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Sika Management: Four Scottish Case Studies

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Background

Sika deer present a management problem to many deer managers in Britain. They are thought to be more secretive than red or roe deer, to be able to reach higher densities and to potentially cause more damage to young trees and to habitats. In 1993 work by the Deer Commission for Scotland at two sites in Dornoch Forest District suggested that controlling sika was harder than controlling red deer and might not be possible with the resources being put into deer control at that time. The Deer Commission for Scotland and Forest Enterprise therefore set up a project to monitor deer populations densities, culls and culling effort both at the original Dornoch sites and at two other sites in the Scottish Highlands where sika were also numerous. The major findings of that project are presented here. A more detailed description of the project and its results can be found in Armstrong (2001a,b).

The sites

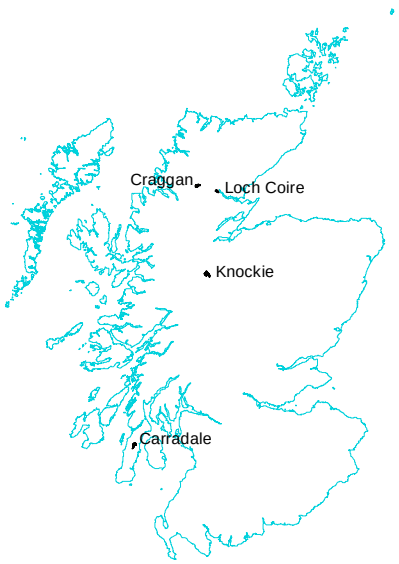

Fig. 1 Location of the four study areas

The project was conducted at four sites in the Scottish Highlands (Fig.1). The sites differed in terms of the species composition and ages of the stand types. Loch Coire was the most uniform, being completely covered in thicket stage lodgepole pine and hybrid larch. Craggan was similar but had some small areas planted with a number of species other than lodgepole pine as well as of open ground. There was also a large area of open ground that included a hilltop. Knockie and Carradale were more diverse with Knockie having a number of small open areas and a wide range of tree species that were largely at the thicket-stage. Carradale was the most structurally diverse with a wide range of planting dates leading to a range of stand types. Sitka spruce was the major tree species but there was also a wide range of other tree species present as well as open ground. Sika was the most abundant deer species at all sites however red deer made up almost one third of the total deer culled at Knockie and roe deer made up the same proportion at Carradale.

Sika densities

Standing crop dung density was used to estimate deer density at all sites. Cohort analysis was also used, where there were sufficient numbers of years of cull data. Loch Coire initially held the highest density of sika deer found at any of the sites (Fig. 2a). Densities at Loch Coire appear to have declined between 1990 and later dates. Craggan retained moderate densities of sika throughout the study. At Knockie sika densities were apparently halved between 1996 and 1997 then remained at a low level. Carradale probably had a similar density of sika to Craggan but this conclusion relies on the results of cohort analysis since the dung density results gave much lower densities. Since cohort analysis is likely to underestimate deer densities this suggests that the dung density estimates at this site were inaccurate. This highlights the benefits of checking dung density estimates of deer density against cohort analysis wherever possible. At the other sites, cohort

analysis gave results that were close to those obtained from dung density measurements.

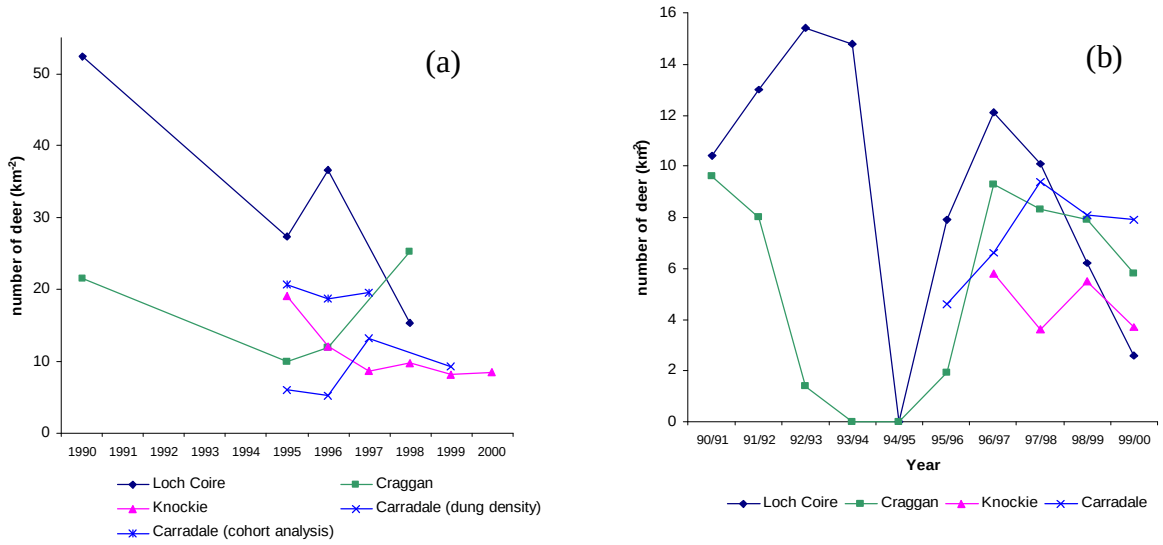

Fig. 2 Sika densities and culls at the four sites during the study. a) Densities b) Culls.

Sika culls

At Loch Coire no culling took place in 1994/95. In the other years, the number of sika deer culled per unit area was generally higher than at the other sites (Fig. 2b). Sika densities were also highest at Loch Coire (Fig. 2a). At Craggan few, or no, sika were culled between 1992/93 and 1995/96. In the other years, numbers of sika culled per unit area were generally slightly lower at Craggan than at Loch Coire, as were sika densities (Fig. 2b). The sika cull at Carradale increased after the first year of the study and remained high until the end. The sika cull at Knockie was lower than elsewhere but sika densities were also lower after 1996. Sika densities at Knockie appeared to decline between 1995 and 1997 and then to stay constant at fewer than 10 sika km^{-2} (Fig. 2a). This result suggests that it is possible to maintain a high sika cull even at quite low densities of sika.

Age distribution of culled sika

Young sika deer (calves, 1- or 2-year-olds), both male and female, made up most (58 – 75%) of the total cull, over all years, at all sites (Fig. 3). At all sites except Loch Coire the cull appears to have higher proportions of at least one of the older age classes than a younger age class. Unless there is immigration of 1- and /or 2-year olds, this cannot reflect the proportions of animals in these age classes in the population (which must decline with age). This implies that there may have been problems in aging deer up to 2 years old if we assume that the cull was non-selective. Since the problem, where it occurred, was between calves and 1-year-olds or between 1- and 2-year-olds, and applied equally to males as to females, it does not appear that there is one consistent bias in aging young deer nor that it is a problem with only one sex. For the same reason, the explanation is unlikely to be that the different age classes of deer are consistently not being shot in proportion to their occurrence in the population. An alternative explanation is that immigration of young deer, was occurring at these sites. This possibility is supported by the results of the population modelling for two of these sites (Craggan and Knockie, see below). At Knockie, no sika older than 7 years were found whereas at the other sites sika of 10 years and older were found (Fig. 3). This may be due to high culling percentages (see population modelling below) however it may also be due to a lack of accuracy in aging older deer and to small sample sizes for Knockie.

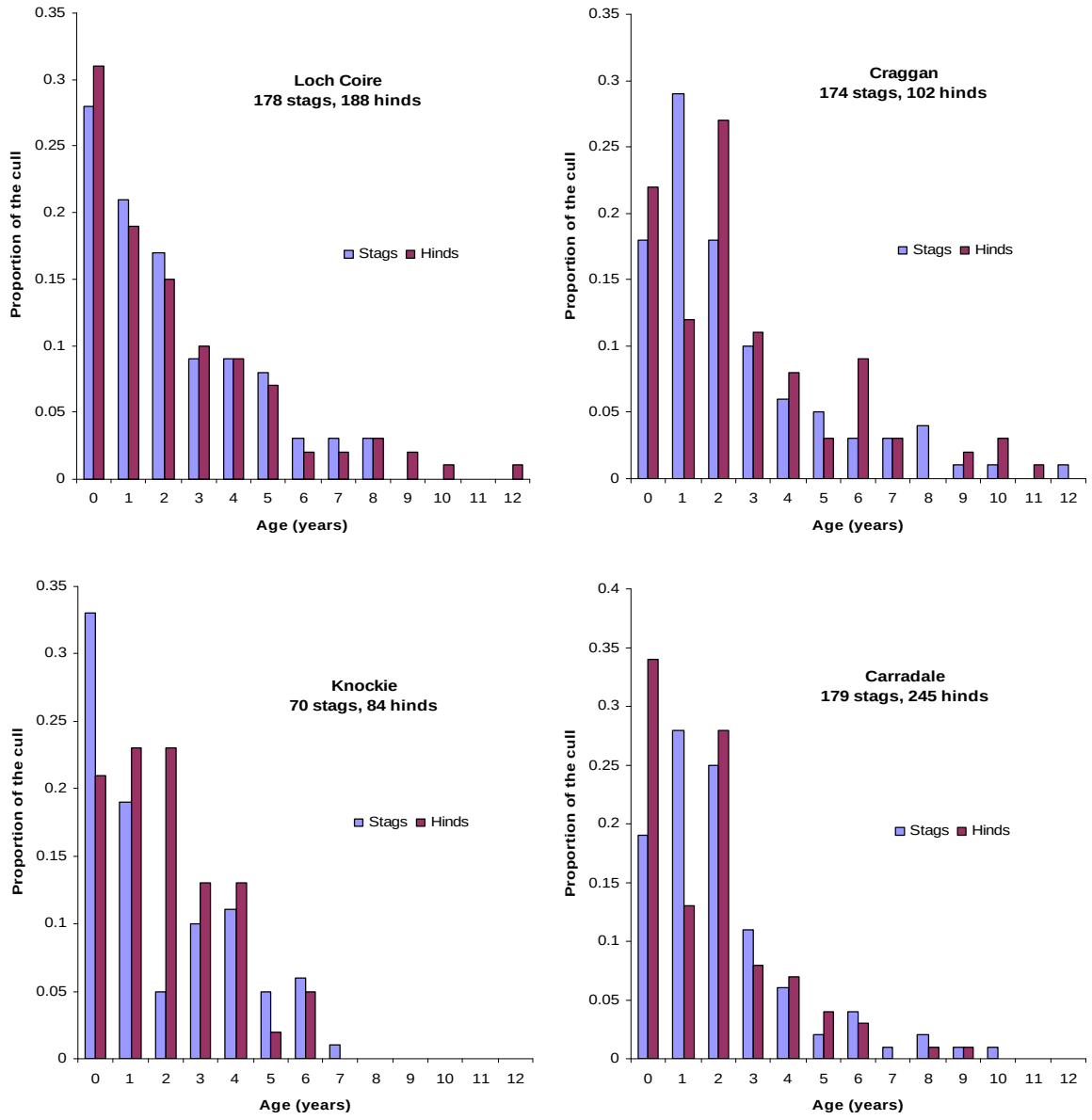

Fig. 3 Proportion of culled sika deer of each sex in each age class.

Measures of recruitment rate

The pregnancy rate for culled hinds at Carradale is the lowest of the four despite the high culled calf:hind ratio for this site (Fig. 4). This suggests that the pregnancy information for this site may not be reliable. Loch Coire and Craggan appear to have the highest proportion of pregnant hinds (Fig. 4). Without information on pre- and post-natal mortality, pregnancy rates are of limited use in estimating recruitment rates. Calves rarely became pregnant and negligible numbers of 1-year-old sika hinds were found to be lactating at all sites. Thus all calves were born to hinds of 2 or more years old. In theory, the proportion of hinds lactating and the calf:hind ratio (Fig 4) should be the same (if all hinds, which were, or had been, lactating were recorded as lactating) but, in practice, the two figures are similar only for Craggan. At the other two sites the proportion of hinds lactating was lower than the calf:hind ratio. The proportion of sika hinds found to be lactating at Loch Coire (Fig. 4) was so much lower than the calculated calf:hind ratio that it is likely to be unreliable. This suggests that lactation rate, in this case, was not a good indicator of recruitment rate. The calf:hind ratios calculated from the cull data suggest that Knockie has a particularly poor recruitment rate with Craggan almost as low (Fig. 4). Loch Coire and Carradale both have high calf:hind ratios. However the uncertainty over the accuracy of aging of calves, 1-

year-old and 2-year-old animals means it is impossible to say whether these differences in calf:hind ratio are real.

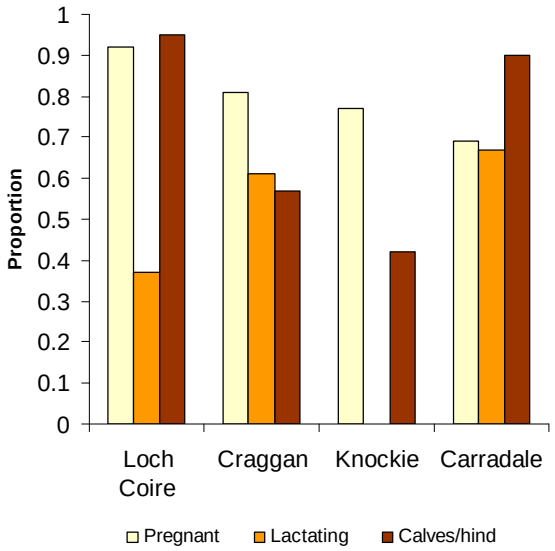

Fig. 4 Proportion of culled adult sika hinds pregnant and lactating (³ 2 years old only) and calf:hind ratio (for hinds ³ 2 years old only) at each site. Data are for all culled hinds over the whole study period. Only aged hinds could be used to calculate lactation rates. All unaged hinds were assumed to be adult for the calculation of pregnancy rates. No information on lactation was collected for Knockie.

Stalker effort

Information on the stalking effort required to cull stags and hinds was collected from only three of the four sites and, of these, the information was collected separately for stags and hinds only at Craggan and Loch Coire (Table 1). The killing rate for hinds is lower than the killing rate for stags at both sites as is the ratio of deer killed to deer seen (Table 1). This suggests that stags are easier to cull than hinds. Since travelling and extraction time were included in the calculation of stalking time at Loch Coire and Craggan but not at Knockie, it is not possible to compare between all three sites. It appears to have been harder to cull sika deer at Craggan than at Loch Coire (Table 1).

Table 1 Stalker effort at each site (mean over all years).

Site	Hours stalking per deer seen	Hours stalking per stag seen	Hours stalking per hind seen	Hours stalking per deer killed	Hours stalking per stag killed	Hours stalking per hind killed	Deer killed / deer seen	Stags killed / stags seen	Hinds killed / hinds seen
Loch Coire[1]	2.2	5.0	5.9	7.1	16.4	31.3	0.33	0.40	0.20
Craggan[1]	3.6	5.5	9.3	9.9	12.9	32.1	0.38	0.42	0.29
Knockie[2]	1.4			3.1			0.46		

[1] Travelling and extraction time are included in stalking time.
[2] Travelling and extraction time are not included in stalking time.

Population modelling

A population model was used to predict the culling effort that would be needed to maintain, or reduce, each population of sika deer. The recruitment rate was set at 0 for 1-year-old hinds and at the calf:hind ratio from the Loch Coire cull for hinds of 2 years or older. The figure for Loch Coire was used throughout because of the anomalies in the age structure of young hinds at the

other sites and because the lower calf:hind ratios at the other sites yielded predicted numbers that were much lower than those estimated in the field. Mortality rates, not including culling, were set to 0.10 for calves, 0.80 for deer older than nine years, 0.01 for 2-year-olds and 0.02 for all other ages of deer (Ratcliffe 1987). The initial age structures of the stag and hind populations were set according to the age structure of the total stag and hind cull for Loch Coire (Fig. 3) since this was the only site where there were no anomalies in the age class distribution (see above).

Loch Coire

Predicted populations followed the same trend as estimated populations (Fig. 5b) but the predicted populations tended to be higher. An annual cull of >21.5% of the population was predicted to reduce deer numbers (Figs. 5a,b). The model results suggested that population declines were achieved in six of the ten years (Fig. 5). However, even with a consistent cull of 40%, it would take nine years to reduce the population to 5 deer km^{-2}, the maximum density thought to be compatible with natural tree regeneration in many circumstances. This is brought down to six years if, for the first two years, culling effort is concentrated on hinds, with 80% of the hind and 10% of the stag population being culled. However, this will require increased effort since the stalking time required to cull a hind is greater than that required to cull a stag. (see above).

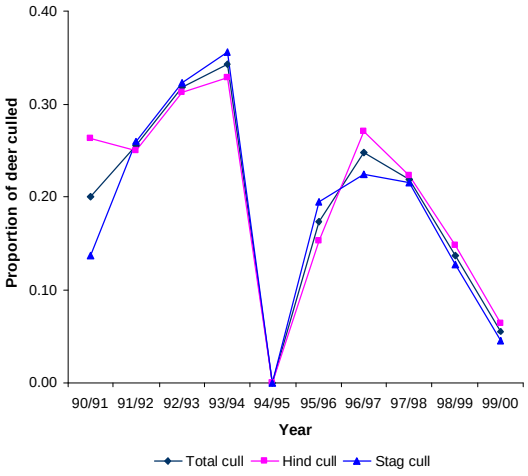

Fig. 5a Actual culls as a proportion of the predicted spring deer numbers at Loch Coire.

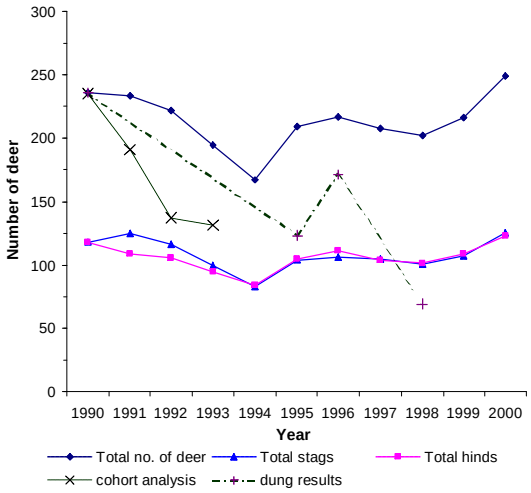

Fig. 5b Predicted spring deer numbers, including calves, at Loch Coire, using actual cull numbers and an initial population as estimated in 1990 (Fig. 3).

Craggan

The model predicted that the population would go extinct by 2000 (Fig. 6b). This was not reflected in the population estimates (Fig.6b). However, the model did predict population growth between 1992 and 1995 when culls were low or zero (Fig. 6b) as would be expected. The predicted population changes were mirrored by the cohort analysis until 1996 although the predicted population did not rise as fast as the cohort analysis suggested it should have when culls were low or zero. From 1996 onwards the cohort analysis and the dung density estimate indicated that numbers continued to increase whereas the modelling suggested that numbers should have declined (Fig. 6b). The results suggest that there was considerable immigration onto the site from 1996 onwards.

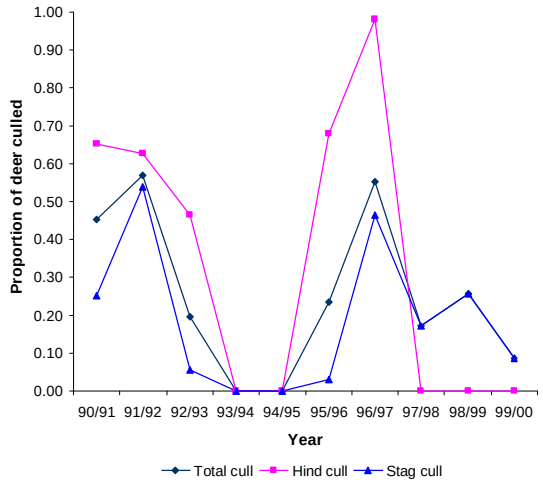

Fig. 6a Actual culls as a proportion of the predicted spring deer numbers at Craggan.

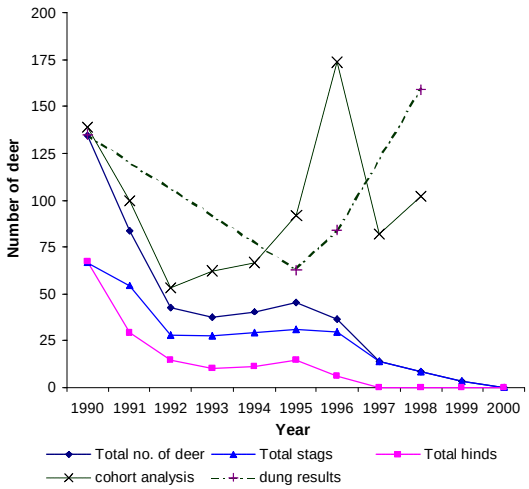

Fig. 6b Predicted spring deer numbers, including calves, at Craggan, using actual cull numbers and an initial population as estimated in 1990.

Knockie

The population was predicted to fall constantly from 1996 to 2000 (Fig. 7b). The estimated population from dung counts also fell from 1996 to 1997, and by a greater amount than the predicted population but it then stayed fairly constant (Fig. 7b). This suggests that, after 1999, there may have been some immigration. The decline in deer numbers was predicted to be rapid because the total cull was always above 21.5% and the hind cull was considerably higher (Fig. 7a).

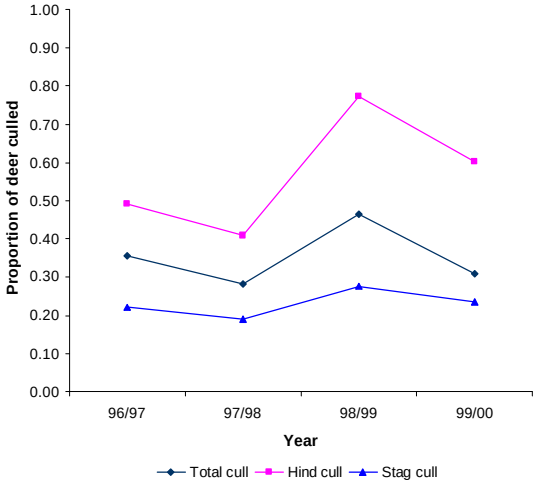

Fig. 7a Actual culls as a proportion of the predicted spring deer numbers at Knockie.

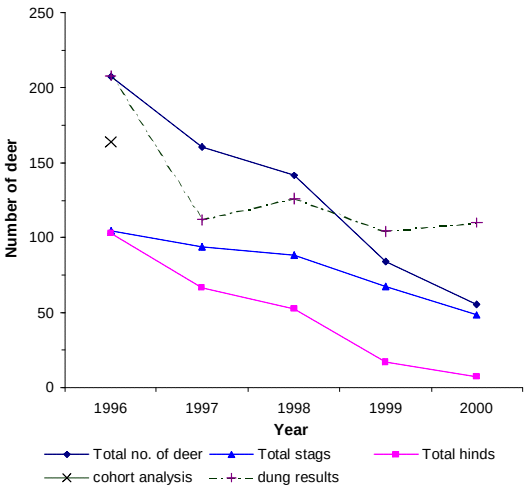

Fig. 7b Predicted spring deer numbers, including calves, at Knockie, using actual cull numbers and an initial population as estimated in 1996.

Carradale

The population was predicted to stay constant from 1996 to 1998. This agreed well with the results of the cohort analysis (Fig. 8b). It was then predicted to decline until year 2000. The modelling suggests that culling rates were sufficient to reduce numbers of sika deer in two of the four years.

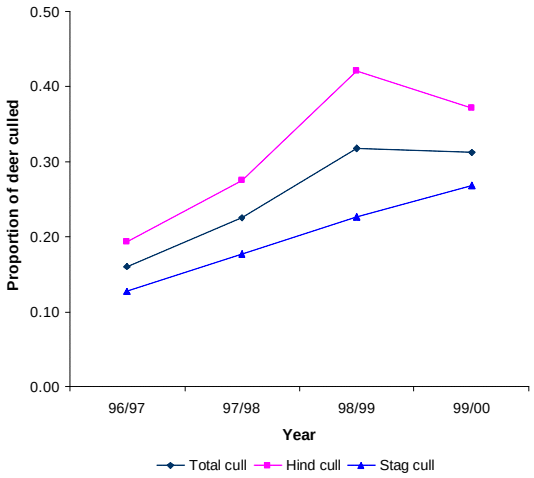

Fig. 8a Actual culls as a proportion of the predicted spring deer numbers at Carradale.

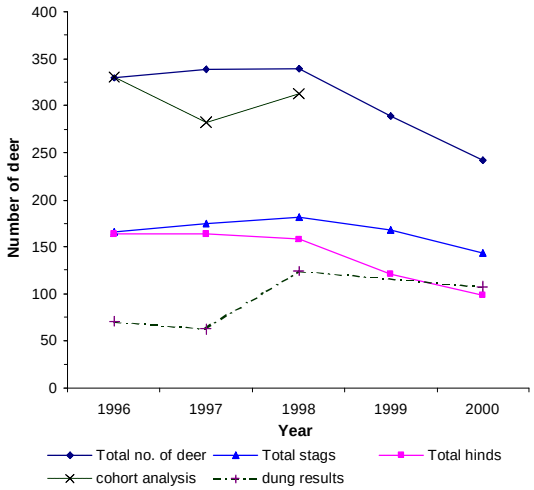

Fig. 8b Predicted spring deer numbers, including calves, at Carradale, using actual cull numbers and an initial population as estimated by cohort analysis for 1996.

Conclusions

The following conclusions have been derived from the complete study, not all of which has been reported on here.

Sources of data for model inputs

1. Pregnancy and lactation, if they are to be recorded, must be recorded systematically and on all, or on a random sample, of hinds for the results to be useful. It is essential that animals that have been checked but have been found to be not pregnant or not lactating are recorded as such. Sample sizes must be large (at least 100). Where good data exist they can be used to support calf:hind information from the cull.
2. A negligible number of 1-year-old sika hinds was found to be lactating at all of the four sites. Given the differences in habitat types between sites, this would suggest that 1-year-old sika hinds in Scotland do not generally have calves.
3. If the calf:hind ratio cannot be accurately estimated from the cull then an assumption of 0.95 calves recruited per mature female with a winter mortality of 10% or less will give predictions of maximum likely future populations.
4. The calf:hind ratio, derived from the cull, is potentially a useful estimate of recruitment rate and can be used for population modelling if young deer have been accurately aged, calves have been culled in proportion to their occurrence in the population and the sample size is large.
5. In later years, cohort analysis can be a useful additional means of estimating population numbers, if aging is reasonably accurate and culling has been non-selective.
6. Good quality data are needed, especially on the ages of young, culled deer and on initial population sizes, if the information gathered from the cull, and from population estimates, is to be used to set culls and achieve targets. If these data are not good quality then there is little point in collecting them.

Results and their implications

7. Less stalking time was needed to cull sika stags than hinds.
8. The results suggested that it is possible to control numbers of sika deer in a range of forest types given normal FE or DCS stalker effort. However this effort must be sustained.

9. For a regularly culled population, a cull of more than 21.5% of the population will normally be needed to reduce sika numbers, with the rate of population decline being greater the higher the proportion culled. A higher proportion will have to be culled if the population is initially unculled, or lightly culled, so has a higher proportion of breeding-age hinds.
10. Even where a high proportion of the population is being culled, several years will be needed to bring sika numbers down.
11. Culling will be more effective at reducing sika numbers where priority is given to culling hinds rather than stags. This is more likely to be possible where hinds can be shot outside the normal stalking season.
12. Population modelling can highlight cases where immigration is likely to be high. This was the case at two of the four sites investigated in this study.
13. Red deer management package principles can be used successfully to set culls for the management of sika deer if calves, 1- and 2-year-olds are accurately aged and if there are good population estimates, especially initially.
14. Data on the impact of deer on ground vegetation or tree regeneration, if collected using scientifically valid methods, could provide additional useful information to link deer management to the achievement of woodland management objectives.

Further reading

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