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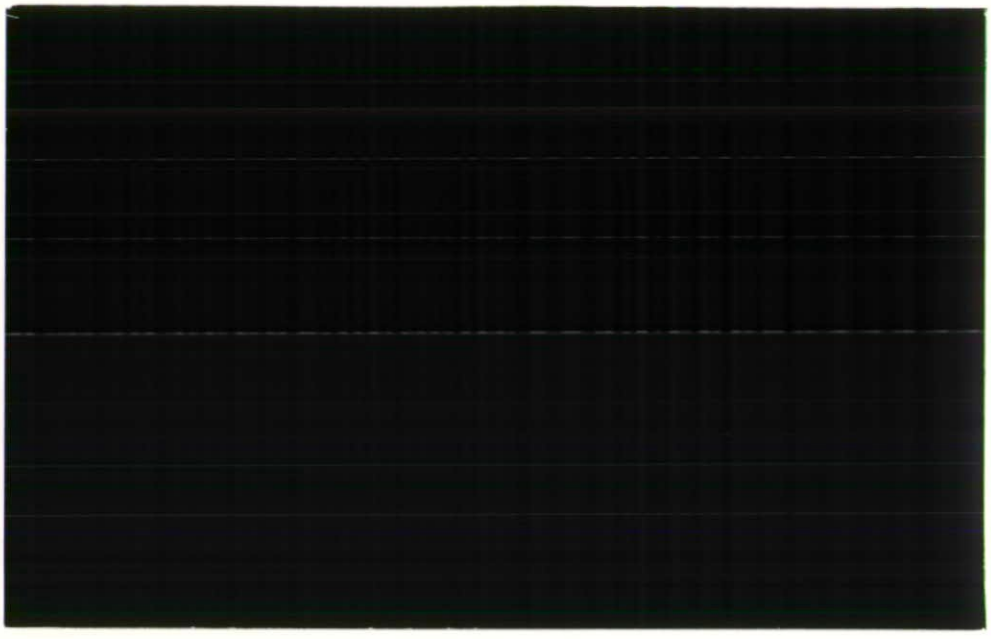

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IMPLEMENTATION OF THE

CAIRNGORMS ECN SITE

Report to

Scottish Natural Heritage

by

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Implementation of the Cairngorms ECN site

The Environmental Change Network (ECN) is a multi-agency, long term research programme to record, analyse and predict environmental change in the UK. ECN was launched in 1992 with the following objectives:

- to establish and maintain a selected network of sites within the UK to obtain comparable long-term data sets;
- to provide for the integration and analysis of these data sets;
- to make these data sets available as a basis for research and for prediction of possible future changes;
- to seek links with existing and developing long term environmental networks in Europe and elsewhere.

ECN is sub-divided into terrestrial and freshwater sites representing as wide a range of UK environments as possible. By August 1994 there were 10 terrestrial sites and 37 freshwater sites (21 river and 16 lake) operational. The Cairngorms is proposed as the first combined terrestrial and freshwater ECN site.

The Mountains

We recommend that the existing research programme into the impact of airborne pollution on the mountain environment be intensified and that the Partnership coordinate an integrated monitoring programme which will provide explanations of why change is occurring. We also support the proposal that a site in the Cairngorms should be nominated for the Environmental Change Network (ECN) established by NERC to coordinate long term environmental monitoring on key sites throughout the UK.

Administration and Management Mechanisms

We support this proposal [to locate an ECN site in the Cairngorms] *and recommend that, as well as serving the national and international constituency, it should also be an integral part of the monitoring arrangements for the Cairngorms Area in support of the Management Strategy.*

Report of the Cairngorms Working Party (1992)

1. Cairngorms ECN Site

The Cairngorms is proposed for inclusion in the Environmental Change Network (ECN) as a combined terrestrial and freshwater site for the following reasons:

- a combination of continental and oceanic climatic elements;
- a range of UK ecosystems not found outwith the Cairngorms;
- relatively low atmospheric pollution levels;
- one of the most near-natural areas in the UK;
- an area where future environmental changes could be highly significant;
- the presence of the Allt a Mharcaidh research catchment;
- the existing links with other National and International research programmes.

The Cairngorms ECN site (Fig.1) is proposed to incorporate the **Allt a Mharcaidh** catchment which is currently in the UK Acid Waters Monitoring Programme, the UN-ECE Programme on Integrated Monitoring, was part of the Surface Waters Acidification Programme (SWAP) and EU ENCORE programme and has the potential to be included in other National and International Networks.

The Allt a Mharcaidh catchment is classified as *transitional*, that is, a catchment with a pH of around 6.0 yet which is subjected to acute acidic shocks associated with high flow events generated by rainfall and snowmelt. It has a large altitude range (800m) which supports an extreme range of environmental indicators from the climate and snow packs to the soils and vegetation species (representing 74% of the land cover in Scotland).

This report is intended to provide information and recommendations on the implementation of the Cairngorms ECN site including the establishment of the monitoring programmes and the management of the site. In preparation of this report reference has been made to the ECN monitoring protocols and the ECN Central Coordination Unit. Those organisations most closely associated with past research in the Allt a Mharcaidh catchment (MLURI, SOAFD, IH and NERPB) contributed to the report through meetings and consultations sponsored by the SNH.

The ECN provides importance guidance for the UK Conservation Agencies regarding environmental monitoring. CCW will soon launch a new ECN site in North Wales and SNH will shortly publish a major report on 'State of the Natural Heritage', explaining the importance of environmental audit to the Scottish environment.

2. Variables to be monitored for the ECN

Detailed protocols for the Terrestrial sites have been developed by the ECN (Terrestrial) Technical Working Group (published in March 1994) which include the variables to be monitored, the frequency of sampling, the methodology of sampling, analysis and archiving. For the Freshwater sites a list of variables has been produced by the ECN Freshwater Working Group (published in April 1994).

Table 1 gives the list of variables to be monitored for the Terrestrial and Freshwater sites and comments briefly on the current status of monitoring at the proposed site. The following notes include additional information of relevance to individual variables:

1. The automatic weather station and surface water discharge instrumentation are installed for existing research programmes. New instrumentation could be purchased for the ECN or alternatively they could continue to be rented from IH. In the latter case some initial upgrading of the stations would be required including the purchase of extra sensors required by ECN;

2. Snow monitoring is not an ECN requirement but it has been carried out in the catchment and is likely to be one of the first indicators of environmental change in the Cairngorms. Current snow observations are 2-weekly snow depth measurements at 9 points in the Allt a Mharcaidh catchment and samples taken for chemical analysis at 3 points during snow conditions. Snow density measurements will be started during the 1994-5 winter;

3. The current monitoring of precipitation chemistry is carried out at 3 sites in the catchment, rather than the one required by the ECN, due to the range of altitudes which influences the precipitation input;

4. Soil characterisation has been carried out in the catchment on the 3 major soil types: alpine, peaty podsols and peats (but this did not include the full range of determinands required by the ECN).

Table 1 Terrestrial and freshwater variables required by the ECN with organisation currently carrying out monitoring in the Allt a Mharcaidh catchment.

Variable required by the ECN	Terrestrial Sites		Freshwater Sites	
	Organisation	Comment	Organisation	Comment
Automatic weather station	IH	Station on rent from IH		
Manual weather station		NCM		
Surface water discharge	IH	Station on rent from IH	IH	Station on rent from IH
Snow	MLURI	2-weekly		
Surface water quality	SOAFD	Weekly sampling at gauging station	NERPB	Monthly sampling downstream from gauging station
Atmospheric chemistry: NO_2		NCM		
Precipitation chemistry	MLURI	3 samplers		
Soil solution chemistry	MLURI	Monitored at 3 major soil types		
Soil survey and classification	MLURI	Catchment surveyed		
Soil characterisation	MLURI	Monitored at 3 major soil types		
Terrestrial vegetation	MLURI	Coarse survey		
Moths		NCM		
Butterflies		NCM		
Ground predators		NCM		
Spittle Bugs		NCM		
Birds		NCM		
Moorland breeding birds		NCM		
Deer		NCM		
Rabbits		NCM		
Bats		NCM		
Tipulidae		NCM		
Frog Spawn		NCM		
Aquatic invertebrates			NERPB	
Macrophytes			SOAFD	
Periphyton			NERPB	
Fish	SOAFD	Annually	SOAFD	

NCM - Not currently monitored

3. Proposed Organisation of the Cairngorms ECN

3.1 COMBINED TERRESTRIAL/FRESHWATER SITE

As the Cairngorms ECN site is being proposed as the first combined terrestrial and freshwater site **it is recommended that a combined monitoring scheme is designed for the site.**

3.2 MANAGEMENT/COORDINATION

The proposed Cairngorms ECN site is likely to be funded and monitored by a number of organisations, it is therefore imperative that the management of the site and the coordination of the research are formally organised during the implementation stage of the site.

A two tier management/coordination structure is recommended comprising an ECN Management Group and a Research Coordination Group. The ECN Management Group should be lead by a Site Manager and include representatives of the funding organisations. Their responsibilities would include the securing and management of long term funding for the project, formal arrangements such as planning permission, the link with the ECN Central Coordination Unit and the supervision of the overall programme. The Research Coordination Group should comprise representatives from each of the main physical, biological and chemical disciplines and the organisation responsible for coordinating the site database. They would ensure the monitoring and data handling were carried out to the ECN specifications, the ECN monitoring was integrated in the full range of research being carried out in the area and links with other National or International Networks were developed and maintained.

3.3 LOCATIONS OF MONITORING SITES AND SITE BOUNDARY

Table 1 lists the variables currently being monitored in the proposed Cairngorms ECN site and those additional variables which ECN require. Of the 26 variables to be monitored 13 are currently being monitored within the Allt a Mharcaidh catchment, Fig.1. As most of the permanent instrumentation is already established within the Allt a Mharcaidh catchment **it is recommended that the boundary of the site be the watershed of the Allt a Mharcaidh catchment.** It is highly relevant to the initial costs of establishing the Cairngorms ECN site that this boundary be chosen not least because the baseline soil and vegetation maps have been completed. If a larger site is selected then considerable extra funds (approximately £10-12K per $10km^2$) would be required to extend these surveys.

The Allt a Mharcaidh catchment includes the Sgoran Dubh plateau area but, although some of the spatial surveys should include this area, it should not be considered for permanent installation of instruments because of the general objective of considering the plateau a *wilderness experience.*

ECN requires a Target Sampling Site (TSS) to be selected within which more detailed

sampling is carried out. The TSS should be representative of the major or predominant vegetation and soils of the ECN site. For the Cairngorms ECN site there are three major vegetation and soil units, **it is therefore recommended that a TSS be established in the central one of these units and secondary sampling sites established on the other two,** as shown in Fig.1. Locations of the spatial surveys such as birds and deer should be selected after further discussion amongst the relevant experts who are chosen for involvement in the site.

3.4 DATA HANDLING

The site has a considerable archive of data, some of which the ECN will request. More time will be needed to organise and pass over these data to the ECN data centre. Once the site is operational, and as the monitoring will be carried out by a number of organisations, **it is recommended that a single data collection centre be identified which will be the point of contact with the ECN data centre.**

3.5 RESPONSIBILITIES

3.5.1 Management

It is proposed that the Site Manager be R C Johnson of the Institute of Hydrology, the Research Coordination Group leader should be R C Ferrier of the Macaulay Land Use Research Institute, and the data coordination should be carried out at the IH Stirling office under the responsibility of R C Johnson. Mr Johnson is a member of the ECN Technical Working Group and has worked in the Cairngorms for many years. Dr Ferrier has been one of the lead researchers in the Allt a Mharcaidh catchment since its inception. The proposed full Research Coordination Group should be:

R Ferrier (MLURI)	- Coordinator and soils
R Harriman (SOAFD)	- Chemistry
A Jenkins (IH)	- Hydrology, meteorology and chemistry
R Owen (NERPB)	- Chemistry and Biology
SNH area officer	- Biology
R Johnson (IH)	- Site Manager and data base

The staff time for the Site Manager, Research Coordinator and Data Coordinator should be costed separately from the monitoring expenditure of operating the ECN site. If R Johnson and R Ferrier were to undertake these roles the costs would be:

Initiation of site:

Site manager	£4000
Research Coordinator	£2000
Data Handler	£2000
TOTAL	£8000

Annual operation of site:

Site manager	£5000
Research Coordinator	£2000
Data Handler	£1000
TOTAL	£8000

A number of routine monitoring tasks can be carried out most efficiently by utilising the services of the current part time field worker, Joe Porter. He has worked in the Allt a Mharcaidh catchment since 1985 and knows the area and procedures very well. The costs of Joe Porter's time, and the other coordinators, are incorporated into the costs in Table 2.

3.5.2 Monitoring

The distribution of monitoring responsibilities should, as far as possible, be a continuation of past arrangements. Some new areas of monitoring will have to be initiated mostly in the ecological areas and it is understood that SNH area staff with the assistance of the current catchment field operator, could undertake some of these responsibilities depending on approval from the Cairngorms Project Board.

The full list of proposed monitoring responsibilities, with estimated capital and recurrent costs, are detailed in Table 2. The estimated cost of initial installations and baseline surveys is £13600 and the estimated cost of the field operations for year 1 is £69200. The year 2 estimate is cut to £58200 due to the reduced soil characterisation and terrestrial vegetation demands. Any contractual requirements for carrying out the monitoring for the ECN should be the responsibility of the Site Manager.

3.6 PUBLICITY

A brochure for the proposed terrestrial site was produced by R Johnson of the Institute of Hydrology, funded by Scottish Natural Heritage. **It is recommended that this is modified to incorporate the combined terrestrial and freshwater nature of the site.** The recommended modifications are shown on the copy inserted at the end of this report. The estimated cost of the reprint is £1000.

Table 2 Variables to be monitored for the combined terrestrial/freshwater Cairngorms ECN site

Variable	Estimated costs (£)		Responsible organisation
	Initial	Annual	
Automatic weather station	1000	2500	IH
Manual weather station	3000	500	IH
Surface water discharge	500	2500	IH
Snow	0	3000	MLURI
Surface water quality	0	5000	SOAFD
Atmospheric chemistry: NO_2	0	500	MLURI
Precipitation chemistry	0	10000	MLURI
Soil solution chemistry	5500	15000	MLURI
Soil survey and classification	0	0	MLURI
Soil characterisation	0	7000 (5-yearly)	MLURI
Terrestrial vegetation	3000	4000 (Year 1)	SNH*
Moths	200	1500	SNH*
Butterflies	0	2500	SNH*
Ground predators	100	3000	SNH*
Spittle Bugs	0	500	SNH*
Birds	0	500	IH
Moorland breeding birds	0	500	IH
Deer	0	500	IH
Rabbits	0	500	IH
Bats	0	600	IH
Tipulidae	100	600	IH
Frog Spawn	200	500	IH
Aquatic invertebrae	0	2000	NERPB
Macrophytes	0	2000 (3-yearly)	SOAFD
Periphyton	0	2000	NERPB
Fish	0	2000	SOAFD
Total cost	**13600**	**69200**	

* - SNH area staff may undertake these responsibilities

4. Summary

The Cairngorms ECN site is being proposed for inclusion in the Network on the ground that it has a combination of continental and oceanic climatic elements, a range of UK ecosystems not found outwith the Cairngorms and relatively low atmospheric pollution levels. It is also one of the least extensively managed areas in the UK and an area where future environmental changes could be most significant. It will be the first combined terrestrial/freshwater ECN site in the UK where the most comprehensive environmental monitoring will be carried out.

The site builds on scientific research currently being undertaken by IH, MLURI, SOAFD and NERPB in the Allt a Mharcaidh catchment which has a history of inclusion in the UK Acid Waters Monitoring Programme, the UN-ECE Programme on Integrated Monitoring, the Surface Waters Acidification Programme and EU ENCORE programme. It is also likely to be promoted by the Cairngorms Partnership Board and will become a lead ECN site which will give the Cairngorms wider recognition and the opportunity to play a major role in other National and International networks.

4.1 RECOMMENDATIONS

The recommendations for the implementation of the Cairngorms ECN site are:

- the site should be a combined terrestrial/freshwater monitoring site;
- a two tier management/coordination structure be established comprising an ECN Management Group and a Research Coordination Group;
- the boundary of the site should be the watershed of the Allt a Mharcaidh catchment;
- the target sampling site should be established in the central soil/vegetation unit and secondary sampling sites established in the other two;
- the monitoring should be carried out by a range of organisations;
- a single data collection office be identified which will be the point of contact with the ECN data centre;
- the Cairngorms ECN brochure should be modified to incorporate the freshwater elements of the site.
- the implementation should be carried out during 1994-5 so that the site is fully operational by April 1995.

4.2 COSTS

Table 3 Summary of estimated costs

Initiation of the Cairngorms ECN site (Year 0: 1994-5)	
Function	**Cost(£)**
Site manager (IH)	4000
Research coordinator (MLURI)	2000
Data handler (IH)	2000
Staff time for installation (IH/MLURI)	1800
Staff time for baseline surveys (MLURI)	5200
Capital	6600
Brochure	1000
TOTAL	**22600**

Operation of the Cairngorms ECN site (Year 1: 1995-6)	
Function	**Cost(£)**
Site manager (IH)	5000
Research coordinator (MLURI)	2000
Data handler (IH)	1000
Monitoring (IH)	9200
Monitoring (MLURI)	35500
Monitoring (SOAFD)	9000
Monitoring (NERPB)	4000
Monitoring (SNH)	11500
TOTAL	**77200**

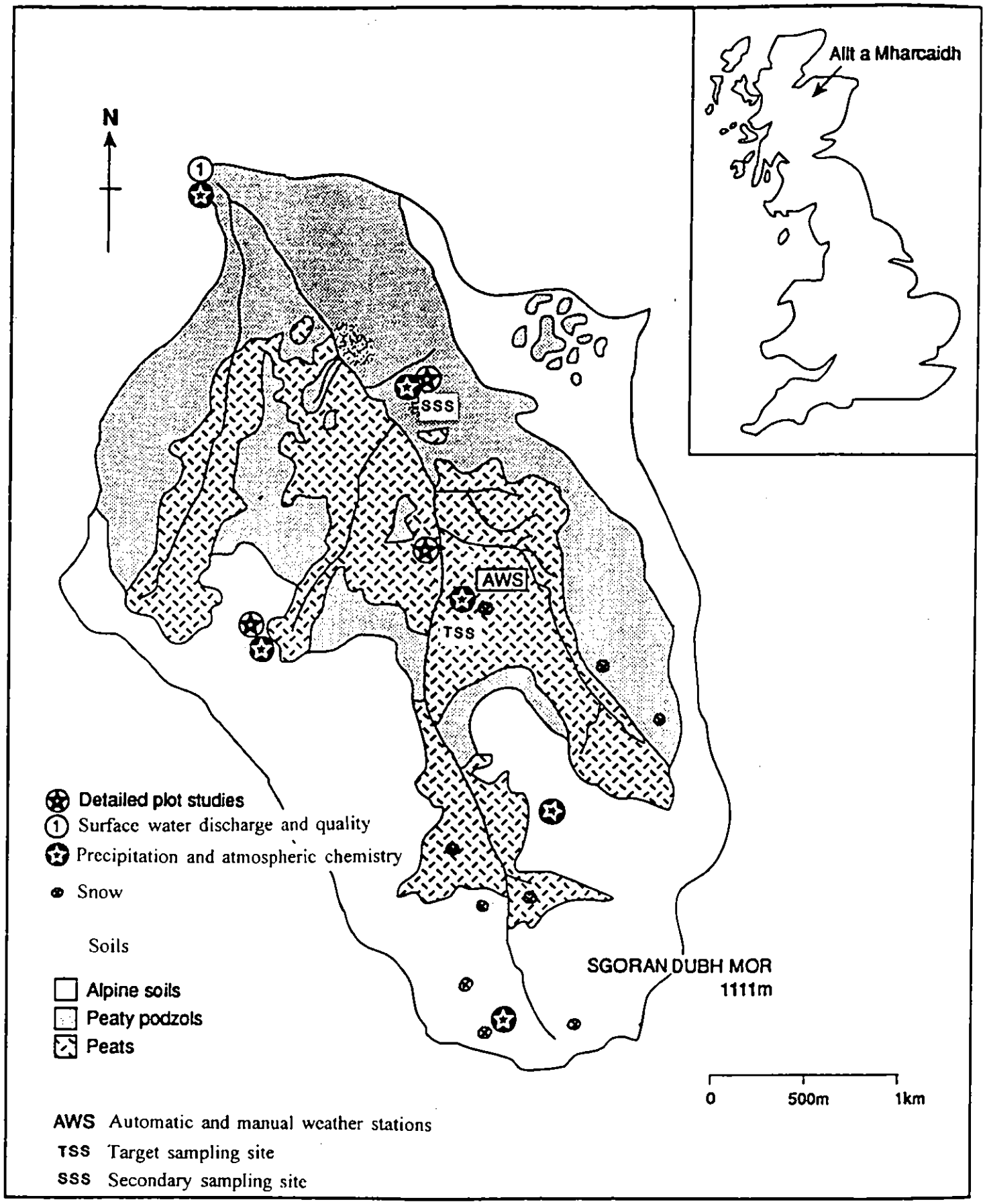

Fig.1 Locations of physical and chemical sampling sites in the Cairngorms ECN site