ECOLOGICAL COLLECTIONS AND LONG-TERM MONITORING WITH RESPECT TO THE WAGNER PEATLAND

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INTRODUCTION

The following is intended to provide an assessment of the Wagner Natural Area as a candidate for long-term ecological monitoring of environmental change. Factors considered are choice of site, sampling procedures and logistical support. In some cases general considerations for long-term sampling have also been addressed where the need was indicated.

CHOICE OF SITE

Danks, Wiggins and Rosenberg (1987) attributed three desirable characteristics to the choice of a site for long-term environmental monitoring and ecological sampling.

1. Limited variability.
2. Sensitivity to environmental change.
3. Pre-existing interest in the habitat.

1. HABITAT VARIABILITY: The reasoning inherent in the need for low variability in the choice of habitat is that any change can be more easily observed. The Wagner Natural Area, a mixed peatland west of Edmonton, is a highly complex mosaic of habitats ranging from spring-fed marl pools exhibiting basic pH to sphagnum/black spruce areas exhibiting acidic conditions. This mosaic of habitats is responsible for the high species richness of the area (445 species of plants and 1,070 species of arthropods to date; arthropod richness is estimated to be between 3,000 and 4,000 species). Although limited variability is considered desirable, ecological changes at Wagner are likely to involve faunal reductions because either acidic or basic conditions are likely to dominate the habitat. Any change is therefore easily observable, thus in effect meeting the requirement of low variability.

2. HABITAT SENSITIVITY: The Wagner Natural Area is particularly sensitive to water-level fluctuations. Decreasing water levels promote an increase in acidity because sphagnum hummocks, which acidify the surrounding habitat, overgrow the marl flats and ponds. Increasing water levels decrease acidity by extending the marl pools and by killing the black spruce, which is acid tolerant but affected by high water levels. In either case species richness is reduced. Water levels in the area are affected by changes in annual precipitation and groundwater usage: wells, farming, forest clearing and road construction.

3. HABITAT AWARENESS: In recognition of this relatively unusual habitat, the Alberta Department of Forestry, Lands and Wildlife in cooperation with the Wagner Natural Area Society have preserved the habitat as part of the Natural Areas Program. The Wagner Natural Area Society actively promotes research in the area and monitors vegetation growth rates at several sites, monitors birds annually and continuously records water levels. The site is open to the public with nature trails and board walks and is located 8 km west of Edmonton on a 320-acre parcel of land including a surrounding buffer zone.

From *Newsletter of the Biological Survey of Canada (Terrestrial Arthropods)*, Vol. 7, No. 1, Spring 1988

SAMPLING PROCEDURES

Any technique or combination of techniques that is capable of collecting a more-or-less complete sample of the species present allows comparison with such samples from other areas or in the future. Since all known techniques collect only a fraction of the existing species it is important to use a combination of techniques and to record sampling protocol and habitat in detail. Specialists in various groups should be consulted for collection techniques and preservation requirements peculiar to groups in their areas of expertise. Spot collections and short-term samples are not particularly useful because seasonal conditions can vary considerably from year to year and the insect fauna undergoes substantial change during a season. Because of such season-to-season variations and seasonal faunal succession, the most ecologically significant collections are obtained by sampling for the duration of activity throughout the year. This can include mid-winter in some Canadian habitats.

Long-term ecological sampling cannot be considered without concurrent monitoring of the postulated environmental changes. Long-term collecting without monitoring environmental variables will result in the expenditure of a huge effort for relatively little return. Such effort is useful in determining only that a change has taken place but is useless in postulating the nature of that change (i.e. critical levels of an environmental factor, rate of change of an environmental factor with respect to the fauna) or predicting environmental impact. Thus in order to be cost effective, long-term sampling must, in conjunction with the sampling program, identify and monitor environmental variables that are subject to change.

Finally, the sampling procedure must be broad-spectrum. Danks, Wiggins and Rosenberg (1987) have suggested that sampling might emphasize specific groups that would provide data of particular interest. Such approaches are often more relevant to a scientist's short-term research or grant than they are to documenting the nature of long-term environmental change. Even so, if a particular group is selected for long-term monitoring, extreme caution must be exercised with this approach. Can we predict what organisms will be affected and to what degree by an environmental modification? For instance, if the target organisms do not change in species richness in response to a given environmental modification, then no information or misleading information is obtained with respect to the nature of any repercussions on the fauna. If, on the other hand, the target organisms are eliminated by a given environmental modification, misleading and ultimately no further information may be obtained even though other groups may still exist and possibly exhibit increasing species richness. In long-term studies it is important to document gains as well as losses in species richness.

The target group or indicator species approach is good in assessing habitat quality but of limited use in documenting and predicting faunal impact of a long-term environmental modification. The indicator species lends itself to diversity studies rather than richness studies. Diversity is a function of both numbers of species and abundance of species while richness considers only numbers of species. It is difficult to provide a standard sampling protocol for diversity measurements because abundance curves must be known for each species sampled at each sample site. Sampling indicator groups or species can provide evidence of a faunal change but caution must be used in extrapolation of the nature of that change to the total fauna. It would be difficult to prove that a particular group of organisms acted as an indicator of diversity or richness for the entire arthropod fauna. Broad-spectrum sampling for species richness overcomes all of these difficulties but brings on logistical problems of its own.

Summary of sampling procedures:

1. The sampling program should be conducted for the duration of activity throughout the season.
2. Any combination of techniques that provide a more or less complete sample of species allows comparison with other such samples in space and time.
3. Any postulated environmental changes must be monitored concurrently with the sampling procedure.
4. Any sampling procedure should be broad-spectrum and measure gains as well as losses in species richness.

LOGISTICAL SUPPORT

Once the above considerations for choice of site and conditions for sampling procedures have been met, one can be faced with collections of elephantine proportions. It is practically impossible for a single or even a few people to process and analyze all groups of arthropods in collections of this type. Analyses conducted at the species level provide a high degree of biological reality relative to the more abstract higher levels like genus or family but a lesser degree relative to individual or population analysis. The latter depends on abundance measurements and for the most part is precluded from the type of collection just described. Analysis of higher levels will usually dilute or obscure any environmental effects on the fauna but can provide substantial insights when used in conjunction with species analysis.

In our experience it is relatively quick and inexpensive to sort general collections to ordinal level and store those sorted samples in alcohol. Specialists with short-term research concerns or interests in particular groups may then be consulted and those groups of interest sorted from the alcohol material (specialists should also be consulted at the sampling-procedure stage about collection and preservation techniques peculiar to their groups). The more specialists contributing expertise in particular groups the more meaningful will be the overall analysis. In order to obtain maximum input from as many specialists as possible a registry of collections that meet the above requirements should be maintained and distributed on a regular basis.

A major project of this nature with general sampling can be expected to consume three to five years and at some point in the future the exercise must be repeated. Unfortunately most institutions cannot afford to commit such resources to a single habitat on a long-term basis without outside support. Long-term monitoring requires cooperation. Local and national museums are in the best position to initiate and manage long-term studies. They are also able to provide expertise and facilities necessary for long-term storage and curation of large amounts of material. Universities through graduate programs are reservoirs of specialists able to use these types of collections for short-term more exclusive types of investigation. Unless granting agencies recognize that support is necessary both for curation and housing at the museum level and for research on these collections at the university level then it is unlikely that arthropods will ever be considered in a comprehensive long-term monitoring proposal.

CONCLUSION

The Wagner Peatland seems to be well suited to long-term monitoring of arthropods with respect to fluctuating water levels. It meets virtually all requirements for choice of site. In addition an arthropod sample meeting the conditions described above has been collected, sorted and much of it identified to species by various specialists. However, our mandate is such that we

cannot devote resources on that scale to a single habitat over a long period without outside support. Cooperation between museums and universities is essential to the success of long-term monitoring projects. Finally, granting agencies should be aware of the need for curation and housing of these collections as well as research on the material, and provide funding accordingly. If proposals for long-term research are to be sustained long enough to provide meaningful results then museums, universities and granting agencies must act in concert.

REFERENCE

Danks, H.V., G.B. Wiggins, and D.M. Rosenberg. 1987. Ecological collections and long-term monitoring. *Bull. ent. Soc. Can.* 19(1): 16-18.