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Wildlife as disease carriers

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1 Introduction

Wild mammals and birds, to which this paper is confined, have many diseases and provide reservoirs of infection which may be passed on to domestic animals and man. Since I reviewed the subject some years ago (Thompson 1961), there have been major agricultural changes, even in our stable and settled conditions, and a quickening interest in epizootics. Because of its geographic isolation, Britain is relatively free from disease, even compared with mainland Europe, and this situation can lead to a complacent attitude that is all too easily shattered when an infected animal slips through quarantine and an alarm is raised.

2 Viruses

Rabies provided alarm in 1969, when a rabid dog was at liberty on a common in the Camberley area of Surrey for some 50 minutes, after it had bitten its owner. The dog had been imported from Germany and there were fears (fortunately groundless) that British wild mammals might have become infected. Starting from Poland in the 1940s, rabies in wildlife, especially foxes, has spread across central and western European states and eastwards into the USSR (Steck 1982). Other wild mammals and domestic mammals, particularly cats, have become infected, but there have been few human cases. In the USSR, wolves and wolf-dog hybrids may be rabid and cause concern, as in Kazakhstan, because of attacks on man (Cherkasskiy 1983). The 1969 incident led to increased research on fox biology, both in state laboratories and in universities, to an official Inquiry (MAFF 1971) and a tightening-up of quarantine regulations, with severe penalties for offenders.

Myxomatosis is a disease limited almost entirely to rabbits, and occasionally hares, but is mentioned here because of the immense effect of rabbits on habitats and on agriculture and forestry. The introduction of the disease to Britain in 1953 and its subsequent spread in 1954-55 greatly affected the natural scene and encouraged the cultivation of downland and some former upland grazings. It also led to an expansion of research on the disease, the effects of rabbits on vegetation, rabbit biology, behaviour and control (Fenner & Ratcliffe 1965; Fenner & Myers 1978; Ross 1982).

Foot-and-mouth disease poses problems in many parts of the world, and the involvement of wild animals in its epizootiology is little understood. Wild birds are often suspected of carrying this and other diseases and the subject has been reviewed by Keymer (1958), and by McDiarmid (1962). Starlings, for example, have often been suspected, on circumstantial grounds, of being mechanical carriers of foot-and-mouth disease, but Murton (1964), Thearle (1968), Snow (1968), and Feare (1980) were unable to find convincing evidence.

Newcastle disease, or fowl pest, puts the national poultry flock at risk, and there is a need for more research on wild birds in this context and, especially, on the hazard posed by the trade in captive birds which come from all over the world, but particularly alarmingly from some African countries and the Far East. Ashton (in press) has drawn attention to the dangers of spreading this disease, and also psittacosis, influenza viruses and others. On 6 February 1984, the UK Government banned the import of all cage birds because of an outbreak of Newcastle disease at quarantine stations in north London and Essex.

Thousands of budgerigars, canaries and parrots were slaughtered as a precautionary measure (Anon 1984). Subsequently, a domestic outbreak of the disease, the first large outbreak since 1970, resulted in the slaughter of 250 000 poultry in Shropshire and Yorkshire.

Louping-ill, an infective paralytic disease of sheep in northern Britain, transmitted by the sheep tick, has also been found in red grouse which can act as an amplifier host for the virus (Reid *et al.* 1978; Duncan 1983). The breeding of grouse is affected in high tick areas, and more research is needed.

3 Bacteria

Bovine tuberculosis, a disease of both cattle and man, has only recently (Muirhead *et al.* 1974) been found to involve a wild mammal, the badger, in parts of Britain. In 1934, it was estimated that 40% of dairy cows were infected with TB and total eradication was planned. Using the tuberculin test and a policy of slaughtering reactor cattle, the incidence was reduced to one fifth of 1% by 1961. The incidence of reactors was much higher in south-west England than elsewhere, and it was quite by accident that the badger was found to be infected. As a result, badgers found to be infected, and those exposed to infection, were killed in areas where cattle reactors were disclosed, but the disease persists and an extensive programme of research, involving biologists, veterinarians and ethologists is in progress (Zuckerman 1980; Wilesmith *et al.* 1982, Little *et al.* 1982a, b). The prevalence of TB in wild badgers *now* is being studied and, to discover how they contaminate pasture and how cattle may be infected, other work including observations on cattle/badger behaviour is being done. The immune status of badgers is being studied and the possibility of managing badger populations so as to reduce or eliminate cross-infection with cattle must be considered (Thompson 1982).

Salmonellae have been isolated from many living animals and are an important cause of food poisoning in man and disease in domestic animals. The commonest of all salmonellae, *S. typhimurium*, is common in wild birds (Taylor 1969), although Feare (1980) discounts its importance in relation to starlings. Among mammals, some rodents, especially brown rats and mice, are very susceptible to salmonella infection, and isolations have been made from the fox and hedgehog. The serotype *S. enteritidis* var. *danysz* is highly pathogenic to brown rats and was at one time misguidedly used for rodent control, occasionally resulting in infection in domestic animals and man.

Leptospirosis is infection with spirochaetes of the genus *Leptospira*, and causes jaundice in dogs, cattle and pigs and Weil's disease in man. Recent studies (Salt & Little 1977; Hathaway *et al.* 1983a, b, c) indicate the extent to which brown rats, field voles, bank voles, wood mice, grey squirrels, hedgehogs, badgers, mink and foxes are infected. The emergence of the Australis serogroup as a cause of disease in domestic animals and the discovery of a substantial wildlife reservoir are potentially very important.

4 Rickettsia

Q fever was first described in Brisbane in 1935 as a disease of unknown etiology among abattoir workers. The 'Q' indicates Query (Baca & Paretsky 1983). The disease is not of direct agricultural importance but is a public health concern, particularly in relation to the obstetrics of cattle, sheep and goats, since a survey indicated that 28% of veterinary surgeons in north-west England had a significant level of Q fever antibodies. The causal organism, *Coxiella burnetii*, elicits no symptoms in domestic or wild mammals, although it is widespread. In Europe, the organism has been found in the hedgehog, brown rat and house mouse, but has not yet been isolated from wild mammals in Britain (Little 1983).

Diseases enzootic in wildlife may result in high epizootic mortality at times, but seldom effectively control the wild species. The existence of reservoirs of disease calls for strict precautions and prompt treatment where the infection of man and domestic stock is concerned. The need for much more research into the ecology of diseases in wildlife is evident.

5 Summary

The pressure of increasing human populations stimulates agricultural development, leading to loss of semi-natural habitats and often increased contact between man and wildlife, which may result in the spread of infections.

Geographic isolation has resulted in Britain being relatively free from disease, and this should be maintained by strict quarantine. Specific diseases are discussed, notably rabies in foxes, bovine tuberculosis in badgers, and myxomatosis in rabbits, and reference is made to others such as foot-and-mouth disease, salmonellosis, leptospirosis, psittacosis, Q fever and louping-ill. There is a need for much more collaborative research on infections in wild mammals and birds, by ecologists, veterinarians and agriculturalists. Research should include the optimum use of culled animals for the study of viruses, bacteria, protozoa, ecto- and endo-parasites, mycoses and neoplasms.

5.1 Priority points for new research

5.1.1 The fullest use of material from ecological studies and control programmes (eg of badgers, rabbits, rats, coypu, deer).

5.1.2 More research on infections in wild birds, eg using material obtained when bird ringing.

5.1.3 Further studies of leptospirosis in wildlife, particularly voles, and possible infection of domestic stock.

5.1.4 Assessment of disease risks posed by the trade in captive birds (there is a danger of importing non-indigenous pathogens; over 300 000 birds were imported in 1983).

5.1.5 Research on Q fever, which is of some public health importance, is necessary. The agent, *Coxiella burnetii*, is present in sheep and cattle in Britain but has not yet been isolated from British wild mammals.

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A questionnaire survey of farmers' opinions and actions towards wildlife on farmlands

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1 Introduction

There can be no doubt that much modern agricultural practice can be detrimental to the survival of wild animals and plants. Equally, there are wild species which can damage agricultural interests. Opinion differs about the extent to which these facts throw the farmer and conservationist into irreconcilable dispute (Mabey 1980; Mellanby 1981; Shoard 1980). The results of our 6-year project on aspects of conservation and farmland convince us that, although imperilled by economic strictures, there is much in common between farmers and wildlife conservers. Most important, minor adjustments of farmland management can cost the farmer little, while benefiting wildlife considerably. Identifying these adjustments, and quantifying their advantages and disadvantages is a high priority. Less than 0.5% of England and Wales is devoted to nature sanctuaries, while 78% (about 12M ha) is farmed. The cumulative benefit to wildlife of numerous, even if small, conservation-oriented changes in farm practice could be great.

The aim of this paper is to sketch a profile of wildlife on farmland, and so to highlight problems which might be resolved by future research. Although all the ingredients of the farmland ecosystem are dependent, I emphasize here the need for research on the impact of agriculture on wild mammals. The term 'wildlife management' is sometimes mistakenly taken as a euphemism for the killing of pest species. A better usage embraces much more, ranging from the conservation of fauna and flora, through the ranching of game, to the control of disease among its vectors (Macdonald 1981). The conservation of each of the 60 or so terrestrial species of British mammal could benefit from a better understanding of the relationships between agriculture and wildlife, as could the control of the 2 dozen or so supposed pests amongst them. The science of wildlife management in the British Isles must grow if it is to shoulder the task of integrating the necessities of agriculture with the desire for a diverse ecosystem and abundant flora and fauna.

At Oxford, we are trying to develop studies according to 4 stages:

i. to establish the farmer's view of wildlife and non-agricultural land on his farm (questionnaire surveys and conversation), and thereby to identify useful topics for investigation;

ii. to quantify the elements of these topics (by further questionnaires and field work), and thereby to develop hypotheses about the consequences of management practice upon wildlife and agriculture;

iii. to gather the data (by field work) necessary to test the hypotheses;

iv. to inform the farmer and countryman of the results, thereby influencing their opinions and/or management practices.

As an example of this sequence of stages, we sought farmers' opinions on the merits and demerits of retaining hedgerows and managing them according to various regimes; we then quantified the pattern of hedgerow management employed by each farmer; and, third, we studied the numbers of species and individuals of birds which nested in hedgerows under different regimes. The aim was to provide the farmer with straightforward, numerical advice on the likely consequences for hedgerow birds of his hedgerow management programme. Other examples include the impact of farm practice upon badgers and of hedgerow management on small mammal populations, and the impact of field sports on farmland habitat. These results will be published elsewhere. This paper briefly reviews farmers' attitudes and actions towards (i) non-agricultural land and (ii) wild mammals and birds as pests and as assets. It analyses questionnaire data for 2 predatory mammals, the Eurasian badger and the red fox, and discusses some questions which arise in relation to integrating management of wildlife with agriculture.

2 Methods

Ten regions were selected as embracing the major lowland agricultural landscapes of England (with reference to Coppock's (1976) agricultural atlas). From these regions, 867 farmers (Sample A) filled in an initial questionnaire which included 130 questions relevant to diverse aspects of wildlife on their farms. A further 101 'midland' farmers from Oxfordshire, Buckinghamshire, Northamptonshire and Warwickshire subsequently completed a more comprehensive questionnaire involving 236 questions. The questions put to Samples A and B differed in 2 main respects: first, those put to Sample B were partly generated by the answers from Sample A; second, the questions put to Sample A often involved the selection of options (eg tick which of the following . . .). Sample B emphasized questions where the respondent was required to be forthcoming (eg list the factors which you believe are