IV. HABITAT USE OF WILD UNGULATES: DISCUSSION

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Introduction

Many methods for the measurement of habitat use were discussed, but two received the most attention, i.e., faecal pellet counting and direct observation. The discussion touched several times on problems concerned with the measurement of food intake, diet selection, and impact on the vegetation. The importance of defining in advance what one wants to know and why one wants to know it was underlined, because these two questions determine to a large extent the choice of methods for the research. Methodology concerns the selection of the study site, the study population, the parameters, and the sampling methods. Extrapolation from one study area to other areas is impossible without experimentation, because otherwise the causality of the processes cannot be understood: a description of habitat use by a study population alone will not yield enough information to provide a model of even the study site itself, let alone to serve for predictions concerning other sites. The discussion dealt with methods that can be used:

I. to assess the occupancy of the habitat by the animal species under study;

II. to assess food intake or to arrive at a description of the diet of the animals in question;

IIIa. to assess the amount of food on offer and the impact of these consumers on the vegetation and, b. on the use of the phenological calendar.

The discussion dealt primarily with wild ungulates, but parts were also valuable for free-ranging domestic animals. The methods discussed can be divided into two groups, viz., direct methods in which direct visual or other contact with the animal to be observed is used to establish its presence or activity and indirect methods, in which traces of various kinds are interpreted as indicating presence or activity.

Direct methods

Visual observation

It was generally felt that direct visual observation of the species under study is the best way to collect reliable information about habitat use, food selection, etc. Even when telemetry is feasible, it should be used in conjunction with direct visual observation for control. Several direct visual methods were discussed, roughly divided according to sit-and-wait and search-and-follow. With the sit-and-wait method a hide is erected and the observer remains in it as long as necessary. Only when the density of animals is quite high, the chance that one will observe the animals quite good; at low density 'you will sit and see nothing'. It was pointed out that one major drawback of this method is that the selection of sites for the hides will introduce a stong bias against the presence of all habitat types. Nevertheless, it can provide excellent information in some open types of habitat. The method can also be used at night with night vision equipment (and if necessary with infra-red floodlighting).

The search-and-follow method is strongly dependent on the habitat type (e.g., inapplicable if too steep or too densely vegetated) and on the wariness of the animals. The search-and-follow method is easily biased - and to an unknown degree - by the disturbance caused by the observer. Observation from a vehicle is preferable but the observer should never use the same type of vehicle as the hunters employ. Cessation of hunting is recommended for a study area where direct observation is to be carried out; sometimes animals (e.g. deer) react quickly, becoming tamer (Ireland after the Chernobyl fall out), but in many areas they take a long time to do so. It was suggested that admittance of the general public (without dogs) could promote tameness of the study population. A last resort could be observation on horseback.

Observers should arrange to be as comfortable as possible (a nice temperature for working and a comfortable place to sit), because there is a strong correlation between the quality of the observations and the comfort of the observer(s). Nocturnal observations do not pose a problem if one is seated in a vehicle or in a hide. Many animals quickly become accustomed to spotlight, and night vision equipment gives good results, but moving around is more difficult at night. Telemetry can help to locate the animals. It is not clear why some populations have nocturnal

feeding habits and other diurnal. There is no reason to expect a quick change from nocturnal to diurnal if hunting is stopped in a study area. The easiest way to solve this problem is to find another population which is not nocturnal; if that is impossible, the difficulty must be coped with in some other way.

Visual marking of individuals

Individual recognition is not only imperative for studies involving the social organization of the population, but also for dealing with problems of biased sampling (e.g., good data on food selection might concern some tame deer happening to use a specific habitat type that is hardly used by the majority of the population). An attempt should therefore be made by preference to mark all individuals of a population (or use natural markings) but this marking system means having to capture the animals. Paint spraying or paint shooting was not discussed, but these methods may give good results too. Patterns of movement can only be studied if a number of individuals have been marked, and 'radio-marking' of individuals can also serve this purpose.

Radio-marking of individuals

After individuals have been caught they can be tagged and fitted with transponders. In connection with the present discussion on habitat use, it was agreed that telemetric methods can determine where the individuals are at a given moment with some precision, but will tell nothing about *why* the animals are there; furthermore, it remains doubtful whether they will supply enough information about *what* the animals are doing there. Some felt that with sufficient effort enough information can be obtained with telemetry if heart rate, head up/down movements, number of bites, etc., are recorded with different sensors. It was emphasized that one should strive to collect data that can be analysed in a straightforward fashion and with statistical methods.

Other participants were more catholic in their approach, and pointed out that one ends up with many notebooks full of 'data' that are impossible to analyse ('two roomfulls of collected and unanalysed data for each publication'). Although the majority agreed that this was a valid point, they preferred to use notebooks because they needed them later on

Automized radiotracking demands major investments of time and money.

for their analysis of the numerical data. Moreover, they did not believe that any telemetry system will function all of the time, so they felt a need for the back-up system supplied by their notebooks.

It also was remarked that the social structure of a group of animals is often habitat dependent (e.g., small groups in closed habitat, larger ones in open habitats). Thus, if one relied exclusively on telemetry and only a few individuals had been fitted out or could be tracked, erroneous information would be obtained about habitat use by the population as a whole. As capturing of all individuals or getting all transponders to work is unlikely, 'old-fashioned' methods must be relied on as well.

Indirect methods

Hoofprints

One of the so-called old-fashioned methods is to look for tracks left by the animals. If there is an extensive network of unmetalled roads in the study area one could consider tying brushwood (e.g., *Crataegus*, *Prunus spinosa*) on the rear of a vehicle to obliterate old tracks so one could check for new tracks every day. If these roads lie along the perimeter of different habitats, the tracks left by the animals could yield some information about the differential use of the habitats. However, the

number of tracks is not dependably correlated with such items as percentage of habitat occupancy or of time spent in different habitats, and therefore the data will give only a general idea about habitat use by the population. The 'track method' can nevertheless supply additional information in some study areas.

Dung depositions

In this respect, too, the group had grave reservations about the usefulness of methods based on the distribution of faecal pellet groups and interpretation concerning the habitat occupancy. Droppings tell where animals have defaecated, but the interpretation of dung densities in different habitats is not simple. Experienced participants agreed that the methods work better in areas with little variation compared with areas showing a complex pattern (many types of habitat). Used together with stratified sampling in different habitats, the method could provide good estimates of the total population size, but it is uncertain whether it could lead to a reliable estimate of densities in different habitats. Even the best searchers show a differential success in pellet finding in different habitats, but a correction can be established by scattering a known number of pellets in a plot and scoring the number of retrieved pellets.

The identification of pellets is also more difficult than might be expected (in a known mixture of pellets of red and roe deer, 25% of the pellets were wrongly identified; so, test yourself). For statistical reasons the number of plots in each habitat must be at least eight, irrespective of the relative area of that habitat type, but one should try to have at least 20 plots. Systematic sampling, which gives better covering of the area than a random sampling of plots, is not statistically inferior to the latter, but some of the participants still felt that a dung method to study habitat use only gives information about differential defaecation in the habitat types. This drawback could be overcome by calibrating the pellet counts against information on habitat use obtained by direct visual observation or telemetry, even though the telemetric results are biased too. This problem was not discussed further but is of paramount importance. It is felt that two sources of imperfect information can yield better results than one source (as suggested by e.g. Baeysian methods of interference).

For comparison of the use of different habitats on the basis of the

dung method, it is very important to establish the smallest possible confidence limits for each estimate of dung density in the habitats in question. Although the decay rate of the dung is not important when the clearance method is used (i.e., all pellets removed from a plot after each count), this method is less reliable than the faecal standing-crop method (i.e., counting all pellets in a given area), because the latter method yields fewer zero values (theoretically this cannot be true). Zeros are extremely difficult to interpret, and for the analyses it must be assumed that the values from the different plots have a negative binomial distribution.

Information from bite marks

Since participants showed a general mistrust of indirect methods, it is hardly surprising that they voiced reservations about the use of bite marks for the study of habitat use, the quantification of foraging time, and the assessment of off-take. They were less doubtful with respect to woody species than about bite marks on grass or herbs. The main problem associated with bite marks is the difficulty of estimating the number of bites on herbs. One misses too many bites (but no one knows how many) to reach any quantitative conclusion about habitat use on the basis of scoring of bite marks. Even if one could score all bite marks on a sward and knew the total herbage mass, a 10% error in assessing the bite depth would lead to an error of +40% in bite weight and thus in forage offtake. This is rather depressing if you have worked 14 hours in the field to collect data of these types. Furthermore, certain food items completely escape notice with the bite mark technique, e.g. acorns.

Assessment of food intake and diet composition

Direct visual observation and telemetry

During the present discussion this subject was only touched upon briefly. Estimation of bite size cannot be based on gravimetric quantification. The same applies to telemetry: the number of bites can be recorded via sensors attached to the jaw but an estimation of bite size is very difficult (Chapter VII).

Faecal analysis: reliable information on the defaecation rate and the amount of faeces produced is difficult to obtain for wild animals

(Chapter VII). Faecal analysis has been used extensively for the assessment of the botanical diet composition, but bias with respect to the qualitative and quantitative composition should be checked by means of controlled experiments.

Rumen analysis: rumen analysis is unreliable not only because of the differential passage rates of the particles of different sizes but also the different rates of digestion of plant species/plant parts.

Bite marks: the tallying of bite marks was considered completely unreliable for grassy vegetation and herbs; it appeared to be more reliable for animals feeding on woody species.

Exclosures and standing-crop assessment: during the discussion several participants repeatedly emphasized the point that both the food on offer and the offtake can be measured quite reliably by the use of temporary exclosures. This method was considered especially necessary for grassy vegetation or herbs. It must be kept in mind, however, that certain types of exclosure, particularly those using a cage, can induce an increase of primary production. This method is more suitable for estimation of the offtake from a certain habitat type or location than for assessment of the animals intake, because most areas are heterogeneous.

Assessment of food supply and grazing impact

Exclosures and standing-crop assessment

Although this method was only touched on briefly, it appears to be the most reliable. Knowledge of phytomass on offer and food offtake in a given type of habitat or location and the animals' intake (per unit of time, per day) is essential if one wants to know why the animals are at a given place in the area at certain times. Information of this kind can only be obtained by the expenditure of much care and effort.

Vegetation description and impact assessment based on bite marks

This subject was not adequately discussed. The Braun-Blanquet method, as advocated by Petrak, makes use of a non-linear scale to weigh the importance of different plant species, and attaches too much weight to rare species. The method is apparently appropriate to describe plant species associations but is not adequate for estimation of the relative impor-

tance of the amount of food offered by the individual plant species. In this respect the point-quadrat method seems to be superior. The impact on vegetation was not adequately defined, but if it is taken as damage to e.g. trees as interpreted by foresters, Petrak's method could be of value. The problems would then be what foresters view as damage and the ecological meaning of their interpretation of bite marks. Petrak agreed that if interest is concentrated on biomass removal and its effect on the plants, use must be made of exclosures and harvesting techniques.

Habitat description

One of the major problems encountered in the study of habitat selection is how to understand a situation from the animal's angle. Many aspects must be taken into account here, not only the vegetation but also the degree of shelter, steepness of slope, height of shrubs, amount of timber, etc. Even cluster analysis of these data will not show how to weigh the various factors. When aspects and parameters are selected, the potential limiting factors for the animal should be considered and availability in the research area assessed. Factors such as available *ad libitum* level will have no influence. An attempt should be made to rank factors according to their relative importance and relative availability. Habitat classification - which must of course precede mapping for habitat-use studies - has proven to be very difficult. Perhaps the only satisfactory approach is to describe the habitat units in a very old-fashioned way, i.e., to use terminology to distinguish one 'unit' from another (e.g., heathland, shrub, thicket, forest, meadow), and then use these units in the classification, mapping, and description of the habitat. But it is evident that this would give only a poor approximation of the animals' 'view' of the area.

Incidental and unpredictable habitat characteristics can have a strong impact on habitat use, e.g., the presence of leaves or branches on the forest floor after a storm.

Usefulness of the phenological calendar

The participants agreed that the phenological calendar can be useful for the comparison of study sites within a large geographical area (e.g. Europe). The relevant data are often collected in botanical gardens belonging to the network of phenological stations in Europe. (The U.S.A. has a network of this kind too.)