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RECALIBRATION OF THE REGRESSION MODEL USED TO PREDICT DEER DENSITIES IN THE BLUE MOUNTAINS RECREATIONAL HUNTING AREA

(Short Answers in Conservation Science)

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RECALIBRATION OF THE REGRESSION MODEL USED TO PREDICT DEER DENSITIES IN THE BLUE MOUNTAINS RECREATIONAL HUNTING AREA.

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Introduction

Southland Conservancy of the Department of Conservation (DOC) commissioned Weeds and Pests Division, Manaaki Whenua - Landcare Research, to recalibrate a regression model used to predict deer densities in the Blue Mountains Recreational Hunting Area (RHA) from hunter-reported deer sighting rates and hunting effort.

Background

Between 1984 and 1989 hunting effort, hunting success rates, and deer densities in RHA Hunting Area (RHA) were monitored by the Forest Research Institute (now part of Landcare Research), and regression model was developed that used the deer sighting rate (deer seen/hour hunted) and hunting effort (estimated total hours hunted/forested ha/yr) to predict deer densities (Nugent 1990). After the completion of that project, however, hunting return data was collected using a single return per party, rather than one return per individual as previously - this eliminated the multiple reporting of deer sightings within a party (Nugent 1991). As a consequence sighting rates for 1990 onward are not comparable with those obtained up to 1989, and cannot be used to predict deer densities using the "1984-89" equation. This has made interpretation of deer population trends difficult.

Objective

To recalibrate the 1984-89 regression equation for use with post-1989 sighting rate data, and to use the revised model to assess recent trends in deer density in the RHA.

Methods

Hunting return data for the RHA (blocks 1-34 and Brandy Gully) were compiled for the 1984-1992 period. Data up to 1990 inclusive were already held by Landcare Research, and 1991 and 1992 data were obtained as computer files (Dbase IV software package) generated by DOC staff. As far as possible the 1991 data was checked against written duplicate records.

Indices of deer density based on faecal pellet density were obtained for 16 groups of hunting blocks from each of three surveys (in January 1985, 1987 and 1990). Multiple linear regression was used to compare pellet-based indices with various measures of the hunting effort and success reported by hunters for each of the groups of blocks for the years preceding the pellet surveys. The best-fitting regression model that did not include any sighting rate variables was then used to predict an index of deer density for selected blocks for each year between 1987 and 1992. The analysis was restricted to the "central" blocks (3, 8, 12, 13, 14, 19, 20, 27, 28, 29, 30, and 31) and only the data for the June to November period was used, because these blocks were not subject to any harvest restrictions during these months that might have affected the relationship between deer sighting and kill rates.

Separate regression models were then developed for each of the 1987-89 and 1990-92 periods that related deer sighting rate and total annual hunting effort to the predicted indices of deer density. Because the dependent variables and one of the two independent variables (the

estimated total hunting effort/forested ha/yr) in these two models were exactly the same, equating the models permitted the derivation of formulae that could be used to convert pre-1990 sighting rates to values directly comparable with post-1990 data and vice versa. Substituting one of these formulae into the "1984-89" deer density model then permitted prediction of deer density indices for 1990-92.

A summary of the updated data for the 1984-1992 period was compiled, and compared with summaries from previous years to assess trends in the deer population and hunting pressure.

Results and discussion

The partly computer-generated 1991 data file supplied by DOC contained many errors and omissions, and therefore had to be checked and corrected. The 1992 data set was not checked against original data, but appeared to complete (i.e, there was record for every permit issued). However, it too contained a few obvious errors, most notably a record that indicated 75 pigs had been killed (even though only 47 had been sighted) in a single hunting trip. These errors are the source of at least some of the interpretative difficulties noted in the 1992 Annual Report for the RHA (Freer 1993).

A good relationship was found between the numbers of deer killed per hectare of forest, the total hunting effort in hours hunted per year, and the pellet frequencies recorded in the 1985, 1987, and 1989 pellet surveys ($R^2 = 0.69$, df = 52, $p < 0.01$). The pellet frequencies predicted for individual blocks using this relationship were found to be closely related to the deer sighting rate and hunting effort in those blocks in both the 1987-89 and 1990-92 periods ($R^2 = 0.50$, 0.53 respectively), but the regression parameters for the two periods differed substantially. Equating the regression equations for the two periods indicated the reported sighting rates for the 1990-92 period were about 22% lower than those for the preceding period independent of any changes in deer density.

The following conversion equations were derived:

Equation 1: $(\text{Deer seen/hr})_{1987\text{-}89} = [1.277 \times (\text{Deer seen/hr})_{1990\text{-}92}] + [0.004 \times \text{hr/fha/yr}]$

Equation 2: $(\text{Deer seen/hr})_{1990\text{-}92} = [0.783 \times (\text{Deer seen/hr})_{1987\text{-}89}] - [0.003 \times \text{hr/fha/yr}]$

where hr/fha/yr is the estimated total hunting effort in hours per ha of forest per year, and the subscripts for the deer-sighting-rate variables indicate the period to which they apply.

Using Equation 1, the parameters for the 1984-89 deer density regression model were recalculated, giving the following formula:

$$\text{Deer density (deer/ha)} = [0.801 \times (\text{Deer seen/hr})_{1990\text{-}92}] + [0.0027 \times \text{hr/fha/yr}] - 0.029$$

The updated annual summaries of hunting in the RHA (Table 1) indicate total hunting pressure in 1992 was down on previous years, partly because of a marked reduction in winter hunting effort (presumably reflecting unusually severe weather then) and partly because weekdays permits were more rigidly structured than previously. The proportionately smaller winter hunting effort is also reflected in an increase in the average number of hours hunted per day because hunters hunt longer each day in autumn and spring.

The estimated annual deer harvest has remained reasonably stable over the last three years, despite decreasing hunting effort. However, sighting rates and the indices of deer density

based on them suggest the deer population has declined from a 1990 high (Fig. 1). Although the deer sighting rate declined, the deer kill rate for 1992 was higher than for 1991, indicating hunters killed more of the deer they saw. Overall, the present deer population appears to be about 45% above the 1984 level (Fig. 1).

The pig harvest for 1992 was sharply down on 1991 (Table 1), probably reflecting a significant population reduction caused by higher than usual use of expert pig dog teams in 1991 (K. Cronin, pers. comm).

Conclusions and recommendations

The 1991 and 1992 hunting return data had clearly not been checked against the original information after it has been entered on the computer. In future, it is essential that this be done if the computerised permit-and-return system is to provide meaningful results.

The previously developed model used to predict deer density was based on sighting rates. Although other combinations of variables based primarily on kill rates were almost as useful in predicting deer density, a model based on sighting rates is considered preferable because kill rates can be affected by voluntary (or enforced) changes in hunter selectivity (i.e., in the proportion of deer seen that hunters choose to shoot). It therefore seemed better to recalibrate the previous "sighting rate" model rather than develop an alternative "kill rate" one. It is stressed that the revised recalibration should be seen only as an interim approximation, and that, if possible, the model should be recalibrated with a purpose-designed pellet survey.

Deer density indices based on sighting rates suggest the deer population is in decline, even though hunting pressure has reduced somewhat. The total harvest (and kill rates) has not declined as much as sighting rates because hunters appear to have become less selective. Because the recalibration of the regression model was based on assumptions that could not be fully verified, these conclusions rely mainly on the data for the last two years. They should therefore be regarded as provisional, particularly since some doubt remains over the accuracy of the computerised return data supplied. Any changes to the harvest regulations for the RHA based on these conclusions should not be made until data for 1993 (the third full year in which data will have been collected under the new system) can be analysed.

References

Freer, L. 1993. Blue Mountains Recreational Hunting Area annual report - 1992. Unpubl. Department of Conservation (Tapanui, Southland Conservancy) report. 14p.

Nugent, G.1990. Monitoring the Blue Mountains Recreational Hunting Area. Forest Research Institute contract report FWE 90/24. 25p.

Nugent, G. 1991. Summary of 1990 hunting returns for the Blue Mountains Recreational Hunting Area. Forest Research Institute contract report FWE 91/26. 12p.

Table 1. Hunting-return data for the Blue Mountains RHA (Blocks 1-34 and Brandy Gully) for the 1984-1992 period. The table includes the hunting done in January and December 1984 and 1985, and in January 1986.

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992
Permits	4054	3858	3619	4097	5492	5416	2299	2445	2554
Returns	3662	3560	3451	3199	5051	5011	2097	2096	2260
Return rate (%)	90.3	92.3	95.4	78.1	92.0	92.5	91.2	85.7	88.5
Hunting effort									
Reported days	3861	3860	3701	3948	6057	6420	4909	5679	5384
Hours/day	5.3	5.4	5.4	5.4	5.5	5.5	-	5.5	5.8
Total hours	22698	22465	20909	27438	36060	38169	-	37051	35130
Deer									
- seen/hour	0.1368	0.1429	0.1502	0.1558	0.1660	0.1693	-	0.1416	0.1297
- killed/hour	0.0192	0.0186	0.0174	0.0150	0.0139	0.0159	-	0.0183	0.0190
- seen/kill	7.1	7.7	8.7	10.4	12.0	10.7	-	7.73	6.83
- corrected kill	436	417	363	412	500	606	706	679	667
Pigs									
- seen/hour	0.0158	0.0125	0.0160	0.0140	0.0126	0.0170	-	0.0155	0.0102
- killed/hour	0.0067	0.0057	0.0061	0.0072	0.0055	0.0079	-	0.0088	0.0062
- seen/kill	2.5	2.2	2.6	1.9	2.3	2.1	-	1.9	1.9
- corrected	151	129	128	198	198	303	322	328	219

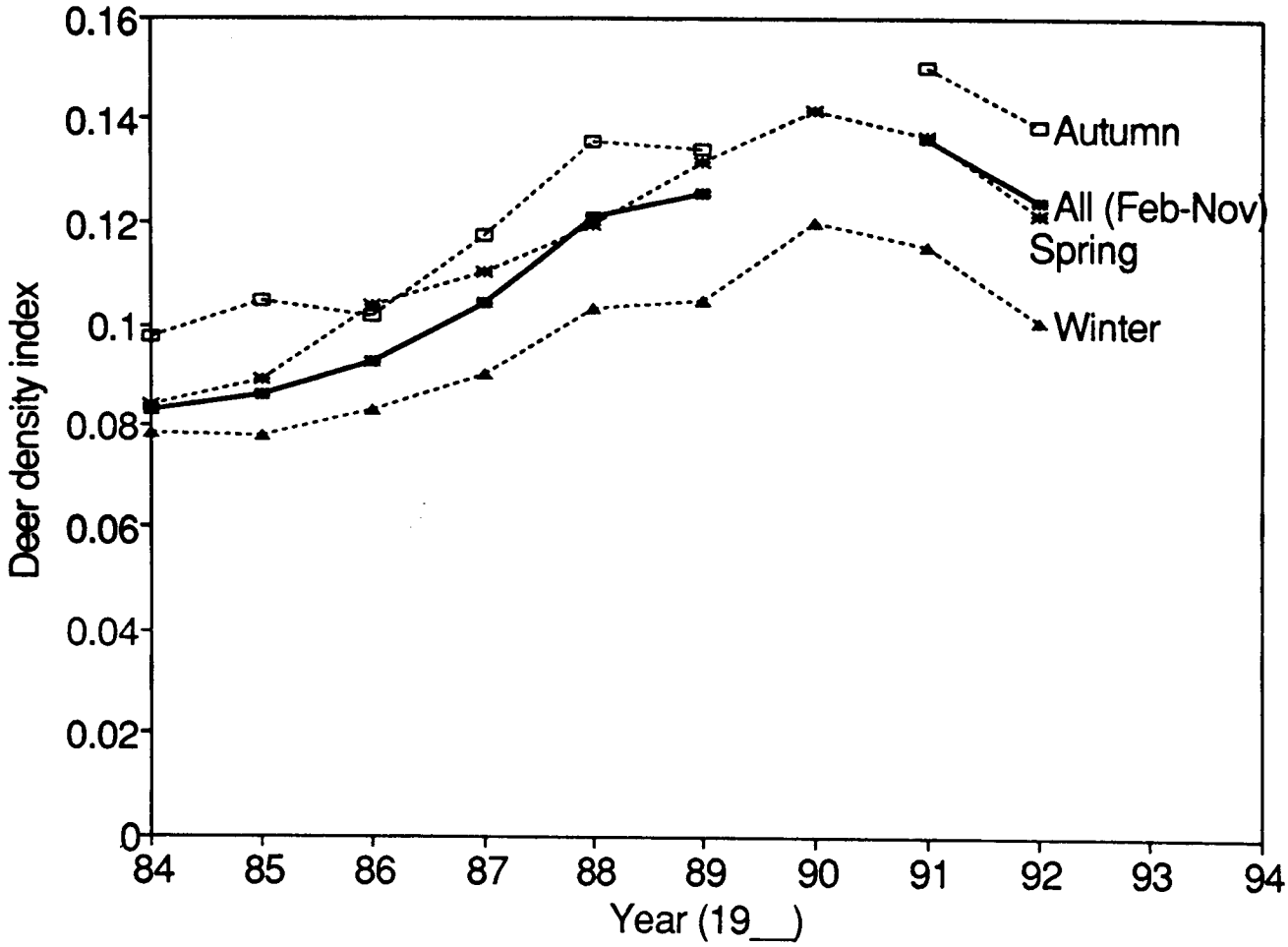

Fig. 1. Deer density indices for the 1984-1992 period, as predicted (using the recalibrated regression model) from deer sighting rates and the estimated total annual hunting effort. The overall average is based on the February-November period because no hunting was permitted in January and December from December 1986. The differences in the indices between seasons within years reflect seasonal differences in deer vulnerability, rather than actual differences in deer density, illustrating that the indices are only approximations of actual deer densities.