Conclusion of Working Group 2:

MONITORING MIRES/PEATLANDS

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WHY MONITOR?

Accepting that "monitoring" represents at least one of the three activities proposed by GOLDSMITH (1991), presented at Linz as **survey**, **surveillance** and **monitoring**, the Group considered the question of "why monitor?" because it influences all other aspects of decision-making in relation to any specific monitoring programme. The Group first reviewed the general rationale for monitoring, then addressed the question of why it is worth devoting scarce resources to the monitoring of mire systems in particular.

The objectives of ecosystem monitoring

Detection of wider environmental change

Just as individual species or groups of species are used as biological indicators for water quality, for example, so it is possible to use complete ecosystems as holistic indicators of widespread change. The ecosystem is used as a key to unlock a larger mystery.

Detection of specific environmental change

There may be concerns for specific habitats in that evident damage may have occurred to some sites but the overall scale and pattern of change may be obscure. Simple presence/absence monitoring for a sample, or indeed the entire area, of the resource can reveal overall trends.

Detection of quality changes

Going beyond the simple presence/absence view of Objective 2, it is possible to monitor a resource, or a sample of a resource, against a given base-line of quality, or against acknowledged environmental standards. It is possible, through this more detailed approach, to detect more subtle changes in resource quality.

Evaluation of impacts (positive or negative)

The monitoring of a site on which a known activity has occurred firstly reveals the nature of the resulting impact. If the activity is "damaging", monitoring can reveal whether any proposed mitigating activities have succeeded. If the activity is an example of positive conservation management, monitoring data can confirm that the management has had its desired effect.

The pursuit of knowledge

Many ecological processes are still poorly understood. Only by continued scientific investigation, often linked to monitoring or surveillance programmes, will it be possible to bring existing scientific understanding to a level at which many of the results from, for example, impact studies, can be correctly interpreted.

WHY MONITOR MIRE SYSTEMS ?

Natural ecosystems

In many cases, mires represent some of the

most natural and ancient climax ecosystems in the modern landscape. They are therefore of very great nature conservation importance and thus merit the use of resources to determine that the natural processes and biodiversity of these habitats are not declining. Being climax systems, and therefore lacking the more obvious signals of human management, bog systems in particular offer the possibility of detecting subtle background changes in the environment.

Threatened and endangered ecosystems
Unfortunately many mire systems are now extremely rare and continue to be threatened by further development pressures. Monitoring of the resource is therefore necessary to identify the current pattern of threats, and thereby, the conservation strategies required.

The gene pool
Many species with particular adaptations to the mire environment rely on mires for the major part of their global distribution. Changes to the mire environment may not mean that the whole ecosystem is lost but such altered conditions may be unsuitable for the continued survival of such highly specialised groups. Monitoring may be necessary to establish the stability or otherwise of particular elements of mire biodiversity.

The peat archive
Unlike many other habitats, mires generally generate and preserve a chronological record of their own development, plus a proxy record of the surrounding environment, in the form of an accumulating peat desposit. Stored within the peat matrix are mire plant remains dating back many thousands of years, along with a great deal of other material, from plant pollen to human sacrifices, which have been introduced to the peat surface. Mires continue to act as such accumulating history books today, and can thus either assist in the identification of changes in present conditions, or as a source of information about changes in the prehistoric past. They can thus be used as "forward monitors", but also, much more unusually, as "backward monitors" which give us a window into the past.

Hydrological inter-connections
Most mire systems consist predominantly of water (*e.g.* raised bogs are typically 90-98% water by weight - with less solids per unit volume than milk). All systems play an important part in either the local or regional groundwater regime. In areas which contain mire systems it is impossible to construct a hydrological budget without considering the very particular behaviour of these mire systems. Such information can only be obtained from hydrological and ecosystem monitoring.

Functional role in local and global environment
In addition to their contribution to wider hydrological cycles, mires also have a number of other important functions which influence the wider environment. Probably the most significant of these is that they are one of the few ecosystems to absorb carbon dioxide from the atmosphere and hold it in long-term storage. The continued operation of these functions is a legitimate subject for mire monitoring programmes.

WHAT TO MONITOR ?

From the preceding paragraphs, the general range of aspects which merit a monitoring programme should be evident. However, to summarise these various components, which can first be divided onto three broad groups, they are:

Presence/absence of the resource

Health of the resource
- **biotic factors**
- **abiotic factors**
- **structural factors**
- **human factors**
- **interactions with the environment**

"Backward monitoring" of the peat archive

HOW TO MONITOR?

A complete list of features and techniques is provided below, but, for any particular monitoring programme, specific factors appropriate to the issue involved should be selected from this list.

DOCUMENTATION

Mapping

-satellite imagery
-aerial photography
-field survey
-cartographic survey
(old and new maps)

Photography (all in stereo)

Stereo-photography does not necessarily involve complex planimetric technology. For most purposes it is sufficient simply to take the same view, with a normal camera, but moving the camera sideways 4-5 cm between photographs. When viewed through a stereo viewer (from any cheap plastic viewer to a full planimetric system) a *very* much clear picture of the habitat can be obtained than is possible with a mono photograph, to the extent that it barely seems worthwhile using mono photos for monitoring programmes. This additional information is achieved at *minimal* extra cost.

- general view
- fixed-point view
- vertical quadrat

Published information (archive and recent)

PEAT : USE OF THE PEAT ARCHIVE, STRUCTURE AND CHEMISTRY

Water regime

- dip-wells
- maximum-minimum water level recorders
- continuous water level recorders
- lysimeters
- seepage tubes
- rainfall gauges
- evaporation pan
- system for measuring occult inputs (precipitation deposition from cloud or mist)
- weir gauges
- flow meters

Water chemistry

MICRO/MESO CLIMATE

The surface "roughness" of many peatland systems, combined with their extremely high water content, tends to produce very particular micro- and meso- climates. Activities which alter either these factors, or others responsible for the "input climate" of the mire, will have an impact on its hydrological and biotic processes.

STRUCTURAL FEATURES

Mire morphology and size

- photogrammetry
- field survey
- peat anchor (for shrinkage or expansion)
- ice penetration instrument

Surface microtopography

- aerial photography
- field survey
- permanent transects

BIOTIC FEATURES

Vegetation

- transects/permanent plots
- bioindicators
- mapping of structures and boundaries

Invertebrates

- transects/permanent plots
- k-species/bioindicators

HUMAN FACTORS

Document search

- interpretation of historical records
- drains, etc., on maps
- documents, pictures, illustrations, etc.
- archaeology/peat archive
- biological records
- comparison of data sets

Field/socio-political survey

- local population
- administration
- public authorities
- private companies
- NGOs

CONSTRAINTS

Probably the most serious and underestimated problem to constrain the monitoring of mire systems is their **inherent sensitivity**.
It is extremely difficult to carry out repeated visits to such a site without causing very considerable damage to the fabric of the ecosystem. Special techniques must therefore be employed to ensure that such damage is at least kept to a minimum. Clearly these techniques and the materials involved must not, by their nature, use or composition, cause more problems than they solve.

WHERE TO MONITOR?

- Within the site
- Within the catchment or functional unit of the site
- As part of a biogeographic network of sites

HOW TO USE THE RESULTS?

- Arguments for nature conservation action
- Support for conservation management programmes (including the "do nothing" option)
- Control of management quality
- Long term strategies for conservation
- Education/publicity for resource/site protection
- Dissemination of data to the scientific community
- Maintenance of the site "memory", i.e. a record of the site in the past for site managers of the future
- Evidence for conservation casework.

References

GOLDSMITH, F.B. (ed.) (1991): Monitoring for Conservation and Ecology. Chapman & Hall, London. 275 pp.

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