Invertebrates in Habitat Monitoring

1. Introduction

From a conservation perspective invertebrates have been the least understood of our flora and fauna in Britain. However, recent years have seen an increase in interest in the role that invertebrates play in our ecosystems and in turn people with responsibilities in habitat management are increasingly attempting to make more provision for the invertebrate interest of sites.

There are a number of features of the biology of invertebrates that give them the potential to be the most sensitive barometer to changes in the quality of habitats on both a macro and micro scale.

1. Many are highly specialised into very narrow, often vulnerable niches and very many species co-exist within a habitat, with subtle differences in their partitioning of microhabitats.

2. Their largely annual life-cycles mean that they can be very sensitive to short periods of adverse conditions. They tend to react very swiftly to downtrends in habitat quality, giving an indication that something might be amiss much sooner than might be detected from vegetation change.

3. Many species are also poor at recolonization, having limited powers of dispersal, and therefore make good indicators of continuity of suitable habitat conditions. The absence of species normally typical of the habitat may indicate major changes some time in the past.

4. Different life stages often need different habitats within close proximity and therefore are useful monitors of the continued interrelationship between habitat types - habitat mosaic.

5. Some species are associated with degradation of habitat, so that their presence in large numbers can indicate that something is amiss.

Monitoring selected invertebrates should be a part of any strategy for site management because they are sensitive indicators of continuity and consistency.

2. Aims

There can be two aims of invertebrate monitoring. Firstly, to mark changes in populations and habitats of a particular species, usually a rare one. It is worth pointing out at this stage that there are certain species protected by national and international law and we have a statutory duty to protect these species. A scientific basis is also required for the Country Agencies, through the Joint Nature Conservation Committee to carry out their statutory duty to advise the government on revisions of species in the Wildlife and Countryside Act as well as complying with EC Directives.

The second aim of invertebrate monitoring is to look at habitat quality for management. Where there is a visible change in the flora it is more sensible to use plants to demonstrate changes. There are however instances where it is more advisable to monitor the invertebrates rather than the flora and these can listed as follows:-

1. Changes in some habitats can be detected more quickly or easily using invertebrates than vegetation.

2. Changes in the habitat either enhance or do not affect the interest of the flora but may be detrimental to the fauna. If it is known that management changes are imminent then monitoring may record the changes to the invertebrate communities.

3. Invertebrates reflect changes in habitats and micro habitats that are of little or no interest to botanists, but which are essential to the invertebrates. E.g. shingle, bare substrates or dead wood. There are SSSI s that have been notified wholly or largely on invertebrate grounds (Star Pit, The Flits NNR, Herald Way Marsh).

There are undoubtedly problems associated with using invertebrates to monitor habitats. Before undertaking any monitoring it is worth being clear about the aim of the exercise. What exactly are we trying to show? Having decided on the reason for monitoring, suitable groups need to be selected. Does the habitat in question contain enough species of a group to be of any use? Is the expertise available to identify the specimens correctly? Historically, monitoring exercises have lent very heavily on the goodwill of entomologists to identify specimens free of charge. The time has come when if monitoring using invertebrates is to be undertaken it is appropriate to pay for the identifications to be carried out. A botanist would not be expected to survey a bog for free so why should an entomologist?

Perhaps the biggest problem facing site managers is standardisation of methods. The past has seen a minimalist approach to invertebrate monitoring. This has not only reflected the lack of resources available but also the absence of guidance. JNCC needs to take the lead on this issue in conjunction with the relevant specialists to establish some sort of common base because at present one does not exist.

A further difficulty is deciding upon the thresholds for action. At what point do you start changing management? The difficulties discussed above may appear daunting - indeed they are! But the only way that they are going to be resolved will be if people make genuine attempts at addressing them. The importance of monitoring is becoming increasingly apparent and appropriate methods of invert monitoring will have to be developed.

3. Considerations

When considering the appropriate groups for monitoring the following considerations should be taken into account.

1. The group should contain a manageable number of species, say 400 maximum.

2. The species must be taxonomically tractable, with widely available keys.

3. The group must include species with wide ecological requirements.

4. The species must cover a wide geographic range and not show marked latitudinal or longitudinal decline in richness. This restricts selection to well recorded groups whose distributions are known.

5. The biology of the species must be well enough known so that changes in the composition of the group can be interpreted meaningfully.

6. Most of the species must show relatively poor powers of dispersal so that their presence is indicative of the place they are recorded; or if most of the species are wide-ranging, then the habitat specificity must be well known for each species.

7. The methodology for sampling must be easily standardised, give relative abundance s and be easy to carry out.

8. Ideally, the group should be popular to attract funds, interest and money.

If it is intended that a rare species is to be chosen for monitoring the following factors should be considered.

1. Can anything be done if monitoring shows a species to be declining catastrophically? Are there management contingencies? Can an autecological study be initiated to discover how to save it?

2. Is it so rare or so dispersed that it is impossible to estimate its population size or even its distribution. Will the techniques used to monitor the species damage the population?

3. Was a particular rare species an important reason for site notification? If so, monitoring the species ought to become an essential part of site monitoring.

4. Example

A survey of the invertebrates of five lowland bogs in Cumbria in 1989 by the England Field Unit indicated that the following groups could be of value for monitoring purposes.

1. Dolichopodid flies

2. Leaf hoppers

3. Spiders

4. Ground beetles

The rationale for the selection of the above groups is given as follows:-

a) They show marked differences in composition between open and wooded stations, and most tend to show decreases in uncommon bog specialists in open bog close to trees and on dry heather dominated heath. Management to restore the bog to its original open, wet condition would be reflected by these four groups.

b) Each group contains uncommon bog specialists.

c) Either water traps or pitfall traps may be used to collect at least two of the four groups in large numbers suitable for analysis.

d) The groups are large enough, in terms of species, to cover the range of habitats found on the bog.

Having decided upon the groups to use to monitor a bog the next problem is determing the amount of effort required to give enough data to draw sensible conclusions. A magical figure of five seems to have been used a great deal in the past. The origins of this figure owe more to resources available than to statistical theory. Usher (1991) discusses implications of small numbers of samples. Text books usually advise that preliminary sampling is always a good thing and this would help determine the appropriate number of traps for a given sites. The other consideration that needs to be taken into account is cost of sorting the samples. Porter (1994) suggested the following based on samples taken from a malaise trap:-

	No of Tubes	**Hours to Sort**	**Hours per Tube**
Syrphids	123	56	0.45
Dolichopodids/Empids	152	190	1.25
Muscids	40	80	2.00
Sciomyzids	47	67	1.43

The above table gives some idea as to the possible costs although it was stated that not all tubes were full. and some contained only a small number of individuals.

5. Conclusions

It may appear that the use of invertebrates in monitoring is fraught with overwhelming difficulties. there are problems without a doubt but they can be overcome and some site managers are attempting address some of the problems that are listed above. There are two main points that I would wish to get over. Firstly, invertebrates should not be regarded as a cheap way of monitoring a site. Proper resources have to be made available or it is not worth the effort. The second point is that whilst no standard methods are yet available this should not be regarded as a bar to attempting some sort of monitoring exercise. As long as the programme is statistically sound it will be of value.

Richard Lindsay showed some very interesting slides in his talk and discussed the use of satellite imaging in monitoring large areas of peatland. I look forward to the day when our knowledge of invertebrates is such that we too can use those images and predict the state of the invertebrate communities on those areas!

References:

England Field Unit (1989). Project No. 80. A survey of the invertebrates of five lowland bogs in Cumbria.

Usher, Michael B. Scientific requirements of a monitoring programme. In: Monitoring for Conservation and Ecology. Ed. Goldsmith (1991). Chapman & Hall.

Porter, Keith (1994). Inventory survey of sites: South Region s Approach. Spineless News, Newsletter of the Invertebrate Forum:Issue 1.

Monitoring Birds

Frank Mawby, English Nature

1. Introduction

Before we can look rationally at monitoring birds it is necessary to consider constraints to objective thinking:

1 Birds have a high public profile.

2 Birds have popular appeal.

3 Birds may be highly political.

Birds have been monitored in many ways for a long time by many people at various levels. The wealth of data about them far exceeds that of most other living organisms; a large number of books and research papers offers testimony to that. Finding people to undertake work on birds is also easy: they are popular subjects for both the professional and amateur alike. Thus, birds can assume a disproportionate value in our hearts, minds and management plans.

Of course being people trained in objective thinking we don't fall into the trap of being overly influenced by a bundle of feathers, do we? At least not until our management actions result in a perceived threat to a bird and the birding fraternity falls about our ears. Birds are censured regularly and watched avidly. The data is collected for national or local surveys and you do not always know when your birds are being counted. You soon will if you do something wrong. Beware, taking rational, objective decisions about birds or their habitats is not easy.

What more objective reason could you have for monitoring them? What is more you are more likely to be able to find someone to do it on a voluntary basis than for any other species or habitat.

2. Conflicts

The next bog the unwary site manager can fall into is to accept management plans with potentially conflicting objectives.

To quote:

1 *To recreate an active raised mire over the existing SSSI extending this management to surrounding parts of the hydrological unit as necessary and when the opportunities arise.*

2 *To maintain notable bird species.*

Take a a bog with a damaged but intact acrotelm that grows a lot of heather and is burnt regularly. It attracts red grouse, a notable bird, and we hope to turn a wet heath back to a *Sphagnum* bog. Question: How long will the red grouse survive? That is over simplifying the problem but it is the long term scenario. It may be far better to leave the red grouse out of the equation if you want an active bog. But can you do this? The red grouse in a lowland situation is unusual, it attracts attention, there is local pressure to keep it there, some owners say they burn the moss because it will help the bird survive. In the end it takes some well thought out discussion to rationalise the bird out of your management plan in the short term. Having accepted it, what sort of obligation does the plan impose for monitoring it? It could equally be argued that the other breeding birds of the bog, the curlew, meadow pipit and skylark, are more at home on the wet heath type vegetation of a semi-moribund bog rather than on the active *Sphagnum* dominated areas. I have

not made any commitment to monitor them on Glasson Moss but my instinct tells me that they are perhaps declining, but is this a national trend?, is it a short term blip in population dynamics locally or is my management having a deleterious impact?

On Wedholme flow we have an entirely different situation, from old sold cuttings that attracted a few pipits and pied wagtails (that nested in the peat stacks, we have transformed the area to a wetland with lots of temporary open water and bare peat. This has attracted lapwing, redshank, teal and black-headed gulls to breed. Lots of snipe and duck use the area and there are the associated raptors. This will be a transitional habitat for some of these species, notably the lapwing. But do I have a responsibility to them knowing that they are rapidly disappearing from farmland? If they are forced off the bog where will they go? Should I make a commitment to monitor them and if so how do I interpret the information? If something even more notable turns up what sort of pressures do I face and how do I respond? I have no doubt that a number of peatland sites face the same dilemma. The problem is we have no means of predicting what the long term impact of our management will be and what effect it will have on the range of birds that currently use the bog habitat.

There is no doubt in my mind though that diversity of habitat through human intervention has created greater diversity of birds. Birds will inevitably impinge on our management objectives and it is essential to know how they are responding. There are simple standard techniques for monitoring.

3. Conclusions

Usually it is not difficult to find reliable volunteers to do the work and it is easy to feed the results into national data to look at trends. We need to be wary about having specific management objectives for them in our plans. We should accommodate them within management objectives for the habitat via prescriptions to monitor how they react to management. The transition period for the habitat may be so long that overall impacts on the birds will be minimal. What we do require is well prescribed monitoring methods because the present BTO methods are either too detailed, the 10 visit CBC method 40 to 50 hours per season or inadequate to deal with all species, the new Transect Method 2 to 3 hours per season but only picking up trends from total birds present. Basically it is hard to ignore birds and if you do, you do it at your peril.

Monitoring Peatlands

Richard Lindsay, Scottish Natural Heritage

This talk was first presented at the Linz International Workshop in October 1993 and has been published by IWRB. The paper is reproduced as an annex to this report with permission from IWRB. The full proceedings are available from The Natural History Book Club, 2-3 Wills Road, Totnes, Devon TQ9 5XN, UK. **Reference:** Lindsay, R.A. and Ross, S. (1994) Monitoring of peat bog ecosystems. In Aubrecht, G., Dick, G. and Prentice, C. *Monitoring of Ecological Change in Wetlands in Middle Europe.* Stapfia, 31, 73-92.

MONITORING BOGS WITH A TINY RESOURCE THE VOLUNTARY SECTOR APPROACH

Emma Wilson, Scottish Wildlife Trust

1. Introduction

The Scottish Raised Bog Conservation Project is a European Union 'LIFE' funded project based at Scottish Wildlife Trust (SWT) in Edinburgh. One of the main aims of the project is to evaluate the management practices used on raised bogs throughout Europe and to assess the different techniques being implemented, particularly in Scotland. These assessments will be drawn from botanical and hydrological monitoring programmes that have been devised and implemented over a range of raised bogs in various stages of degradation. Ultimately, the project aims to draw conclusions from all these sites to ensure recommendations in the new *Bog Management Handbook* are not restricted to one isolated example.

At the present, the monitoring programmes are set up on the sites and the collection and interpretation of data has commenced. Unfortunately, the monitoring programme has many resource restraints: time, money and manpower in particular. These inevitable restrictions have played a their role in governing the way in which the programmes have been formulated.

In addition to these restraining factors, it is important to ensure that monitoring continues once the Project completes its two year contract in July 1995. However, scientific monitoring is a time consuming activity and may prove too large a task for SWT to undertake. Therefore, to ensure the programme is carried out satisfactorily we aim to train a volunteer team to complete the fieldwork and to enrol the Reserve Managers to undertake the data analysis.

The following factors are the primary parameters which have governed the monitoring programme methodology.

1) **Cost** - there will be limited funds allocated to peatland monitoring within SWT once the Project is completed. It therefore vital to ensure all the equipment is relatively cheap to replace.

2) **Simplicity** - the methodology needs to be clear and repeatable to ensure standardisation amongst a non specialised field team.

3) **Time** - to reduce field time and to prevent the methodology being so laborious as to deter the work force, the methodology should be relatively quick to complete.

Due to the ombrotrophic nature of raised bogs and the three governing factors mentioned above, schemes were devised to concentrate on water table fluctuation and the effects of this on bog vegetation. Obviously other parameters do exist such as internal water flow. However, it was decided that such factors were not within the remit of the Project.

From the initiation of the monitoring programme, the integration of vegetation and water table has been of the utmost importance.

2. Hydrology

We are primarily concerned with the water table fluctuations in relation to the bog surface and given the importance of precipitation, the local precipitation rates. The water table is monitored through the installation of dipwell and WaLRaG (Water Level Rain Gauge recorder) transects.

2.1 Dipwells

Dipwells are constructed from 2 inch diameter plastic tubing, approximately 1 - 1.5 metres long and drilled over the whole length with small holes. They are extremely cheap (£3.50 each), easy to make and simple to install and therefore require no specialist training. Once the dipwells are installed into the peat and capped, they are marked with a bamboo cane and clearly numbered. These actions enable the transects to be easily found and the recorder to be instantly orientated on the site.

2.2 WaLRaGs

WaLRaGs are maximum/minimum water table recording instruments. Due to their considerable expense (£50 approximately) they are used far less frequently than dipwells: generally 4 or 5 to a site, depending on its ecological variability. WaLRaGs cannot be constructed by Project staff and are therefore made up by a specialist.

2.3 Rain gauges

Rain gauges have been installed alongside the transects, on all sites, to record the local precipitation rates. Precipitation is obviously an important parameter which will have a direct effect on the system. The gauges are read once a month, at the same time as the other monitoring instruments. As yet there has been no analysis of the recorded data as it has been presumed that a relatively long data set will be needed to ascertain accurate conclusions.

2.4 Transect location

The transects are positioned so they correspond with the areas where management is to take place on the site. We can therefore record how the water table directly responds to management actions such as ditch damming and scrub clearance.

2.5 Surveying

Once the dipwells and WaLRaGs have been installed in the site, they are levelled to a base point (these base points - generally the highest point on the dome may, in future, be levelled into ordnance datum). This information provides an accurate representation of the bog surface which is necessary for data interpretation process.

2.6 Recording

The transects are recorded once a month on each site. The recording is started prior to management activity to provide a full baseline data set for comparative purposes. However due to the time limitations of the Project there are no baseline runs of data which exceed 3 months before management proposals commence.

All the recording is completed on a standard form (see Appendix 1). The dipwells are read with a battery operated probe and the WaLRaGs from the incorporated scale. Both instruments are relatively quick and simple to read.

Each site has a sketch map which indicates the position of the transects and the numbering system over the site. The map is frequently updated and spare copies are always available for reference. These maps enable volunteers to orientate themselves on a new site and provide useful additional information.

3. Vegetation

The hydrology and vegetation of a raised bog are intrinsically linked. The vegetation communities are primarily governed by the relative height of the water table to the bog surface.

3.1 Permanent vegetation plots.

Permanent vegetation plots have been installed alongside the hydrology transects. Each vegetation plot has an adjacent dipwell. It is, therefore, possible to relate any long term changes in water table to changes in vegetation composition.

Plots are recorded using fixed vegetation quadrats. The design for the quadrat is based on a rectangular box transect with individual quadrats subdivided into 15 cm squares by elasticated string. These compartments increase the accuracy of the percentage cover estimations as each species is recorded in each compartment. Quadrat size has been reduced to a minimum to decrease the time spent in the field. An elongated shape is also ideal for fitting into the frame of a camera; an additional bonus for stereo photography. The area monitored is 1.8 m x 0.45 m and is divided into 2 separate quadrats measuring .9 m x .45m. Quadrats are made of plastic which is cheap, durable and easy to construct.

In a similar vein to the hydrology transects the vegetation are located principally in areas where management activities will have the most effect on the plant communities. In addition, several plots are located away from zones of management. This enables information on the overall status of the bog to be collected.

The methodology has been designed with the future use of volunteers as main data recorders in mind.

3.2 Platform

To reduce the effects of monitoring around the permanent vegetation plots through trampling, which will inevitably result in "monitoring the effects of monitoring", raised platforms have been constructed adjacent to the plots. The platform consists of 4 untreated wooden stakes with a one inch notch sawed from the top. The stakes are driven into the ground until approximately 20cm protrudes above the surface and a ladder is supported across them (Figure 1) This raises the recorder above the vegetation, thus eliminating trampling in the immediate vicinity of the quadrat. It also enables the recorder to take photos directly over the quadrat.

3.3 Recording

The quadrats are recorded every 6 months on each site, on a standard recording form (see Appendix 2). To ensure the data collection is time efficient not all the species within the quadrat are recorded. Seventeen 'Indicator' species have been used for several reasons.

1 They are all relatively easy to identify in the field with a good key and a hand lens.

2 Their presence is indicative of some prevailing condition on a site, which will respond to management activity.

Established cover abundance scales have not been chosen to estimate species cover, instead a much simpler method has been devised. A broad, simple scale will be easier to remember and will also"absorb" any recorder errors within the wide divisions. The species percentage cover scores are as follows;

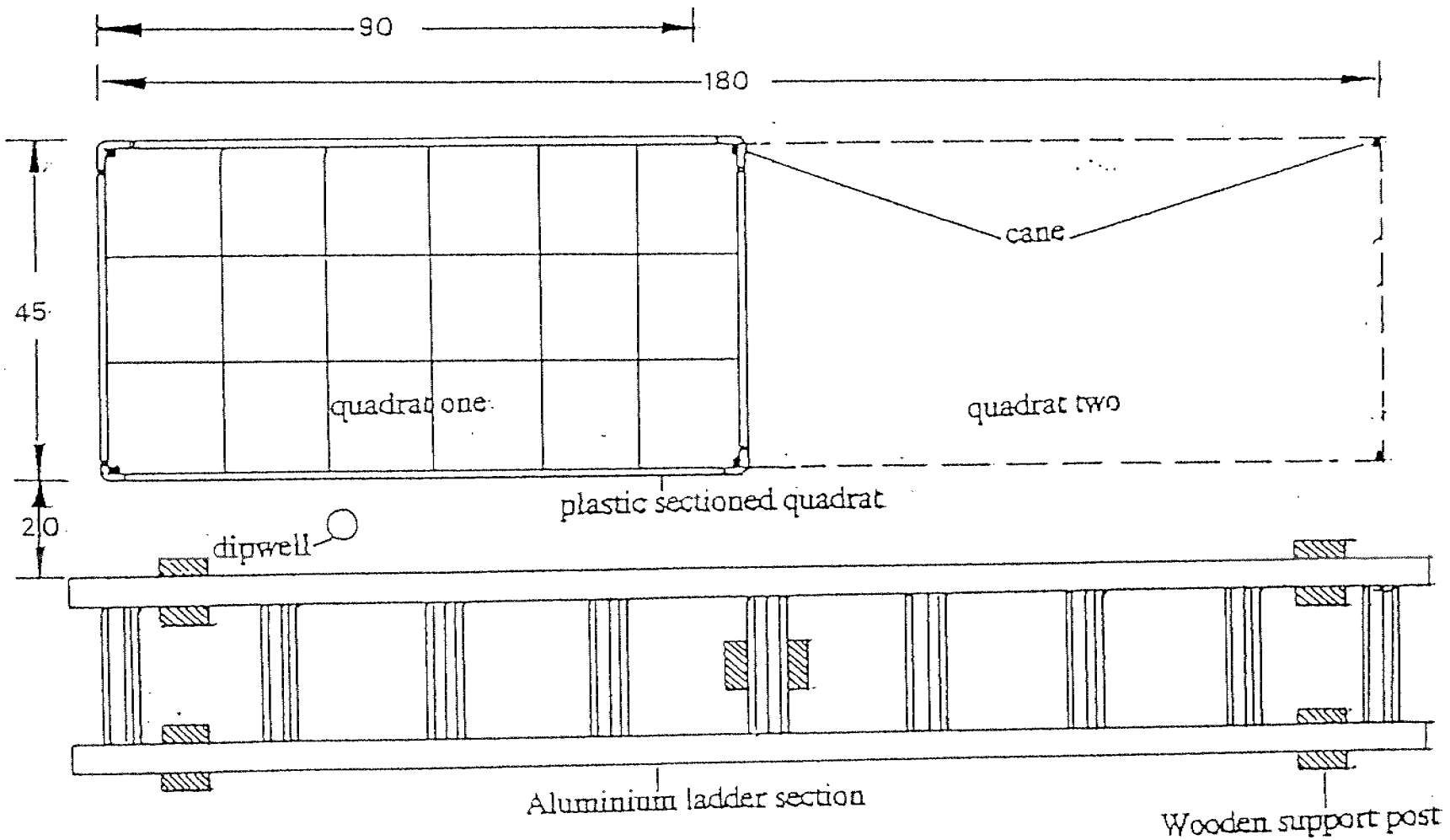
0 - ABSENT - 0%

1 - PRESENT - 1-20%

2 - FREQUENT - 21-50%

3 - DOMINANT - 51% +

Figure 1: The permanent vegetation transect and adjacent platform



Each indicator species receives a score for its estimated percentage cover in each 15cm compartment of the quadrat.

Recently a volunteer, who is presumed to be at a similar level of botanical knowledge as the future volunteers, was timed whilst recording a fixed quadrat. In total, including identification time, he took 45 minutes to complete the box transect.

4. Fixed Point Photography

Fixed point photography is considered an important area of monitoring on raised bogs. Stereo photographs are taken on 3 levels at all the sites.

1 **Large Scale**, these are primarily landscapes. These are used to assess and compare long term change over a site, for example encroaching scrub.

2 **Meso Scale**, these are generally areas which will be directly influenced by management practices. For example vegetation near drains.

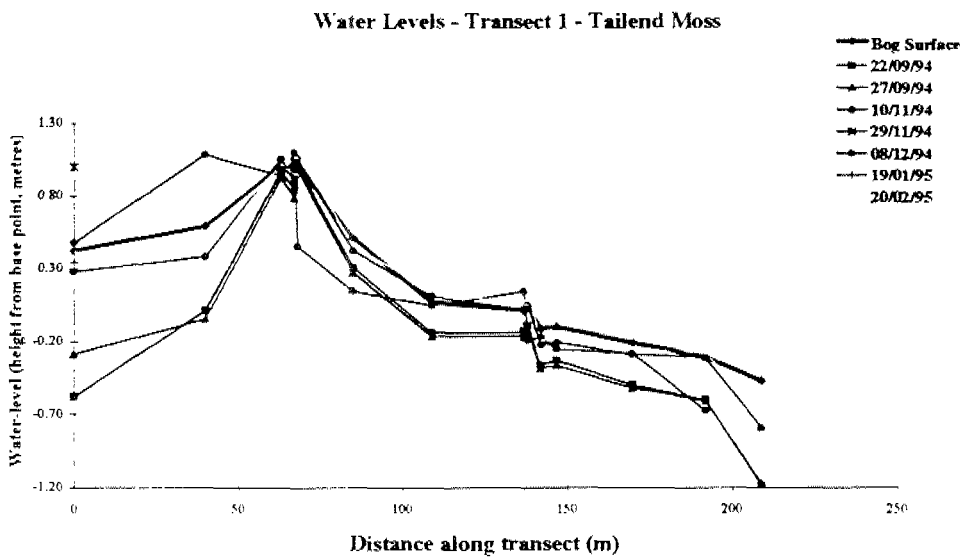
3 **Small Scale**, these are close up pictures of the vegetation quadrats. These records provide an invaluable visual aid for species and species boundary changes.

5. Interpretation and Analysis

In the long term, it is as important to develop an effective and efficient method of data storage and interpretation as it is to collect the data in the field. A high proportion of the time allocated to the monitoring programme has been spent developing a user friendly series of spreadsheets (Excel).

5.1 Hydrology

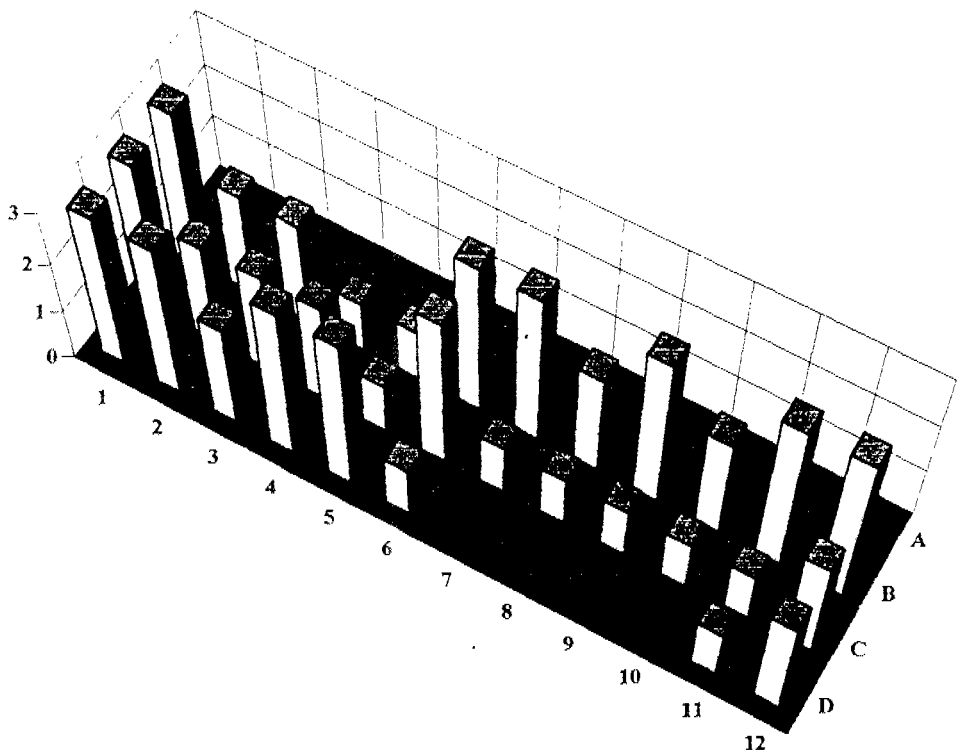
The raw data are entered into a simple table on a spreadsheet. From this charts are drawn which show the profile of the bog, (from the surveying information) with each months water table data added on progressively. The charts graphically show the monthly variation in the water table in relation to the bog surface (Figure 2 below).



5.2 Vegetation

For the botanical raw data the spreadsheet has a similar layout as the field sheet. Each species has a 3D chart which shows its distribution within the box transect (Figure 3 below). At present the vegetation spreadsheets are little more than a method of data storage, with the charts being a good visual representation of the data. The sheets need to be developed further once a second data set has been collected to enable us to compare datasets. This will allow us to establish actual species and species boundary changes between recordings.

Distribution of Sphagnum cuspidatum across a 1.8m x 0.6m permanent quadrat.



6. Volunteers

Each site has a Management Committee. The committees consist of enthusiastic and knowledgeable individuals who are familiar with the site and the work which has taken place there. We aim to utilise these committees as our volunteer work force. The volunteers will therefore have a background knowledge of the site - both in an historical and scientific context.

6.1 Training Day

To ensure that the volunteers are familiar with the standard methodology used in the field, a training day has been suggested. The volunteer teams will be taken to an appropriate site where the full extent of the monitoring programme will be explained and discussed. The change-over of the collection of field data from staff to volunteers will not be an immediate exchange. There will be a transistionary period where the project staff will still be available to answer queries and to advise in the field.

6.2 Monitoring Pack

It is highly probable that the volunteer work force will not remain constant. Therefore, as an aid to newcomers and as additional information to the volunteers once the Project has closed a "monitoring pack" is to be produced. The pack will set out all the basic guidelines on how to set up a scientific monitoring programme for botanical and hydrological purposes. It will also include an introduction on the What? and Why? of monitoring.

Additionally, the pack will have an extensive appendix, which will include a *Sphagnum* key, a set of standard recording forms and a list of contact name and addresses. The purpose of including contact names and addresses is 1) to answer any queries and 2) to ensure there is a close link between the fieldwork and it's analysis. The analysis and interpretation of the data is being passed to the Reserve managers because they have access to the computer packages. The pack is also intended to be a available resource for research groups who undertake projects on raised bog sites. It would be extremely beneficial to raised bog conservation as a whole if all monitoring work could be standardised to allow for comparisons between sites to be made.

7. Conclusion

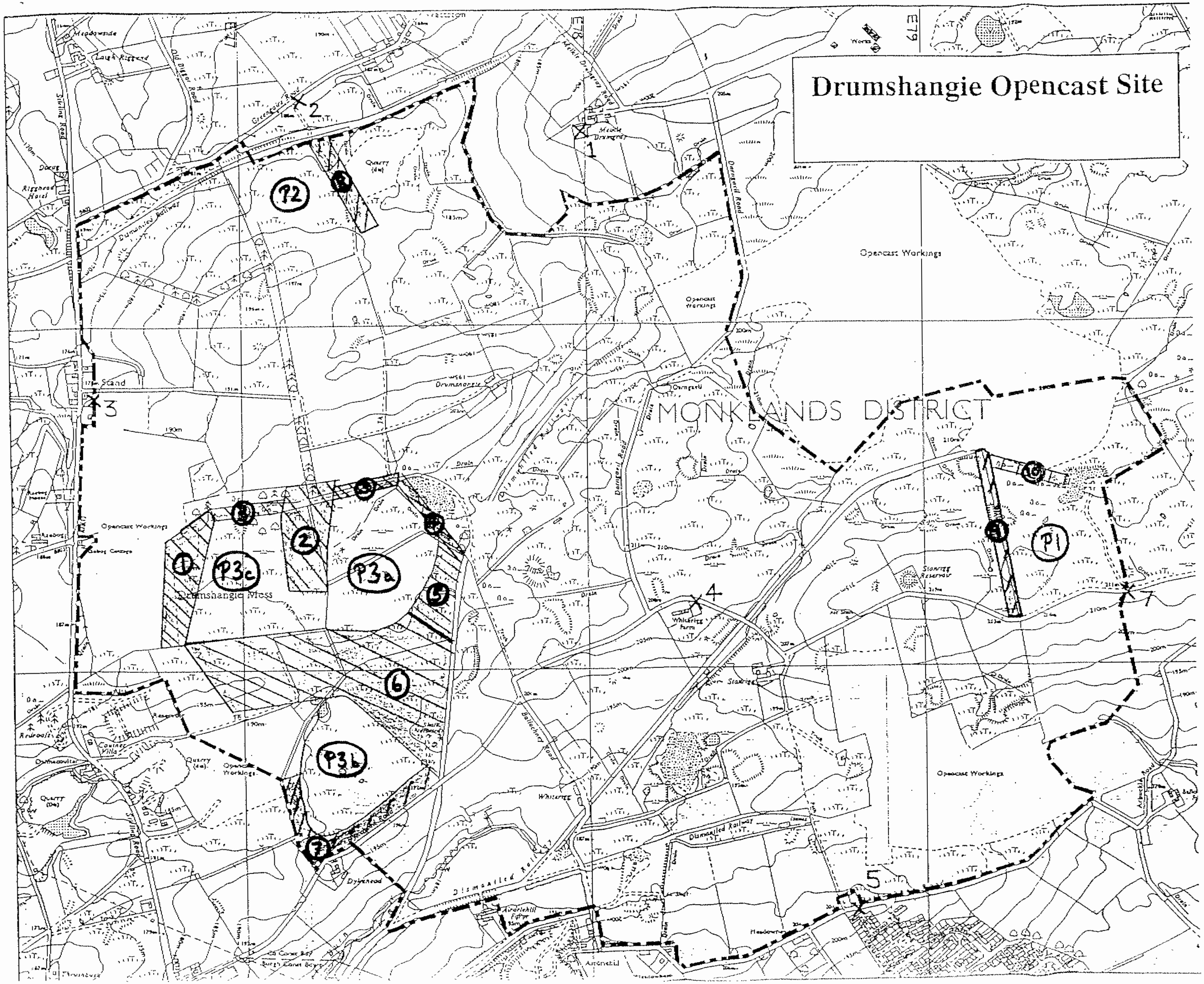
The main aim of the Raised Bog Conservation Project at the present time is to ensure that all the monitoring programmes are set up on the sites and data collection has commenced. The next step is the completion of the "monitoring pack" and it's distribution and the organisation of the training session. The most important factor to consider is the insurance that all roles are defined and that everyone involved is fully informed of the changes. It is believed that both the pack and the training day will fully accomplish this aspect if they are well organised and executed.

APPENDIX 1

Site Name Date Time

Precipitation

Dipwell #	Height	Reading	Walrag #	Height	Reading	Max	Min	Notes



Drumshangie Opencast Site
MONKLANDS DISTRICT
Drumshangie Moss
Opencast Workings
P1
P2
P3a
P3b
P3c

APPENDIX 2

Vegetation Monitoring Form

Site Name:
Transect Number
Recorders Name
Date

Quadrat 1
% Open Water:
% Bare Peat:
% Sphagnum Cover:

Quadrat 2
% Open Water:
% Bare Peat:
% Sphagnum Cover:

Pinus spp.

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Betula sp.

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Calluna (alive)

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Calluna (dead)

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Erica tetralix

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Molinia caerulea

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Eriophorum angustifolium

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Eriophorum vaginatum

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Polytrichum spp.

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Hypnum spp.

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Sphagnum papillosum

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Sphagnum capillifolium

	1	2	3	4	5	6	7	8	9	10	11	12
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B												
C												
D												

Sphagnum recurvum

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Sphagnum magellanicum

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Sphagnum tenellum

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Sphagnum cuspidatum

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Cladonia spp.

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Other dominant species - specify

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Other dominant species-specify

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												

Stereo photos

	Frame numbers		Date photos taken
Quadrat 1,	left	right	
Quadrat 2,	left	right	

Other comments/observations,

APPENDIX 3

Monitoring Pack - An Aid To Volunteers and Research Groups

- What is monitoring?
- Why monitor?
- Hydrological Monitoring. A standard Methodology
  - Introduction
  - Dipwells
  - Walrags
  - Setting up a transect
    - How
    - Why
  - Recording
    - When and how
    - Recording form
- Analysing Results
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- Vegetation Monitoring. A standard methodology
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  - Recording
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