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STUDIES ON THE ECOLOGY OF LYMNAEA TOMENTOSA PFEIFFER 1855
AND L. COLUMELLA SAY 1817 (MOLLUSCA : GASTROPODA), INTERMEDIATE
HOSTS OF THE COMMON LIVER FLUKE FASCIOLA HEPATICA LINNAEUS 1758
IN NEW ZEALAND

A thesis presented in partial
fulfilment of the requirements for the degree
of Doctor of Philosophy in
Veterinary Science at
Massey University

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December 1974

ABSTRACT

Studies on the ecology of Lymnaea tomentosa and L. columella were carried out to provide a basis for further studies on the ecology of Fasciola hepatica infections in New Zealand.

Intermediate hosts of F. hepatica in New Zealand are the native Australasian species L. tomentosa, an introduced American snail L. columella, and the European host L. truncatula. The literature on the systematics, geographical distribution, general biology and ecology of these snails, together with their relationships with F. hepatica, is reviewed.

Field observations on snail habitats indicated that L. columella occupied ponds and spring fed marshes which remained wet even in dry seasons. L. tomentosa was found in similar marsh habitats. Stability appeared to be an important quality of the habitats of both species; factors unfavourable to the snails included rapidly flowing water, marked seasonal fluctuations in water level, and shade from tall vegetation. The calcium content of water in habitats ranged from 4 to 70 ppm. Snails were more often found on flocculent than on firm mud and this preference was more marked in the case of L. tomentosa.

Snail population dynamics were examined on one pond habitat and three marsh habitats of L. columella and a marsh habitat of L. tomentosa. Age structure and density of populations fluctuated widely between and within each of the five years of the study. These changes were greater in populations of L. columella and not directly related to rainfall or temperature variations. Field and laboratory evidence showed that both species could breed throughout the year even when temperatures were as low as 5°C but populations were much larger in summer and early autumn.

Studies of the fecundity of the two snail species and the relationship between temperature and rate of development of eggs showed that whilst L. columella has a higher adult mortality rate it also has a much greater reproductive potential than L. tomentosa. Eggs of L. columella develop over a wider range of temperatures, hatching up to 34.5°C whereas temperatures above 30°C are lethal to eggs of L. tomentosa. Eggs of both species underwent some development at temperatures between 5 and 10°C but the proportion that hatched at low temperatures was very small, particularly in the case of L. tomentosa.

Both species showed similar responses to desiccation on filter paper at 16.5°C and 80 to 90% relative humidity; survival time was closely related to shell length, with large snails considerably more resistant than smaller specimens. When snails were subjected to desiccation on mud results were much less predictable and the mean shell length of survivors was often less than that of snails which died.

A biometric analysis of shell shape showed distinct differences between large specimens of L. tomentosa and L. columella but shell dimension ratios were not diagnostic in specimens under 4 mm in length. Examination of a pond and a marsh population of L. columella showed no differences in shell shape attributable to habitats.

Over a 5 year period there was no detectable relationship between the intensity of F. hepatica transmission from a L. columella habitat and snail population density. The only correlation between F. hepatica transmission and rainfall was a possible inverse relationship between uptake in tracer sheep and December/January (mid-summer) rainfall. There was no evidence of any overwintering infection of F. hepatica infection in L. columella. Uptake of flukes by tracer sheep was almost totally confined to the period between mid-summer and mid-winter. Both experimental and circumstantial evidence indicated that pugging by cattle rendered marsh habitats more suitable for snails, although exclusion of cattle from the experimental area coincided with an increase in the uptake of F. hepatica by tracer sheep.

PREFACE

Fasciola hepatica Linnaeus 1758, the common liver fluke, is a common parasite of grazing animals in many parts of the world; its wide range of mammalian hosts includes man. It is of considerable economic importance due to its own pathogenicity and as a precursor of "black disease" in association with the bacterium Clostridium novyi. The liver fluke is also of great biological and pedagogic interest as a model of a parasite with a succession of free-living and parasitic stages, as testified by the space devoted to descriptions of its life-cycle in textbooks of zoology and parasitology.

There has been a recent revival of interest in fascioliasis in New Zealand due to an increase in the prevalence and distribution of the disease. The aim of the present study of the ecology of two of the intermediate hosts of F. hepatica, Lymnaea tomentosa Pfeiffer 1855 and L. columella Say 1817, is to provide some basis for further studies on the ecology, epidemiology and control of fascioliasis in New Zealand.

Whenever possible the information obtained in this study was quantified and analysed statistically. The maximum level of probability that a result could have arisen by chance regarded as "statistically significant" is .05. The use of one, two or three asterisks after the result of an analysis implies a probability of less than .05, .01 and .001 respectively, and is equivalent to the terms $p < .05$, $p < .01$ and $p < .001$.

ACKNOWLEDGEMENTS

Many people helped both directly and indirectly in the production of this thesis. Among the latter, who will not receive individual mention, were those friends whose casual enquiries acted as a stimulus to greater effort. More direct assistance was given by the following people:

My supervisors, Dr. W.A.G. Charleston of the Veterinary Faculty of this university and Dr. L.K. Whitten from the Veterinary Research Division of the Ministry of Agriculture and Fisheries were unfailingly patient and helpful. Dr. Charleston, being on hand, bore the greater burden but Dr. Whitten gave much useful advice, usually at short notice and often at inconvenient times. Professor R.N. Munford of the Veterinary Faculty, Mr. G.C. Arnold of the Mathematics Department, and Mr. C.S. Clarke of the Department of Food Technology all assisted with advice on statistical analyses but since they did not act as proof readers any remaining errors are my own.

I had some stimulating discussions with Mr. N.B. Pullan in the early stages of the study, often during the course of a visit to a snail habitat one of us thought would be of interest to the other. Dr. M.J. Winterbourn of the Zoology Department, Canterbury University, identified the Physa found on the Pohangina farm. Others to whom my thanks are due include Mr. D.K. Signal, Pohangina, and Mr. J.M. Ryder, Tokomaru, the farmers on whose property the snail population studies were conducted; both were totally co-operative at all times. The same is true of the management and staff of the C.W.S. Ltd. Meat Export Works, Longburn and the veterinary and lay staff of the Meat Division of the Ministry of Agriculture and Fisheries. Other Massey University staff whose help was invaluable were Mr. T.G. Law of the central photographic unit, the university printer Mr. P.J. Herbert, Mrs. L.C. Battye of the library, and the sheep farm supervisor Mr. P.H. Whitehead. I also acknowledge gratefully the grant from the Veterinary Faculty research fund which paid for sheep, fencing materials and other equipment.

I am especially grateful to a most efficient and enthusiastic typist, Mrs. Joy Pearce. Almost none of the problems alleged to be inevitable in producing type drafts of PhD theses arose, and most of the minor errors discovered in the final draft were due to my inadequate editing at an earlier stage.

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