Methods for Assessing Deer Abundance in Woodlands

Report of a workshop organised by:
Deer Commission for Scotland/
Forest Enterprise/Macaulay Institute

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Introduction

To manage deer in woodland effectively, it is becoming increasingly important to have reliable, cost-effective and accurate tools to assess deer populations, and to measure their ecological impacts. A number of techniques have been developed, and are being used to assess woodland deer populations. Each of the techniques being used - pellet counts, transect counts, thermal imaging etc. - have their advantages and disadvantages, and it is important at this stage to identify the strengths and weaknesses of the techniques, and to co-ordinate future research and development. In response to this, the Deer Commission for Scotland, in collaboration with Forest Enterprise and the Macaulay Land Use Research Institute, organised a seminar, with the support of the Northern periphery Programme of the European Union, to explore the future development of techniques to assess deer populations.

With the establishment of deer management groups as a means to facilitate and improve the management of deer populations in Scotland, the accurate assessment of actual deer numbers is increasingly significant. On the open hill, direct counts are feasible, and can give accurate estimates of deer numbers. The assessment of deer numbers in forests and woodlands is especially difficult, particularly because of the limitations of direct counting methods because of the invisibility of deer, but also because of the significance of deer in relation to tree damage.

Indirect Counting Methods

In the first session of the workshop some of the advantages and shortcomings of the indirect method, the faecal pellet count approach, was discussed, and some of the key modifications to the technique which have been applied in certain cases to improve accuracy and practicality were described.

The most widely used indirect method for assessing woodland deer numbers in Scotland is the Standing Crop Count Method, based on counts of pellet groups from transect surveys. An estimate of the deer density is obtained by the equation:

$$\hat{T} = \hat{D}.\hat{P}/\hat{Q}$$

where $\hat{T}$ = density of animals

$\hat{D}$ = density of dung on quadrats/transects

$\hat{P}$ = mean rate of decay (1 / mean days)

$\hat{Q}$ = mean number of dung piles produced per day

and

$$\widehat{var}(\hat{T}) = (\hat{D}.\hat{P}/\hat{Q})^2 \,.\, [\, \widehat{var}(\hat{D})/\hat{D}^2 + \widehat{var}(\hat{P})/\hat{P}^2 + \widehat{var}(\hat{Q})/\hat{Q}^2 \,]$$

(Peace, 2000)

Deer numbers can be estimated directly from the number of pellet groups found along a transact. The method is relatively fast, as only one site visit is required. It is thus less expensive, and a large area can be surveyed within a limited time period.

The method, however, relies on an accurate estimate of the mean length of time for a pellet group to decay. Pellet groups are subject to a number of influences and their rate of disappearance can be attributed to a combination of factors. These include:

- diet of the deer
- site vegetation
- soil moisture levels
- microbial or invertebrate attack
- the mechanical forces of rain, wind or physical disturbance
- being covered by vegetation or falling leaf/needle litter

Pellet group decay rates are species-, site- and habitat-specific and consequently they should be estimated for each habitat/site combination where faecal pellet groups are to be counted and deer population sizes estimated.

Work was presented (Dr Brenda Mayle) demonstrating some of the variations that can occur in estimating defaecation rate. Within one species, the rate of defaecation can vary as a result of changes in diet:

Natural v concentrate	Higher rates if concentrates fed (Smith 1964)
Moisture content	'Wetter' forage = higher defaecation rate (Longhurst 1954)
Forage quality	Good quality = higher defaecation rate (Rogers et al 1958, Mitchell &McCowan 1984)
Forage diversity	Low variety = low defaecation rate (Rogers 1987)
Intake levels	higher intake = higher defaecation rate (Rogers et al 1958, Smith 1964)

Equally, there has been shown to be considerable interspecific variation in defaecation rate, as shown in Table 1. Data was also presented to illustrate the extent of seasonal variation that has been found in defaecation rates.

Table 1. Species variation in defaecation rates (Mayle, 2000).

Species	p.g. per day	Range	CV (%)	Reference
Fallow	11.3		11.5	Rollins et al, (1984)
	11.3			Bailey & Putman, (1981)
	13			Riney, (1957)
	24			Stubbe and Goretkzi, (1991)
	21.4	10.5 –29.5	15.0	Mayle *et al*, (1996)
Sika	6.9		4.3	Rollins *et al*, (1984)
	11.8			Takatsuki *et al*, (1981)
	26.3			Burkett, unpub, (1995)
	24			Benson, unpub, (1995)
Red	10			Riney, (1957)
	24.3	13.9 – 34.0	7.5	Mitchell & Mc Cowan, (1984)
	21.3	15.0 – 26.1	12.5	Mitchell & Mc Cowan, (1984)
Roe	15.6			Padaiga, (1970)
	6.7			Dzieciolowski, (1976)
	23.4	3.4 – 54.4	28.0	Mitchell *et al*, (1985)
	16.5	6.8 – 21.9	18.0	Mitchell *et al*, (1985)
Muntjac	7.5			Chapman (Pers. Com.)
		7.0- 22.4		Mayle, (Pers. Com.)

It was recommended to use a weighted average estimate of defecation rate, (site observations) with the weighting based upon the proportion of each month's pellets remaining.

Clearance plots
The other main indirect method employed in Scotland to measure deer abundance avoids the need to incorporate an estimate of dung decay, by making the transect in an area, in which the time period during which the pellet groups have been deposited is known. The clearance plot method requires two visits to a site – firstly to remove pellet groups from a marked transect, returning some weeks later to count the groups that have subsequently accumulated.

Defaecation rate is also a significant factor in the calculation of deer density from this method, and consequently a possible source of error.

A hybrid system was also reported (Graham Swanson), in which deer abundance is assessed during the first transect count, as per the standing crop method. Each pellet group is marked, for example, with a cocktail stick, as well as the position of the transect. The transect is revisited later, at which time, the new pellet groups are counted, and the analysis treated like a clearance plot. At the second visit, the state of the remaining marked pellet groups can be assessed, and a more accurate measure of the site-specific pellet decay rate made.

Direct methods
The second session of the workshop explored the use of direct methods for counting deer. New technology in the form of infra red imaging equipment is allowing greater accuracy to be achieved in direct counts. A ground-based method was reported (Robin Gill), as well as the results of trials of an aerial system.

The ground based method uses a military issue infra red imager scanning transects through a wood from the back of a pick-up at night. The equipment is highly effective at detecting deer, and the distance from the transect line can be accurately estimated, with practice. Trials at Alice Holt and elsewhere have demonstrated the system to be useful in the open woodland situation, with a low proportion of thicket. The system is effective and fast, in comparison to the other methods, and it was felt that the high capital cost of the equipment could be offset by the efficiency with which large areas can be surveyed usng the techneique.

The aerial system was trialled using equipment developed for oil industry related survey work (Jennifer Cook). The system was found to detect heat emitting bodies in woodland, but with the equipment used, it was not possible to identify positively the sources. Detection was also only possible in diffuse woodland, as it is not possible to penetrate a thicket using infra red from the air. However, the full capability of the Infrared Camera appears not to have been realised in the first trial, and enhanced performance may possibly be achieved with further work. In such a trial, it is recommended that a GPS data block should be included with the video returns to give specific data for each frame. Winter and moonlight nights would give best data, ie maximum differential between body heat and surroundings.

Deer impacts

Stig Gorseth (Norwegian Forest Owners Assoc.) reported work undertaken within the Northern Periphery Programme of the EU to link impacts and culling targets for elk in Norway. This project will establish a monitoring system for forest owners to record winter damage to trees in a systematic way. The research aims to direct the efforts of the forest owners themselves into a reliable and cost effective system for forecasting appropriate elk culling targets.

Conclusions

From a general discussion of strengths and weaknesses of current methods, the following future research and development priorities were identified:

Indirect measurements of deer density are site and season specific owing to variation in the rates of deposition and decomposition of dung pellet groups.

1. It is well-accepted that transects are more practical than square quadrats (but final decisions are dependent on field circumstances).

2. A reliable method is needed to estimate decay rates in the field.

3. For clearance plot methods, the deposition rate used should be the mean of observations at clearance and count

4. Where possible “scientific estimations should be compared with a practitioner’s estimate estimations. Possibly difficult to do. This must be foreseen in advance of a trial.

5. For standing crop - use weighted average estimate of defecation rate, (site observations) with the weighting based upon the proportion of each month’s pellets remaining
6. At “low” densities, clearance plots are less efficient.

7. Accuracy only needs to be sufficient to meet objectives on the ground. Precise estimates of populations not always necessary - methods required to monitor results of management.

8. Assessment of the deer density should also include an estimate of the accuracy that has been achieved. Comparison where possible should be made of different methods on same sites, including assessment of observer error. This needs accurate description of methods used.

9. As a research tool (e.g. studies on biodiversity impacts), precise measures of populations are required. Methods require clear definition of protocols

10. Natural heritage objectives are not yet clearly defined.

11. Private sector needs to take on some responsibility for deer management to achieve natural heritage objectives.

12. There is a genuine conflict in Scotland between forestry and sporting interests, and a limited market for sporting lets (experience of FE)

13. Thermal imaging, in addition to assessing deer populations is also useful for observing deer behaviour, which may be useful in improving the assessment of immigration and dispersal.

14. Modelling may help to make sense of the complexity involved in deer density assessment.

15. A working group would be set up by DCS to co-ordinate research efforts

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