshire, in 1936–39. *Phil. Trans. Roy. Soc. London*. 236 (638): 505-552.

WHITTLE, P., 1955: An Investigation of Periodic Fluctuations in the New Zealand Rabbit Population. *N.Z.J. Sci. Tech*. 37B: 179-200.

Ecology of the Sea-floor off Southern California

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This paper dealt with work in the offshore region of Los Angeles by the Allan Hancock Foundation, University of Southern California. A combined geological, biological, microbiological, and hydrological study is being carried out on a unique area of continental shelf of partially connected deep basins of varying degree of flushing and stagnation (Cf. Emery, 1954).

The biological work has revealed a mosaic of animal associations—over 60 distinct associations being recognized. The results were discussed with relation to hydrological conditions and nutritional richness and impoverishment. In basins where oxygen level is low, the fauna is particularly impoverished; where there is enrichment from sewage pollution the fauna is correspondingly rich. Molluscs are generally scarce and polychaetes make up the major portion of the biomass (Cf. Hartman, 1955).

REFERENCES

EMERY, K. O., 1954: Source of water in basins off Southern California. *J. Mar. Res.* 13: 1-21.

HARTMAN, OLGA, 1955: Quantitative survey of the benthos of San Pedro Basin, Southern California. Part 1. Preliminary results. *Allan Hancock Pacif. Exped.* 19: 1-185.