THE IMPACT OF WILDLIFE SPECIES ON SHEEP PRODUCTION IN AUSTRALIA
(Invited Paper)

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Summary

Wildlife species of mammals and birds may compete with sheep for pasture or prey on flocks. The extent to which they do so determines whether they are pests which should be controlled.

While the rabbit is an undoubted pest, there is much argument about the status of kangaroos as grazing competitors with sheep. Some people regard them as pests; others consider them as an important natural resource which should be harvested; and others, as unique animals which should be conserved for scientific, aesthetic and sentimental reasons.

Predator species-fox, dingo, raven and wedge-tailed eagle-do not cause as much damage as is often claimed. Physiological and behavioural factors in lambs and ewes are more important than predators in causing mortalities.

The traditional ***ad hoc*** approach in pest control should be replaced by one of "protective population management" based on an understanding of the ecology and behaviour of the pest species.

I. INTRODUCTION

In an earlier paper, Fennessy (1962) discussed 20 species of wild mammals and birds in Australia which are believed to compete with sheep for pasture or which prey on flocks. He concluded that very few measurements of their effects had been made. This paper outlines progress in obtaining data on which rational policies of management for control of some of these wildlife species may be based.

II. GRAZING COMPETITORS

(a) Rabbit

(i) Damage

The most important herbivore competing with livestock is still the rabbit, *Oryctolagus cuniculus* L. Although there is no question that it can cause damage, including outright competition with livestock for pasture, adverse changes in the composition of pasture and sometimes soil erosion, there is little quantitative information about these effects.

The competitive effect of rabbits becomes obvious when rabbit populations are controlled or eradicated and an increase of livestock production follows. One example is from a property in the Central Western Slopes area of New South Wales (Fennessy, unpublished data) which, over a period of six years to 1951, had suffered a major decline in wool production from 250 to 70 bales and sheep numbers had fallen to half of what they were when the property was rabbit-free. This was despite the killing of scores of thousands of rabbits in 195 1 in trapping and ineffective poisoning operations. But within one year of a major organized attack on the rabbit population and with virtually no assistance from myxomatosis, the property could carry twice as many sheep and wool production had trebled to 208 bales.

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Another example is from South Australia (Bromell, unpublished data) in the ten-inch rainfall area where rabbit control has been considered locally to be uneconomic because properties are generally large and sheep-carrying capacity per acre is relatively low. But one landholder achieved almost complete eradication of rabbits from 20,000 acres in 1956 and the average annual production for two 7-year periods immediately before and after the campaign showed an increase in sheep from 3,800 to 4,800-a 26% increase-and in wool cut per sheep from 14.4 to 14.7 lb.-a 2% increase. Seasonal conditions in the second period were generally less favourable; there had been no establishment of new pastures and no major change in management other than the controlling of the rabbit population.

Some striking demonstrations of the depressing influence of rabbits on the stock-carrying capacity of pastures were seen after myxomatosis had first swept through the Australian rabbit population. Reid (1953), after allowing for seasonal influences, estimated that the reduction of the rabbit population by the disease had, in 1952/53 alone, resulted in an increase of production of wool of about 70 million lb (5.47% of the total Australian production). The value of the increased production of wool and meat in that year was about £ 34 million.

Myers and Poole (1963) observed the effect of rabbits on pasture in three 2-acre paddocks. The paddocks were stocked initially with 3, 5, and 10 rabbits to the acre. Sheep grazing at 2½ per acre did not significantly alter the botanical composition of the pasture of clovers, Wimmera rye grass and volunteer grasses, but grazing by the increasing rabbit populations drastically reduced the content of rye grass and clover and increased the proportion of poor volunteer grasses and of weeds. In summer when rabbits had increased to 20-25 and 50 to the acre, they ate as much as 70% of the clover burr, whereas sheep ate only 9% .

Gooding (1955) described damage to pasture by rabbits in the south-west of Western Australia. In areas lightly infested with rabbits, losses of pasture ranged from 10% to 48 % , and where infestation was heavy, from 62% to 100%. Pastures which had been heavily grazed by rabbits had a markedly high proportion of low-quality volunteer species.

(*ii*) ***Control***

The attitudes of landholders to rabbit control are determined mainly by the size of the rabbit population. Populations which are large and are obviously doing damage cause concern and stimulate control activity but those which are relatively low are often ignored. The potential for increase which these low populations have under suitable conditions, and the damage which rabbits have caused in the past, are frequently forgotten.

The controlling effect of myxomatosis has been spectacular and there is no doubt that the disease still kills large numbers of rabbits. But evolutionary changes in the relationship between the virus and rabbits (Fenner and Ratcliffe 1965) indicate that the disease should not be regarded as a means of getting long-term effective control, as distinct from annual or occasional killing of part of the populations.

For the future, increasing reliance will have to be placed on the use of poison. Use of poison 1080 (sodium fluoroacetate) has increased in recent years, and in 1963 it was used for rabbit control on 22,600 properties in Australia. It has been used with most success where the technique of poisoning has been based on a new understanding of rabbit behaviour and particularly of territoriality (Poole 1963). There is also evidence from field trials (Bromell, unpublished data) to show the importance of strategic timing of poisoning operations. Poisoning of a non-breeding population in March gave a kill of 99% but in a nearby population poisoned in September the kill was only 84%. The poorer kill was due to the existence of territoriality in the breeding season and also to the fact that young rabbits which are more than 17 days old may survive if their mothers are poisoned. By the following January the population poisoned in March had increased to 9% of its original level but the population poisoned in September had increased to 28%. Money spent on the poisoning in March was a much better investment.

(*b*) *Kangaroo*

(*i*) ***Damage***

While there is no argument about the pest status of the wild rabbit, the same cannot be said of the kangaroo about which there are different and sometimes opposed views. In summary these are: that kangaroos are serious pests in some areas; that they are an important natural resource which should be harvested on a continuing basis; and that they are animals of a group unique in the world and should be conserved for this reason and also for reasons of personal and national sentiment.

Information about the food intake of the red kangaroo, *Megaleia rufa* Desm., and the grey kangaroo, *Macropus giganteus,* has been gathered in the last few years. Although this is still insufficient to give a clear picture, it is evident that claims that kangaroos eat far more than sheep cannot be substantiated.

Using red and grey kangaroos and sheep in metabolism cages, Griffiths and Barker (1966) showed that large sheep and small sheep ate slightly more lucerne chaff than did large kangaroos and small kangaroos respectively. Foot and Romberg (1965) also using metabolism cages found that kangaroos ate nearly the same amount of lucerne hay but less straw than sheep and they suggested that the kangaroo is better adapted to making use of very poor quality roughage than is the sheep.

Kirkpatrick (1965*a*) measured rates of intake of food when groups of grey kangaroos and sheep of known body weight were grazed on enclosed areas of sown oats. The amounts eaten were determined by measurements of the oat crop before and after grazing. The amount of intake was significantly less for kangaroos than for sheep-the calculated daily green 'food consumption of an average-sized (70 lb) kangaroo was slightly less than half that of an average-sized (100 lb) sheep.

The plant species eaten by red kangaroos have been studied in Central Australia by Chippendale (1962) and Newsome (1962). Their technique was examination by eye and by microscope of samples of rumen and stomach contents to identify the plant species present and make an estimate of the quantities of each. Newsome found that short grasses and herbs predominated in the food of kangaroos; at all times the contents of the stomachs were green. Chippendale sampled cattle and kangaroos and found a preference by kangaroos for *Eragrostis setifolia* and other species which occur almost exclusively in gilgais on treeless flats. Insufficient samples were examined to give a complete outline of species grazed according to season or district.

Griffiths and Barker (1966) studied plants eaten by kangaroos and sheep at Cunnamulla in Queensland. Stomach contents were ground to uniform particle size and the relative proportions of each species of plant in samples were determined by counting under a microscope particles identified from characteristic cuticle patterns, hairs, silica cells and spines. They found that grey kangaroos generally ate more grass than herbs and shrubs, but red kangaroos and sheep ate the same proportion of grass and dicotyledons throughout the year, and for most of the year this was 1 to 1. The similarity of diets was more apparent than real as it was clear that the three species had specific food preferences at any one time. Even in the driest weather, the stomach contents of the kangaroo were green, whereas in sheep at dry periods the contents were yellow because of the presence of dried grass stems.

Kirkpatrick (1965b) has used another method to find what the grey kangaroo eats. In forested country of the southern Darling Downs in Queensland he found that whereas the stomach contents were masticated so finely that identification was difficult, identifiable plant material is often retained in the mouths of kangaroos which have been shot while feeding. He compared the frequency of occurrence of plant species found in the mouths of kangaroos with frequency of occurrence in the pasture measured by point quadrat analysis and concluded that the grey kangaroo was essentially non-selective in its use of pasture. He noted a high use of wire grasses (*Aristida* spp.) which are relatively unpalatable to sheep.

The distribution of kangaroos in an area grazed by sheep has been studied by Frith (1964) who used low-flying aircraft to measure gross changes in abundance of kangaroos along fixed transects which were flown every few months. In the Riverina of New South Wales he found that red kangaroos preferred to graze in areas with short grass. He suggested that with the introduction of Sheep and wholesale clearing of the woodland of boree and its replacement by a grassland of *Danthonia* and *Stipa* and other grasses and herbs, the area is now more favourable for kangaroos than it was previously.

Newsome (1965) gives a similar explanation of the large increases in numbers of red kangaroos which landholders say have occurred in Central Australia in the last twenty years or so. He suggested that the environment of the red kangaroo has been ameliorated by cattle cropping the dry grass of the open plains country, causing it to sprout green shoots. Large areas where kangaroos can find food during drought have thus been provided for them.

Ealey and Suijdendorp (1959) found that the prime cause of deterioration of pastures in the north-west of Western Australia was not grazing by kangaroos, as has been claimed by landholders, but a sheep-stocking policy that was unsuited to the climate and pastures.

(ii) Control

The range of results reported indicates the need for further investigations of the precise nature of the impact of kangaroos on pasture. If control of some species is shown to be necessary, this might well be in the form of a scientifically-based harvesting which reduces the population without eliminating it and provides meat of relatively high protein value (Tribe and Peel 1963) and skins. The future of this type of harvesting will depend on the extent to which those handling the carcases can keep standards of hygiene that prevent the contamination (Anon 1964) which gives a bad repute to kangaroo meat and possibly, by association, to Australian meat exports generally.

Ealey and Richardson (1960) have shown how the effectiveness of the control of the euro, *Macropus robustus,* by poisoning near Marble Bar in the north-west of Western Australia has been enhanced by a detailed study of the ecology of the species. Successful control or conservation, i.e., management, of other species will have to be based on similar studies.

(c) Tasmanian Native Hen

(i) Damage

The native hen, *Tribonyx* ***mortierii,*** is a grazing bird which lives in low-lying areas near water in Tasmania and has for many years been considered a pest.

Ridpath and Meldrum (unpublished data) investigated the damage the bird actually causes. Damage to established pastures and newly-sown crops was studied by using exclosure cages. It appeared that much of the damage to established pastures was in fact caused by rabbits. In young cereal crops in the first six to eight weeks, the native hen caused a loss of 8% in weight of green material and the greatest damage was near the edge of the crop, but in the same crops rabbits caused an almost equal loss although the rabbit population had been reduced by poisoning at some of the trial sites within a month of sowing. Thus it seems that the native hen is a much less serious cause of damage than is the rabbit.

(ii) Control

All damage occurs near water and particularly where the crop area is very small and so more likely to be damaged throughout. Hence, the best way to prevent it permanently is to remove the bird's habitat by clearing from the surrounds the rush vegetation in which it breeds. Alternatively the birds can be poisoned. As they are territorial in behaviour, successful poisoning requires that the furrow in which the poison bait is presented should zig-zag across the paddock so that every territory, and thus every bird, is likely to get some bait.

Local control, rather than indiscriminate large-scale poisoning campaigns, seems to be the most efficient approach consistent with the proper management of this native species which could fairly easily be driven to extinction.

III. PREDATORS

The total impact of predators—raven (crow), dingo, fox, eagle, wild pig—is still obscure. However, in a few surveys in the sheep industry, the losses caused by these predators have been generally small although heavy losses may occasionally be caused in individual flocks (Pullar 1953; Moule 1954; McHugh and Edwards 1958).

Dennis (1965*a*) in Western Australia surveyed farmers' opinions of the causes of losses of lambs. In 726 replies to questionnaires the most important factors were listed as: weather conditions, lack of food, foxes and crows. It is unlikely that opinions expressed by farmers indicate the true causes of losses; there is a natural tendency to blame obvious factors-climate, food supply and predators—particularly if the invoking of other factors implies self-criticism of the farmer's management practices. A pointer to the unreliability of generalized comments from farmers about predators is the result of the examination by Dennis (19653) of 2,400 dead lambs from many districts in Western Australia. Many lambs showed evidence of starvation/mismothering. (They had walked and been active but they did not suck, and they died within three days after birth.) This was the greatest single cause of death and accounted for nearly half the lambs examined; yet only 0.7% of farmers in the survey by questionnaire reported this as a cause of loss of lambs.

Dennis found that predators caused the death of only 2% of the lambs examined. Criteria for a diagnosis that death of a lamb was due to a predator were: absence of signs of diseases or other conditions that could have caused death; no sign of depletion of body fat; indication that the lamb had walked and, usually, that it had sucked; and signs of haemorrhage around the areas attacked.

Similar criteria have been used by McFarlane (1964) in autopsies on 3,039 lambs which died before, during or within seven days of birth. He found that although 46% of the carcases had been mutilated by predators, in many cases this had occurred after death. He concluded that the maximum figure for predation due to foxes, eagles and crows was about 10% of lambs dying or 2% of lambs born. There was a wide variation in losses caused by predators on different properties. About 90% of the deaths classed as due to predators occurred during or just after birth and in about one-third of these cases there was evidence of a prolonged or difficult birth.

Alexander, McCance and Watson (1955) in an examination of the causes of mortality of Merino lambs at Tooradin North, Victoria, found that predators were not a major cause of death. They concluded from other findings that, for an adequate understanding of neo-natal mortalities, there was need for information on the development of physiological function in the lamb, on its tissue reserves and on the ewe's mothering instinct and milk production and the relationship of these to the weight of the lamb at birth. Much information on these aspects has since been collected, and Alexander (1964), in a review of investigations on the physiology of the new-born lamb, stated that most of the lamb mortality in Australia can be accounted for by behavioural and physiological factors in the lambs and their mothers.

It is apparent that predation as the cause of lamb mortalities should not be overemphasized to the extent that more important factors are overlooked and that much effort is wasted in control work inefficiently done because of lack of understanding of the basic biology of the predator species.

(a) crow

Because lamb carcases often show evidence of attack by the "crow" or raven, *Corvus coronoides,* it is commonly indicted as a predator of lambs, but there is no objective evidence' that it is a major cause of lamb mortality. Smith (1965) has reported crows as a major source of predation in two Merino flocks in semi-arid tropical Queensland, but these flocks were mated in late spring and summer and the prime cause of reproductive wastage was not predation but the failure of the ewes to conceive. He reported heavy predation in south-western Queensland;

this was in a Border Leicester flock and was associated with twin births (Smith 1964).

Rowley (unpublished data) in an intensive study of the raven on the Southern Tablelands and in the Riverina of New South Wales has not found it to be a significant predator of healthy lambs. Weak lambs are much more liable to attack but possibly would have died in any case as the result of starvation mismothering and other causes.

A large proportion of the raven population is reproductively immature and is nomadic. Flocks of these birds may concentrate on lambing paddocks after being attracted by afterbirths and carcases. Rowley has found that properties which suffer the greatest attention from ravens are those which are lambing out of phase with the rest of the properties in the district. He points out that the provision of adequate shelter in lambing paddocks not only reduces directly the adverse effect of weather on lambs, but by reducing losses of lambs lessens the production of carrion which might attract ravens.

(b) Wedge-tailed Eagle

The wedge-tailed eagle, *Aquila* ***audax,*** is considered by many to be a predator of new-born lambs, and in recent years bounties have been paid on large numbers of eagle heads (5000 per year in Western Australia; 10,000 per year in Queensland). Others claim that this control effort is not justified and that the only lambs taken are those which are weak or are moribund or already dead.

A preliminary assessment of the distribution and food of wedge-tailed eagles within a 15-mile radius of Canberra, A.C.T., was made over six months in 1964 by Professor A. S. Leopold of the University of California in co-operation with the C.S.I.R.O. Division of Wildlife Research (unpublished data). Examination of the remains of food items at nests showed that rabbit and hare' comprised about half the items and that sheep and lamb comprised another tenth. The proportion of live lambs is unknown, although there was evidence that some of the lambs were dead when taken. Studies are being started to determine the diet in other lambing areas where rabbit populations are low or non-existent.

The density of adult birds near Canberra was one pair of breeding birds per ten square miles. The movement and density of immature birds are unknown but there is some indication that they may congregate around lambing flocks. Successful control, if found to be necessary, will require detailed knowledge of these aspects of the eagle's ecology.

(c) Fox

Direct sighting of killing by the fox, *Vulpes vulpes* L. is rare as it hunts mainly at night. The nature of the mutilation of lambs has been used by Dennis (1965*c*) to identify the predator; foxes usually take the tongue, lower jaw and tail, and commonly attack the thighs and possibly the neck and occasionally open the chest and abdominal cavities.

Stomach contents have been analysed by McIntosh (1963) in a survey of 378 foxes in the Canberra district and in southern New South Wales. He found that the staple diet consisted of rabbit and of sheep material, most of which was recognizably fly-blown or obviously putrid at the time of consumption. Other food items covered a wide range and included many invertebrates, mainly insects.

Probably some live and healthy lambs are killed by foxes but there seems no simple way of determining the number. The possibility should be considered that some of the lamb losses not at present attributed to predators, e.g., those due to starvation and mismothering, may result from the continued presence of foxes causing the disturbance and separation of ewes and lambs.

McIntosh's findings, considered in conjunction with the results of several surveys which have revealed that predators cause a relatively small proportion of losses of lambs, indicate that while local control operations (perhaps by poisoning) against foxes may sometimes be worthwhile, district-wide campaigns, particularly those involving the payment of scalp bounties, are not justified.

(d) Dingo

There is no clear picture available of the damage caused bv the dingo, *Canis dingo.* A major difficulty in assessing the problem is that, in many areas where dingoes occur, the livestock are being run under extensive and 1 argely unsupervised conditions and it is not possible for the landholders to know accurately what losses are due to dingoes. Fennessy and Bromell (unpublished data) in a survey of sheep-raising, beef-raising and dairying properties in the north-east of New South Wales interviewed 600 landholders. All the properties were in, or closely adjacent to, country known to be inhabited by dingoes. Losses were heaviest on sheep properties. On these properties losses of more than 5 % of sheep were suffered on 7 % of properties each year; losses of 1-5 % on 7% of properties; and of less than 1% on 2% of properties. Another 45 % of sheep properties reported occasional losses and 39% reported no losses. The survey indicated the need for control work organized and executed at a local level and for extension work in this field.

IV. CONCLUSION

This review highlights the problems of assessing the pest status of wildlife species. It also indicates the need for less attachment to the traditional "fly-swat type of pest control" which simply reduces symptoms (Geier and Clark 1960), and for implementation of a concept of "management for protection against undesirable species", based on a full knowledge of the animals.

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