Sweden's new national landscape monitoring program, SLÖ

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Background

In Sweden, a sample-based landscape monitoring programme is currently being developed. The focus of the programme will be biological diversity in a landscape context (Inghe 2001, Glimskär et al. 2001). Changes of the Swedish landscape in relation to current policy will be monitored, as well as changes in species composition in relation to observed changes in landscape composition and structure. The programme is scheduled to start in 2003. It will be part of the Swedish national environmental monitoring system headed by the Swedish Environmental Protection Agency. What is written is this paper reflects the plans in autumn 2001.

The intention is that the programme should provide information on changes on a regional and national scale. However, local county administrations will be given an opportunity to participate in the programme by increasing the sampling intensity locally. Thus, the inventory may in some parts of Sweden provide information also for local-level policy decisions.

Design

Preliminarily, a sample of approximately 500 landscape units of size 5 x 5 kilometres will be randomly selected following a stratification procedure. The stratification is introduced to secure a large enough sample from agricultural areas, wetlands, and from the northern mountain region. All sampling units are planned to be permanent; re-measurements will be carried out with a 5-10 year interval.

The sampling units will be divided into two parts. In an inner sector, intensive mapping and inventory of habitat composition and structure, as well as species composition, will be carried out. In an outer sector the landscape, and landscape changes, will be described in a more general way, as an additional input to the understanding of changes in species composition that might occur in the inner sector. The reason for making only a general description of the larger area is to reduce the cost of the inventory. Moreover, the 5 x 5 km unit is intended as a frame, within which already mapped especially valuable wetlands and grasslands will be monitored in connection with the inventory.

The basic components of the design are the following:

- *Stratification*, based on digital maps. Strata are formed for obtaining homogeneous units to improve the precision in national estimates, for obtaining large enough sample

sizes from certain key areas (agricultural areas, wetlands, etc.), and also in order to define regions for which separate estimates should be presented.

- *Aerial photo interpretation* will be an important part of the design; infrared images are planned to be acquired specifically for the purpose of the landscape monitoring programme (cf., Ihse 1993). By photo interpretation, the different cover and land-use classes in the inner sector of the sampling units will be delineated, mapped, and described by a number of characteristics (e.g., cover type, land-use, tree species composition, etc.). In the outer sector, a much simpler interpretation will be made, except in previously identified especially valuable wetland and grassland areas, where the same procedures as in the inner sector will be used.
- *Field sample plots* will be laid out in a (random) systematic pattern over the inner sector of the sampling units, as well as in a sample of the specifically identified wetland and grassland areas. The sample plots will be used for calibrating the assessments made in the aerial photos (e.g. cover type, land-use class, etc.). In addition, field measurements will be made to assess a number of features that will not be possible to assess from the photos. Typically, this involves recordings of indicator species on plots.
- *Line intersect sampling* will be carried out along randomly distributed transects in the field, in order to obtain a basis for the calibration of aerial photo based estimates of the length and quality of linear features (roads, hedges, stonewalls, ditches, patches along roads and ditches, etc.). To obtain a large enough sample from patches of land along linear features, certain rectangular plots will be laid out where the survey lines pass such elements.
- *Strip surveying* might be used in the field in addition to line intersect sampling. The purpose is to obtain better precision for important point elements, like large trees, small ponds, etc. An alternative to strip surveying would be to use larger sample plots.
- *Insect trapping* will be carried out on specifically selected sites within the inner sector of the sampling units. The principle for locating the traps has yet to be decided.
- *Satellite remote sensing* to obtain a full spatial cover of important landscape features, observable in satellite images, might in the future also be part of the programme.

A specification of what parameters should be assessed is currently being developed. Preliminary results are reported by Glimskär et al. (2001). From a design and estimation point of view, the different parameters can be separated into the following classes:

1) Indicators of landscape structure
2) Areas of different cover types or land-use classes
3) Lengths of linear features
4) Numbers of point elements (and totals of some certain characteristic)
5) Frequencies of occurrence of indicator species or key landscape elements (and number of species on plots of a certain size)
6) Abundance indices for the number of trapped insects
7) Cover proportions of certain species, vegetation types, or tree crowns

The computation of landscape metrics of various kinds (normally) relies on a segmentation of the landscape into different cover or land-use categories. The possibility to derive such metrics is one reason for the mapping that will be carried out in the inner sector of the sampling units. Another reason is that the Swedish Environmental Protection Agency strives to allocate other monitoring programmes, e.g. the annual survey of nesting birds, to the same areas. A detailed description of the landscape units will thus provide valuable input to other programmes, in their analyses of species occurrences and changes over time.

To monitor changes in landscape composition, a combination of photo interpretation and field survey will be used. The reference unit of classification will be large field plots and interpretations made in aerial photos can thus be calibrated using the field assessments. A similar procedure will be used for the linear landscape elements. Preliminary estimates will be obtained from photo interpretation. In the field, it will be verified whether or not an element was correctly classified in the photos, elements not found in the photos will be added, and additional quality assessments can be made.

Many of the important point elements in landscapes are quite scarce. Thus, standard plot based inventories will most likely lead to poor precision in the estimates. To solve this, strip surveying, with varying strip width depending on what feature is searched for, might be applied. The strip and line intersect surveys can be carried out simultaneously.

Assessment of vegetation will be an important part of the programme. Ideally, the cover percentage of different species and species groups should be monitored. However, the assessment of cover has in many studies, e.g. Odell & Ståhl (1998), been shown to be quite unreliable. An alternative is to assess only the presence or absence of species on plots. If both large and small plots are used, vegetation changes concerning sparse species can preferably be monitored on larger plots, while changes concerning common species could be monitored on smaller plots. Most likely, however, some assessments of cover will be made in combination with registrations of presence/absence of species.

Traps will be used to monitor changes in the insect fauna. From these trappings, it will be impossible to calculate actual population sizes. Rather, abundance indices will be derived to obtain a relative measure of changes in the population size of different species.

References

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