MINUTES
SCANNET FIRST GENERAL MEETING
ABISKO 22-24 FEB

Photo Nils Åke Andersson

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1. Introductory aspects

SCANNET is a thematic Network. The objective is to establish a network of terrestrial field bases that covers a wide range of climate conditions. SCANNET comes under the EU Specific research and technological programme "Energy, Environment and Sustainable Development". We can therefore not do research but we can:

- Identify longer term data sets of environmental change
- Prepare and compile time and geographical series of data
- Identify major environmental changes and information gaps
- Integrate across subject areas to identify the most significant changes and most sensitive indicators
- Make data sets more accessible e.g. by using modern media
- Coordinate future research activities
- Initiate research or monitoring to fill information gaps
- Formulate protocols for making comparable environmental measurements

There are questions that can focus SCANNET activities:

- Where in the European Arctic are ecosystems and natural resources most susceptible to change?
- How are these changes related to the specific environmental conditions around the field sites and what are the most important drivers of change at these sites?
- What are the consequences of environmental change for stakeholders?
- How is our understanding of environmental change constrained by methodology, technology, perception and policy?
- How does the focus on specific questions lead to the establishment of a network of sites with improved co-ordination of observations?

Participants. Station Managers provide breadth of awareness of data and information sources. Researchers provide depth of data and interpretation. Stakeholders and external users should be active participants in SCANNET development (they are insiders not outsiders).

Three Level Hierarchy of Networks. 1) ENVINET provides a North Atlantic Regional umbrella linking terrestrial sites (SCANNET - Ny Ålesund, Zackenberg, Abisko) with marine and atmospheric field sites. 2) SCANNET provides a more extensive terrestrial / freshwater network. 3) Each SCANNET Core Site acts as a connecting 'Centre' to other sites in their area and also to National networks and National users/stakeholders.

2. Programme

Scandinavian / North European Network of Terrestrial Field bases

SCANNET

FIRST GENERAL MEETING
ABISKO, 22-24 of February 2001

	Time		Location	Name
Wed 21 Feb *Arrival at Abisko*	**22.00**	**Light supper**	***ANS* Dining Room***	
Thurs 22 Feb	**08.00**	**Breakfast**	***ANS Dining Room***	
	09.00	Welcome Address	*ANS New Lecture Theatre*	Terry Callaghan
		Introduction of Participants		All
		Overview of SCANNET		Terry Callaghan
	10.15	***Coffee Break***	***ANS Dining Room***	
	10.45	Presentations of Research Stations	*ANS New Lecture Theatre*	
	10.45	Kilpisjärvi Biological Station		Antero Järvinen
	11.10	Ny Ålesund		Jack Kohler
	11.35	Kevo Subarctic Research Institute		Seppo Neuvonen
	12.00	Banchory Research Station		Neil Bayfield
	12.25	Dovre Research Station		Nils Roar Saelthun
	13.00	***LUNCH***	***ANS Dining Room***	
	14.30	Zackenberg Station	*ANS New Lecture Theatre*	Morten Rasch
	14.55	Abisko Research Station		Terry Callaghan
	15.20	Litla Skard		
	15.45	Sornfelli		Lis Mortensen
	16.15	***Coffee Break Outdoor***	***Local Outdoor Activity***	
	19.00	***Dinner***	***ANS Dining Room***	
	20.00	***Slide show Northern Light***	***Peter Rosén***	
	20.30-23.00	***Ice Breaker at Tundra Bar***	***Tundra Bar***	

Fri 23 Feb	***08.00***	***Breakfast***	***ANS Dining Room***	
	09.00	Detailed Presentation of SCANNET Science	*ANS New Lecture Theatre*	Terry Callaghan Bill Heal Nils Roar Saelthun
	09.30	Detailed Presentation of SCANNET Administration		Margareta Johansson
	10.00	***Coffee Break***	***ANS Dining Room***	
	10.30	Presentation of WP and discussions	*ANS Old Lecture Theatre*	
	10.30	WP 1 WP 2 WP 8		Terry Callaghan Margareta Johansson
	11.30	WP 3		Nils Roar Saelthun
	12.00	WP 4		Neil Bayfield
	12.30	***Lunch***	***ANS Dining Room***	
	14.00	WP 5	*ANS Old Lecture Theatre*	Jack Kohler
	14.30	WP 6		Seppo Neuvonen
	15.00	WP 7		Morten Rasch
	15.30	***Coffee Break***	***ANS Dining Room***	
	16.00	Concluding Remarks	*ANS Old Lecture Theatre*	Bill Heal Nils Roar Saelthun
	17.00	Next steps		Terry Callaghan Margareta Johansson
	19.00	***Conference Dinner***	***ANS Dining Room***	
	21.00	***Tundra Bar***		
Sat 24 Feb	***08.30***	***Breakfast***	***ANS Dining Room***	
	9.30	Exploratory Workshop		Neil Bayfield
	12.30	***Light Lunch***	***ANS Dining Room***	
	13.15	***Departure to the ICE Hotel in Jukkasjärvi***		
	15.00	***Guided tour at the ICE Hotel***		
		Dinner, independent arrangements		
Sun 25 Feb Departure	***9.30***	***Breakfast***	***ANS Dining Room***	

*ANS Abisko Scientific Research Station

3. Participants

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Sornfelli	Lis Mortensen	Brekkutún 1 188 Hoyvík Faroe Islands	+298 35 7000	+298 357001	Lismor@jfs.fo
Litla Skard	Aevar Petersen	Icelandic Institute of Natural History Hlemmur 3 P.O Box 5320 IS-125 Reykjavik Iceland	+354 56 298 22	+354 56 208 15	Aevar@nattfs.is

4. SCANNET Sites

Each site was briefly described and some key points emerging are noted:

Kilpisjarvi Biological Station, Finland (Antero Jarvinen). The station was official opened in 1964 and is owned by the University of Helsinki. The site has vegetation and climate similar to Abisko with mountain biodiversity. It is on the shore of Lake Kilpisjarvi at 480 m a.s.l. and at the crux of Norway, Sweden and Finland. Tourism is of developing interest. Specific long-term studies are backed by more extensive studies on climate, vegetation, soils, rodents, birds and predators etc. Current hypotheses are described in Nature, 1 June 2000.

Ny Ålesund, Svalbard, Norway (Jack Kohler, Andreas Kirchhefer, Elisabeth Cooper). The various national stations based at Ny Alesund cover a very wide range of subjects. Data belong to the nations but a meta-database is accessible. The Norwegian Station was established in 1968. Norsk Polar Institute holds climate data from 1916 which show large variation in winter temperatures with warm weather episodes related to shifts in wind direction from South to North and fairly consistence summer temperature. Local variation in climate is reflected in the decline in mass of two small glaciers but stability in a third. Soil microclimate and permafrost observations need strengthening.

Kevo Subarctic Research Institute, Finland (Seppo Neuvonen). In 1956 the decision was made to build a field station at Kevo and in 1958 the first building was built. During the 1950's and 60's the main research at the station was Floristic and Faunistic. In 1970's a change in research practices occurred towards experimental approaches. Long-term observations of Eperitta (Autumnal moth) include the outbreak in 1964-5 that destroyed more than 5000km^2 of birch woodland. Experiments include reindeer exclosures; treeline gardens established in 1970s; Simulated Acid Rain experiment (80 plots); integrated monitoring catchment. Historically human populations peaked in early 1990s (1600 in 500km^2) but declined to 1400 in last 3 years. Kevo stations concentrates on basic research but fisheries studies are done at Utsjoki and Reindeer Herders Association is active.

Cairngorms, Allt a Mharcaidh, UK (Neil Bayfield, Imogen Pearce). The main site is a west facing granite catchment, rising from the tree line at 700 to 1100m which is well above the tree line. The catchment area is 10 km^2. The area has virtually no natural tree line due to overgrazing etc., but is now responding to reductions in grazing pressures locally. It includes both terrestrial and freshwater observations as part of the UK Environmental Change Network (ECN) and is linked with the GLORIA programme examining temperature effects on vegetation across alpine Europe. The Cairngorms area at an interface between increasing winter precipitation coming from the west and decreasing summer rainfall from the east. The Cairngorms area has been subject to a wide variety of studies, particularly related to tourism impacts.

Dovrefjell, Norway (Niels Roar Saelthun). The study site in the Drivdalen valley is associated with the Kongsvall Biological Station (Norwegian University of Science and Technology, Trondheim) and the Hjerkumi Research Station (University of Oslo). There is a long tradition of vegetation mapping, revegetation experiments, population

data on reindeer, musk ox etc. The site is linked to the EC DART project. A further site at Finse, on the Oslo-Bergen railway, rising to 1220m with a glacier, and diverse research is an additional site strongly linked to the Universities of Oslo and Bergen. The scientific profile at Finse is research on terrestrial and aquatic plants.

Zachenberg, Greenland (Morten Rasch, Hans Meltofte, Knud Falk). The first ZERO expedition took place in 1991 and in 1995 the Zackenberg Ecological Research Station was established. The station is within the southern part of the national park of North and East Greenland. The study area comprises the entire catchment of the river Zackenberg, totalling about 600 km^2. It provides facilities for specific but comprehensive research projects, and for long-term monitoring grouped around three systematic programmes (ClimateBasis, GeoBasis, BioBasis). The initial Danish research is increasingly international and focussed on climate change. Associated sites are at Daneberg, Kystens Perle and the Arctic Station at Disko Island.

Sornfelli, Faroe Islands (Lis Mortensen). The Faroes are strategically placed to detect past, present and future changes in North Atlantic marine currents and atmospheric circulation patterns with little continental influence. The Sornfelli Climate Station was established in 1999 on the mountain plateau at 750m to detect changes and improve the spatial distribution of climatic observations. Hourly photographic observations are designed to record snow features e.g. snow depth and snowline during winter season. The Museum of Natural History is responsible for a mountain profile vegetation recording plus soil erosion, sheep exclosures and additional climate observations.

Litla-Skard, Iceland (Aevar Petersen). In his absence, Aevar Petersen sent details of the west coast Litla-Skard Biomonitoring area of 56 ha, including 2.4 ha water. Climate records go back to 1961 at the Sioumuli station 12 km away. Vegetation mapping dates back to 1977 and the Integrated Monitoring programme is likely to be based on the UN-ECE Long-range Transboundary Air Pollution Programme. Land use and pollution disturbance is minimal in the area. Other Icelandic sites e.g. Lake Myvaten may be considered for specific long-term data sets.

Abisko, Sweden (Terry Callaghan). The Abisko station has apart from the main station 6 additional stations strategically placed in different biomes in the Tornatrask area and including long-term hydrological and glaciological studies. Geosciences, including mass wastage of valleys and sediment transport are focussed on Tarfala while the biosciences focus on Abisko, including a Human Dimensions programme of MaB. Observations go back to the initial establishment in 1912 and include various long-term experiments. There is limited core staff and the facilities are designed to provide access for visiting national and international researchers. Current emphasis is on climate change, including enhanced CO_2 and UVB, builds on past data, historical and Holocene records, including freshwater observations. The breadth of information is now contributing to international modelling using DEM and downscaled climate to explore vegetation distribution and productivity in the Tornetrask valley, leading to an integrated catchment model.

5. SCANNET Work Packages

WP 3. Regional Climate Change Scenarios. Nils Roar Saelthun, NIVA.

Existing and developing (ACIA) regional climate scenarios need to be compiled to provide the main environmental context for all SCANNET activities, with a strong North Atlantic focus. The scenarios should be explored to identify what climatic characteristics are expected to change (probably extremes more than trends) and how they vary spatially. Search for data on the ways in which general climatic conditions are modified by such features as snow cover, topography, vegetation and soil conditions is likely to be critical. Similarly, because climate effects will be modified by UV-B, CO_2 and N deposition, circumstances where there are various combinations will be particularly important.

WP 4. Reviewing Land Use and Society Interaction. Neil Bayfield, CEH.

The introductions to the sites highlighted the diversity of human impact on the site landscapes. An initial action will be to identify the key human drivers of change in the sites, the indicators of change and a risk assessment. This approach will generate risk matrices for SCANNET sites and identify priorities for data search. A specific interactive decision support system will be used in an introductory workshop.

WP 5. Presentation of more accessible data on climatic variability. Jack Kohler, NP.

A key step in this WP is to clarify the climatic variables that are driving change and are most useful indicators. This assessment will help to prioritise data search and identify gaps in network observations. Discussion was concentrated on snow dynamics, timing of freeze, thaw, icing and similar cryospheric observations. These are poorly represented in conventional climatic observations and are important in generating snow pack and other cryospheric models. Similarly, although detailed temporal variation is often emphasised, little emphasis is given to the importance of meso- and micro-topographic variation, including the influence of varying soil conditions. Particular attention to these variables is likely to be an important effort in the search for data and in the potential application to simple (degree-day) or complex (CRREL) models. Although the principle of simplicity is attractive, the importance of non-linearity and events may require more sophisticated models - and associated data.

WP 6. Standardisation of Protocols: spatial and temporal variation of biodiversity. Seppo Neuvonen, Kevo.

There are strong cross connections with WP 3, 4 and 5 and a priority will be to assess formats currently used across the sites. Clear distinction will be made between habitat and species diversity data. Intra-species diversity may be an important survival attribute under the extreme climatic conditions but evidence is likely to be very limited - this may make the search for such data a priority. Low diversity is a feature of many sites in response to climatic severity but also, in many sites, due to spatial isolation. Baseline information on habitat and species diversity needs to be assessed

and also the value of such data for detecting changes in biodiversity. Various questions will have to be addressed at an early stage e.g. Will there be differences in responsiveness between different taxonomic groups? What are the requirements of the stakeholders (CAFF, EEA)? How can we improve standardisation and comparability? We will explore the use of GIS to summarise and predict biodiversity but we need to resolve issues relating to assess to data for sensitive species.

WP 7. Reviewing species performance and phenology. Hans Meltofte, DPC.

The response of species to particular events or circumstances e.g. climatic conditions can provide very precise information on the impacts of environmental change. There are many examples of phenology (or phenomonology) such as flowering dates for Dryas derived from ITEX plots; timing of chironomid emergence; arrival or laying dates for migratory birds; change in treeline position or annual growth. Dominant features of Arctic ecology are related to the distinctive climatic patterns and short growing seasons and indicators will be highly variable across sites. It will therefore be important to explore the variety of indicators of change and in relation to the variables that are expected to change - not only climate. Appropriate data may be available from the main sites but opportunities for accessing data from related sites e.g. Lake Myvatn in Iceland, should be encouraged. One of the cross-disciplinary and cross-site challenges will be to assess comparability; thus totally different ecological variables may be responding to the same climatic variable. Accumulation of large and varied data sets is likely to open the opportunity for synthesis, possibly through research students associated with the project.

WP 1, 2 and 8. Network administration, co-ordination, baseline information, and Station Managers Forum. Terry Callaghan, Abisko.

The centralised activities contained in these WPs are designed to develop the SCANNET network as a whole. The functions require establishment of communication in various directions (between sites; between Work Programmes; with other stakeholders; with the wider scientific community; with the EU), ensuring determination of priorities and standards. A Steering Group of Terry Callaghan, Nils Roar Saelthun and Bill Heal, with Margareta Johansson, will provide the overall project management.

6. SCANNET Following Steps

6.1 Work packages action

WP 3 Regional Climate Change Scenarios
What we will do next:

- Hire a person to work on the project
- Establish detailed work plan for WP 3
- Establish and circulate proposal for scenario variables, format, etc.

What we need from you:

- Feedback on scenario format proposal

What we do for your:
- Circulate proposal for scenario format
- Discuss interaction with WP 5, (Norwegian Polar Institute)

WP 4 Reviewing Land Use and Society Interaction
What we will do next:
- Produce detailed results and interpretation of exploratory workshop and make proposals for further development

What we need from you:
- Comment on workshop results and propose actions for local stakeholder interactions
- Volunteer sites for stakeholder (Workshops)

What we do for your:
- Facilitation software and analysis of stakeholder of other decision workshops or questionnaires.

WP 5 Presentation of more accessible data on climatic variability
What we will do next:
- Assemble data from Ny Ålesund and the other stations and determine what is being measured at different sites
- Identify priorities and then assess gaps in spatial and variable data coverage. In particular explore what observations on snow and winter conditions are being made.
- Decide what to calculate

What we need from you:
- Daily met: Temperature, Precipitation, Snow/rain at the station, other sites.
- List of monitoring

What we do for your:
- Suggestion or a questionnaire of the parameters to be used

WP 6 Standardisation of Protocols: spatial and temporal variation of biodiversity
What we will do next:
- Prepare and send a questionnaire related to WP 6 (Biodiversity…..) on site information and requirements

What we need from you:
- Answers to the questionnaire and/or suggestions of persons/institutions to be contacted

What we do for you:

- Provide the info you need

WP 7 Reviewing species performance and phenology

What we will do next:

- Establish an organisational set up including a backing group
- Find the right person

What we need from you:

- Climate Scenarios
- Metadata on phenology
- Metadata on species performance
- Real data at a later stage

What we do for your:

- Site information
- Metadata of monitoring at Zackenberg
- Real data at a later stage

WP 1, 2 and 8 Network administration, co-ordination, baseline information, and Station Managers Forum

What we will do next:

- Brochure
- Web page
- Pay out the advancement payments
- Start arrange the next two meetings
- Newsletter
- Start a discussion on the bibliography format
- Start a discussion on the register of future research programs
- Appoint a data base manager
- Establish email list server
- Compile basic site description
- Make a presentation of SCANNET at the International Conference 'Detecting Environmental Change: Science and Society' in July 2001 in London.

What we need from you:

- Information for the brochure (nice pictures, diagrams etc.)
- Web links
- Acknowledgement from financial officers
    - Receipt of our letter
    - Bank account info
    - Receipt of payment
- Local organisers for the following meetings, Ny Ålesund and Torshavn
- List of people to be invited to Torshavn
- Information for newsletter when requested
- When a data manager has been appointed, we get back to you with request for the data base

What we do for your:

- Give you money
- The things listed above

6.2 General Actions

- Outline site descriptions should be generated as a priority. These are already published for six sites (Zackenberg, Abisko, Ny Alesund, Dovre, Kilpisjarvi and Kevo) in Appendix 2 of the Proceedings of the SCANTRAN Rovaniemi meeting (Turunen et al 1999). With the addition of the remaining sites (Cairngorms, Sornfelli, Likla-Skard), these descriptions, plus the Tabular and Graphical synthesis, should form an immediate component of the SCANNET website.
- Each site should identify other sites in their region that may be able to contribute particular data and information relevant to SCANNET.
- The different sites already highlighted the variety of sources from which important data and information can be derived. Wide exploitation should be encouraged.
- A variety of manuals and protocols for standardisation of data were identified. An early task is to select those most appropriate to SCANNET.

6.3 SCANNET Meetings

The main series of SCANNET meetings is scheduled as follows:

Time	*Location*
February 2001	Abisko, Sweden.
August 2001	Ny Ålesund, Norway. (Station Managers Forum)
November 2001	Torshavn, Faroe Islands.
November 2002	Reykjavik, Iceland.
November 2003	Kevo, Finland.

6.4 General decisions

Person responsible for each contractor

Institution	*Responsible person*
Abisko	Terry Callaghan
Ny Ålesund	Jack Kohler
Kevo	Seppo Neuvonen
Banchory	Neil Bayfield
Dovre	Nils Roar Saelthun
Zackenberg	Morten Rasch
Kilpisjärvi	Antero Järvinen
Sornfelli	Lis Mortensen
Litla Skard	Aevar Petersen

7. Summary conclusions

The Station Managers met at Abisko and followed the set agenda to realise a successful inauguration of SCANNET. In addition, Work Package 4 was initiated during a half-day workshop in which participants took part in a computer-based decision network related to stake-holder aspects of SCANNET. Initial results are attached in Appendix I.

From the presentations, discussions and workshop, it became evident that the SCANNET network of research facilities in themselves include a good range of geographical, geophysical, climatic, vegetation, faunal, hydrological, soil and land-use conditions. The environmental space occupied by the research stations will now be documented by generating a comprehensive, formalised suite of 'Word models' describing the structure, function and dynamics of the sites. This approach was a useful contribution to the IBP Tundra Biome.

In addition, it was noted that each research station or major site was part of a heirarchy of networks. Each Station/site is associated with the following networks:

- Field sites: sites at which the Station has observations, experiments, environmental characteristics such as biodiversity "hotspots" and where there are particular local stake-holder interests.
- Neighbouring facilities: many of the Stations/sites are associated with neighbouring research facilities in similar or different disciplines.
- Local stakeholder organisations: most of the Stations/sites are in areas controlled by local authorities that represent the local population. Even where a local population is small or lacking, local authorities have relevance for the Stations/sites through, for example, creating and maintaining protected areas.
- National and international science networks: most of the Stations belong to networks in various disciplines of science. Some of these are national, some European Union and others apply to the Arctic Region or are global.

This hierarchy of networks associated with each Station/site will be documented and used to strengthen SCANNET and to increase communication between SCANNET and its potential user community. For example, the location of Stations and individuals provides SCANNET with important opportunities for direct, personal contacts with particular stakeholders or interested organisations eg NorskPolar Institute with ENVINET; Danish Polar Centre with European Environment Agency in Copenhagen; NIVA (Niels Roar Saelthun) with AMAP in Oslo and UNEP-Grid in Arendal; Aevar Petersen with CAFF in Akuryeri, Iceland; Abisko with ACIA (Arctic Climate Impact Assessment) through Terry Callaghan as a Lead Author, IASC, FATE, Tundra-taiga, UNEP expert panel on ozone effects, MaB Northern Science Network etc.

The presentations of the individual work packages resulted in clear "to-do lists". The process in determining these lists and the explicit documentation of these provides a clear platform for the initiation of the work packages. A Policy decision was made

such that the data to be collected for the SCANNET data base could only be purchased if they were cheap.

Discussion of publication policy emphasised the need to publish material resulting from SCANNET in a wide range of fora including scientific journals. Results from one or more SCANNET meetings could be published as a symposium proceedings in for example AMBIO or Ecological Bulletins. We should aim to publish a collection of papers one year before the end of the SCANNET project.

The highest immediate priority is to acquire the initial funding payment from Brussels and to distribute this to partners. This will facilitate the SCANNET becoming fully operational.

Appendix I

Report on Work Package 4 Exploratory Workshop at Abisko, February 2001

AIMS

Work Package 4 is to take account of the possible impacts of land use and socio-economic drivers of change as well as the more ecological drivers, in order to give our network wide relevance to environmental change in the arctic .

The aim of the short exploratory workshop was to try and identify the main types of environmental issues that were perceived to be important for individual sites and for the network as a whole. Also those that were **not** important. We also hoped to undertake an assessment of the perceived risks (likelihood and possible severity) associated with some of the environmental issues under consideration . This was very much a preliminary exercise to test the approach and help us design follow on activities.

METHOD

Prior to the meeting a decision tree had been constructed to take account of issues, pressures and drivers of change identified by individual sites in a preliminary questionnaire. At the meeting each individual ranked the various trunks branches and twigs of the tree to provide a perspective on what might be important at their site. The main trunks represented disciplines (social, economic, biophysical) branches represented topics (transport, hydrology, culture etc) twigs represented issues (pollution etc) and the final level (leaves?) indicators of change. By multiplying the ranking scores (10 best, 1 worst) through the levels of the tree a composite score could be derived that permitted comparison of the rank score of any branch with any other, any twig with any other etc. A software package, *Impact Explorer*, and an electronic voting system were used in conjunction with printed copies of the decision tree to record participants scores. There were only ten voting keypads but scores from those without keypads were taken from the paper copies filled in manually.
Some sites had several representatives present, other sites had only one.

The sites details for the purposes of this comparison were listed by their representatives as:

Site	***Area (km^2)***	***Population (no/km^2)***	***Main human activities***
Abisko	3000	0.1	Reindeer herding, hunting, tourism, research,
Cairngorms	5,000	3	Deer hunting, fishing, tourism

			agriculture, forestry research, nature conservation
Zachenberg	**1,000,000**	**0.000003**	**Met stations, military bases, tourism, hunting, research**
Ny Alesund	**500**	**0.1-0.4**	**Research, recreation, tourism**
Faroes	1400	3.2	Farming, fishing, industry, grazing
Kevo	6000	0.3	Reindeer herding, tourism, fishing, nature/landscape conservation
Kilpisjarvi	500	very low	Tourism, reindeer herding, hunting, fishing, research
Dovre	70,000	0.02	Recreation/tourism, agriculture, fishing, hunting hydro power, transport

RESULTS

Ranking the decision tree

At the first level of branching (disciplines) there was universal agreement that Natural Capital factors were the most important, but there were major differences in perspective on social and economic factors between sites (Table 1). The three Zachenberg representatives, for example, gave low priority to social and economic factors whereas these were given considerably higher scores at sites such as Kevo and Dovre. However, there were also substantial differences in opinion between individuals. Jack and Elizabeth, for example, had strongly different views about the importance of social and economic factors at Ny Alesund. Similarly Bill, Neil and Imogen differed in their views about the Cairngorm area. A broadly similar pattern of agreement and disagreement was shown at the next level (topics).

Considering the network as a whole there was general agreement that all 7 of the natural capital topics were of importance at most sites. Few if any of the Social and economic topics were of such general importance, although several were important for about half the sites where human activities had been given higher rankings. The highest scoring of the economic topics were *economic activity, tourism and recreation, hunting/fishing, transport and investment.* The most important social topics were *planning/regulation, land ownership, cultural heritage* and *stakeholders views*

It is also of interest to note the topics that were of very low importance. *Housing* was judged relatively unimportant at all sites, and *demography, income* and *employment* also had very low scores.

Table 1. Comparison of the composite scores (multiplied across tree levels) for the first two levels of the decision tree (Disciplines and Topics). Green: natural capital, pink: economic and blue: social factors. Sites and individuals indicated by initials: SN Seppo Neuvonen; AK Andreas Kirckhefi; AJ Andero Jarvinen; KF Knud Falk; MR Morten Rasch; JK Jack Kohler; EC Elizabeth Cooper; LM Lis Mortensen; NB Neil Bayfield; IP Imogen Pearce; BH Bill Heal; TC Terry Callaghan. Sites: KEV Kevo; KIL Kilpisjärvi; ZAC Zachenberg; NA Ny Alesund; FAR Faroes; CAI Cairngorms; ABI Abisko. Scores of 5 and above are highlighted in red

Observer	SN	AK	AJ	NR	KF	HM	MR	J	EC	LM	NB	IP	BH	TC	
Site	KEV	KIL	KIL	DOV	ZAC	ZAC	ZAC	NA	NA	FAR	CAI	CAI	CAI	ABI	MEAN
Natural Capital	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Economic factors	8.0	8.0	9.0	10.0	5.0	3.0	3.0	1.0	7.0	9.0	9.0	8.0	3.0	2.0	6.1
Social and political	8.0	8.0	6.0	5.0	2.0	3.0	1.0	1.0	8.0	8.0	9.0	8.0	4.0	4.0	5.4
Observer	SN	AK	AJ	NR	KF	HM	MR	J	EC	LM	NB	IP	BH	TC	
Site	KEV	KIL	KIL	DOV	ZAC	ZAC	ZAC	NA	NA	FAR	CAI	CAI	CAI	ABI	MEAN
Climate	6.0	10.0	10.0	7.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	8.0	8.0	5.0	8.9
Hydrology	4.0	3.0	8.0	10.0	5.0	2.0	4.0	10.0	8.0	8.0	6.0	6.0	4.0	5.0	5.9
Geology/geomorphology	5.0	2.0	4.0	3.0	5.0	2.0	3.0	5.0	7.0	8.0	7.0	4.0	2.0	3.0	4.3
Air	3.0	2.0	5.0	2.0	5.0	5.0	5.0	5.0	2.0	5.0	8.0	6.0	2.0	3.0	4.1
Land use	10.0	5.0	10.0	5.0	5.0	2.0	1.0	1.0	6.0	7.0	10.0	10.0	10.0	10.0	6.6
Biological resources	5.0	5.0	9.0	10.0	10.0	10.0	2.0	10.0	9.0	5.0	10.0	10.0	8.0	10.0	8.1
Landscape	3.0	7.0	8.0	10.0	10.0	5.0	1.0	1.0	8.0	5.0	10.0	3.0	8.0	3.0	5.9
Economic activity	8.0	6.4	9.0	10.0	1.0	1.5	0.3	0.1	7.0	8.1	4.5	6.4	0.6	0.6	4.5
Employment	2.4	2.4	8.1	2.0	1.0	0.6	0.3	0.1	0.7	4.5	5.4	3.2	0.6	1.6	2.4
Income	2.4	1.6	7.2	2.0	0.5	1.5	0.3	0.1	2.8	4.5	4.5	1.6	0.6	0.4	2.1
Public sector investment	2.4	4.0	6.3	4.0	1.0	3.0	0.9	0.5	7.0	4.5	6.3	8.0	3.0	1.0	3.7
Private sector investment	2.4	4.0	8.1	5.0	0.5	3.0	1.5	0.1	6.3	4.5	6.3	6.4	1.8	1.0	3.6
Transport	4.0	4.0	3.6	8.0	2.5	3.0	0.6	0.5	5.6	4.5	7.2	5.6	1.2	0.8	3.7
Tourism and recreation	4.8	8.0	7.2	10.0	5.0	3.0	3.0	1.0	5.6	9.0	9.0	8.0	1.8	2.0	5.5
Hunting and fishing	4.8	6.4	2.7	3.0	5.0	3.0	0.6	0.5	2.1	3.6	7.2	6.4	1.2	1.8	3.5
Stakeholders views	8.0	8.0	4.2	2.5	2.0	3.0	1.0	1.0	4.0	3.2	8.1	6.4	3.2	2.0	4.0
Planning / regulation	8.0	8.0	6.0	2.5	2.0	3.0	0.5	0.1	8.0	8.0	7.2	8.0	4.0	4.0	5.0
Land ownership	8.0	4.8	5.4	2.5	0.4	0.3	0.1	0.1	0.8	8.0	7.2	8.0	3.2	0.4	3.5
Housing	2.4	3.2	4.2	0.5	0.2	0.3	0.1	0.1	0.8	4.0	4.5	2.4	1.6	0.4	1.8
Demography	2.4	2.4	4.2	0.5	0.4	0.3	0.1	0.1	2.4	4.0	9.0	4.8	0.8	0.4	2.3
Cultural heritage	8.0	1.6	3.0	5.0	2.0	3.0	0.2	0.1	5.6	4.0	8.1	1.6	0.8	4.0	3.4

Scores for the third tree level (issues) have been omitted to simplify the presentation, but Table 2 shows scores for possible environmental indicators (final level in the tree). This also shows a pattern of high scores in the Natural Capital category and generally fewer high scores in the Social and Economic categories.

Table 2. Composite scores for the final level of the tree (possible indicators) Symbols etc as for Table 1.

	SN	AK	AJ	NR	KF	HM	MR	J	EC	LM	NB	IP	BH	TC	
Site	KEV	KIL	KIL	DOV	ZAC	ZAC	ZAC	NA	NA	FAR	CAI	CAI	CAI	ABI	MEAN

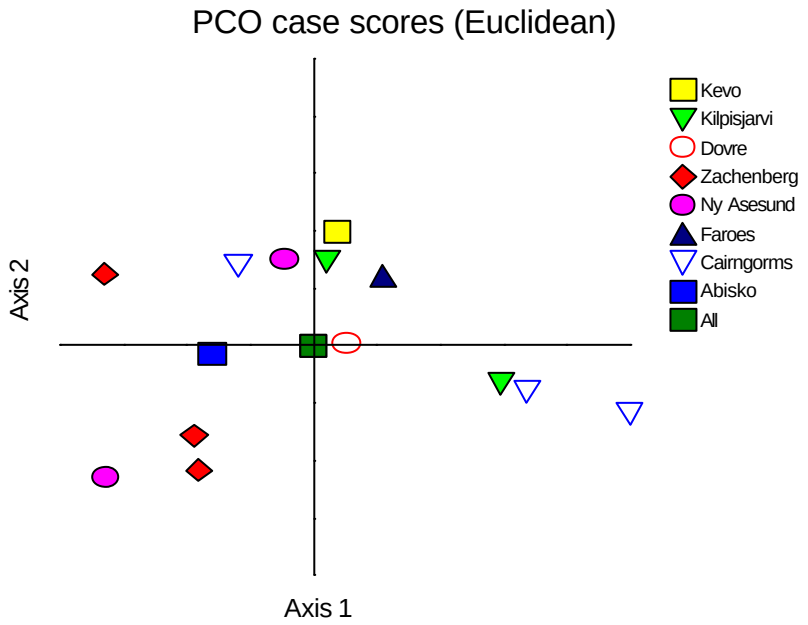
Snow	6.0	10.0	8.0	7.0	10.0	10.0	8.0	10.0	7.2	8.0	8.0	4.8	8.0	5.0	7.9
Glaciers	0.6	1.0	0.8	3.5	10.0	5.0	0.8	5.0	9.0	0.8	0.8	0.5	0.8	4.0	3.0
Permafrost	3.0	3.0	4.0	1.4	5.0	10.0	4.0	10.0	8.1	0.8	0.8	1.0	0.8	4.0	4.0
Meteorological data	4.2	10.0	10.0	7.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	8.0	8.0	4.0	8.3
Runoff chemistry	4.0	3.0	6.4	5.0	5.0	0.5	4.0	10.0	8.0	6.4	4.8	6.0	4.0	5.0	5.2
Stream biology	4.0	3.0	8.0	10.0	2.5	1.0	0.8	5.0	3.2	5.1	6.0	4.2	2.4	4.5	4.3
Hydrographic data	1.2	0.3	6.4	10.0	2.5	2.0	3.2	10.0	6.4	8.0	6.0	4.2	0.4	1.5	4.4
Abstraction rates	1.2	0.3	4.8	5.0	0.5	0.2	0.4	10.0	4.8	6.4	3.6	1.2	1.6	0.5	2.9
Sediment loadings	3.5	1.1	1.2	1.5	0.5	0.5	0.6	5.0	7.0	7.2	2.1	2.8	0.1	3.0	2.6
Erosion rates	5.0	1.6	2.4	1.5	2.5	1.0	0.6	0.5	5.6	8.0	4.2	4.0	0.2	3.0	2.9
Avalanche records	0.5	0.5	1.9	3.0	1.3	0.5	0.1	0.5	2.1	7.2	3.4	0.4	0.2	2.4	1.7
Key features	1.5	2.0	1.6	1.5	5.0	2.0	0.3	2.5	4.2	6.4	7.0	1.6	2.0	1.2	2.8
Transport	0.5	0.4	3.2	0.5	2.5	1.0	3.0	0.1	2.1	0.1	2.1	0.4	0.2	0.3	1.2
Extraction statistics	0.1	0.4	4.0	0.9	1.3	1.0	3.0	0.1	4.2	0.8	1.9	0.1	0.4	0.3	1.3
Ammonia, NOx SO2	3.0	2.0	4.0	0.6	2.5	1.0	4.0	0.5	0.8	2.5	8.0	6.0	1.2	2.4	2.8
Precipitation chemistry	3.0	2.0	5.0	2.0	5.0	5.0	5.0	5.0	2.0	5.0	6.4	4.8	2.0	3.0	3.9
Agricultural areas	3.0	0.5	0.6	2.0	0.1	0.2	0.1	0.0	0.6	1.4	3.6	6.0	0.9	1.0	1.4
Pesticides and fertilizers	2.4	0.1	0.4	0.3	0.5	0.2	0.1	0.0	0.6	1.4	3.2	8.0	0.6	0.1	1.3
Stock levels	0.9	0.5	2.0	2.5	0.1	0.2	0.1	0.1	0.6	3.5	4.0	10.0	3.0	1.0	2.0
Crop statistics	0.9	0.1	0.6	0.5	0.1	0.2	0.1	0.0	0.6	0.4	4.0	1.0	0.9	1.0	0.7
Areas and types of forest use	3.0	1.0	10.0	0.5	0.5	0.2	0.1	0.0	0.6	0.7	8.0	8.0	6.0	1.0	2.8
Timber production	0.6	0.1	2.0	0.1	0.1	0.2	0.1	0.0	0.6	0.1	4.8	5.6	1.2	0.8	1.2
Rangeland areas	10.0	5.0	6.4	5.0	0.5	0.2	0.1	0.1	5.4	7.0	10.0	10.0	10.0	10.0	5.7
Hunting and fishing areas	8.0	5.0	4.8	5.0	5.0	2.0	0.3	1.0	1.2	3.5	10.0	9.0	10.0	9.0	5.3
Conservation areas	10.0	5.0	8.0	2.5	5.0	2.0	1.0	0.1	6.0	5.6	10.0	10.0	8.0	8.0	5.8
Abandoned areas	3.0	1.5	4.0	0.5	2.5	0.2	0.1	0.1	2.4	3.5	4.0	3.0	2.0	1.0	2.0
Plant communities	4.0	5.0	9.0	8.0	10.0	10.0	1.6	10.0	0.0	5.0	10.0	10.0	1.4	8.0	6.6
Animal populations	3.2	5.0	9.0	10.0	10.0	10.0	1.1	10.0	0.0	5.0	10.0	10.0	1.9	10.0	6.8
Soils	3.2	2.5	5.4	1.0	10.0	10.0	1.3	5.0	0.0	5.0	8.0	7.0	1.0	3.0	4.5
Habitat condition	4.0	2.5	7.2	5.0	5.0	10.0	1.1	10.0	0.0	5.0	10.0	10.0	2.4	5.0	5.5
Key species	5.0	5.0	7.2	5.0	5.0	10.0	1.6	10.0	8.1	2.5	10.0	10.0	5.6	8.0	6.6
Key groups	5.0	5.0	8.1	3.0	10.0	10.0	2.0	10.0	8.1	3.0	10.0	10.0	8.0	10.0	7.3
Landscape fabric	3.0	7.0	8.0	8.0	10.0	5.0	1.0	1.0	5.6	5.0	10.0	3.0	8.0	2.4	5.5
Landscape views	3.0	3.5	6.4	10.0	10.0	5.0	1.0	0.1	8.0	4.0	10.0	1.5	8.0	3.0	5.3
Primary sector	8.0	6.4	9.0	10.0	1.0	1.5	0.3	0.1	4.2	4.1	4.5	4.5	0.6	0.1	3.9
Secondary sector	0.8	0.6	5.4	2.0	0.1	1.5	0.0	0.0	0.7	4.1	2.7	2.6	0.6	0.1	1.5
Tertiary sector	4.8	6.4	7.2	8.0	1.0	0.2	0.2	0.0	7.0	8.1	4.5	6.4	0.6	0.6	3.9
No on income support	2.4	0.2	6.5	1.0	1.0	0.6	0.0	0.1	0.1	2.3	3.2	0.2	0.6	1.3	1.4
Employment	2.4	2.4	8.1	2.0	0.1	0.6	0.3	0.0	0.7	4.5	5.4	1.6	0.4	1.6	2.1
Cost/job	2.4	0.2	6.5	2.0	0.5	0.6	0.0	0.0	0.1	0.9	4.3	3.2	0.4	0.5	1.5
Cost of living	2.4	0.2	7.2	0.4	0.1	1.5	0.3	0.1	0.8	2.3	4.5	0.3	0.4	0.4	1.5
Per capita income by sector	2.4	1.6	6.5	2.0	0.5	1.5	0.0	0.0	2.8	4.5	4.5	1.6	0.6	0.4	2.1
Uptake by scheme	0.7	0.4	6.3	2.0	0.0	0.3	0.1	0.1	0.7	1.4	6.3	8.0	1.1	0.1	2.0
Impacts	0.7	4.0	6.3	4.0	0.1	0.3	0.9	0.0	0.7	2.7	5.0	8.0	1.8	0.1	2.5
Uptake by sector	0.7	0.0	3.8	4.0	0.1	3.0	0.5	0.1	2.1	1.1	5.0	6.4	3.0	1.0	2.2
Local development grants	0.7	0.0	3.8	0.8	1.0	3.0	0.0	0.0	1.3	2.3	4.0	3.8	1.2	0.5	1.6
Regional budget by area	2.4	0.0	5.0	2.0	0.1	3.0	0.2	0.5	7.0	2.3	4.4	5.6	1.2	0.5	2.4
Planning applications	1.2	4.0	6.5	1.5	0.5	3.0	0.2	0.1	4.4	0.9	6.3	6.4	1.4	0.2	2.6
New business starts	2.4	1.2	8.1	2.5	0.1	3.0	1.5	0.0	3.8	4.5	6.3	1.3	1.1	1.0	2.6
Levels and sources	1.2	0.4	6.5	1.5	0.1	3.0	1.5	0.0	6.3	0.9	6.3	4.5	1.4	0.2	2.4
Purpose of expenditure	2.4	0.4	4.9	5.0	0.1	3.0	0.3	0.0	3.8	0.9	6.3	5.1	1.8	1.0	2.5
Use of routes	4.0	4.0	0.7	6.4	2.5	3.0	0.6	0.5	5.6	4.5	7.2	5.6	1.2	0.8	3.3
Traffic flows	1.2	1.2	1.8	4.0	1.3	1.5	0.5	0.1	5.0	2.3	5.8	3.9	0.2	0.1	2.1
Public transport	1.2	2.0	3.6	8.0	0.3	3.0	0.1	0.1	1.7	2.7	5.0	0.6	0.2	0.8	2.1
Occupancy rates	2.4	4.0	7.2	8.0	0.3	1.5	3.0	0.5	3.4	4.5	7.2	3.4	0.7	0.7	3.3
Provision	2.4	8.0	6.5	4.0	2.5	1.5	1.5	0.1	2.4	9.0	9.0	5.6	0.4	1.0	3.8
Visitor numbers	4.8	5.6	5.8	10.0	2.5	3.0	1.5	1.0	5.6	4.5	9.0	8.0	0.6	2.0	4.6
Traffic flows	1.4	5.6	4.6	5.0	5.0	3.0	0.8	0.5	3.9	2.3	7.2	4.8	1.1	0.2	3.2
Activity uptake	2.4	5.6	3.6	5.0	2.5	0.3	0.6	0.0	1.1	4.5	9.0	7.2	1.8	1.0	3.2
Bags	1.4	5.1	2.4	3.0	5.0	3.0	0.6	0.1	0.4	1.8	7.2	3.2	0.7	1.8	2.6

Stocks	4.8	**6.4**	2.7	0.9	2.5	1.5	0.3	0.5	2.1	3.6	**7.2**	**6.4**	1.2	1.6	3.0
															0.0
Membership lists	**8.0**	4.0	2.5	1.3	0.2	0.3	1.0	1.0	1.6	1.6	**6.5**	3.2	1.9	1.0	2.4
Surveys of views	**8.0**	**8.0**	4.2	2.5	2.0	3.0	1.0	0.1	4.0	3.2	**8.1**	**6.4**	3.2	2.0	4.0
Planning applications	**8.0**	**8.0**	**6.0**	1.3	2.0	3.0	0.4	0.0	**5.6**	**6.4**	**5.8**	**7.2**	1.6	0.8	4.0
Compliance data	4.8	**8.0**	**6.0**	2.5	2.0	3.0	0.5	0.1	**8.0**	**8.0**	**7.2**	**8.0**	4.0	4.0	4.7
Land register	0.8	4.8	**5.4**	2.5	0.4	0.3	0.1	0.1	0.8	**8.0**	**7.2**	**8.0**	1.3	0.4	2.9
Costs of housing	1.2	0.3	4.2	0.3	0.0	0.3	0.1	0.1	0.6	2.0	2.7	2.4	1.0	0.4	1.1
Register of stock	1.2	0.3	2.5	0.3	0.0	0.0	0.1	0.1	0.2	4.0	3.6	2.4	1.0	0.1	1.1
New planning applications	2.4	3.2	3.4	0.5	0.2	0.3	0.1	0.1	0.8	1.6	4.5	2.4	1.6	0.2	1.5
Population size	1.2	2.4	2.5	0.1	0.4	0.3	0.1	0.1	2.4	1.6	**8.1**	4.8	0.2	0.4	1.8
Population structure	2.4	0.2	4.2	0.1	0.0	0.3	0.0	0.0	1.2	1.6	**8.1**	3.4	0.3	0.1	1.6
Spatial distribution	0.7	2.4	3.4	0.5	0.4	0.3	0.0	0.0	2.4	4.0	**9.0**	2.9	0.1	0.2	1.9
Damage to sites	2.4	0.3	2.1	4.0	2.0	0.3	0.2	0.0	**5.6**	2.0	**8.1**	0.6	0.8	4.0	2.3
Funding	**8.0**	1.6	3.0	1.5	0.2	3.0	0.2	0.1	1.7	4.0	2.8	1.6	0.0	3.2	2.2
Attendance at events	**8.0**	1.6	1.8	**5.0**	0.2	0.3	0.2	0.0	0.7	2.0	**5.7**	1.6	0.0	1.6	2.0
Use of archive material	**8.0**	1.6	2.4	4.0	0.2	0.3	0.2	0.0	1.2	2.0	3.4	0.2	0.2	2.6	1.9

Ordination of individual and site scores

Ordination was undertaken on the indicators scores for each individual. Figure 1 shows the results of Principal Coordinates Analysis, with each individual labelled as a site point. The results show a scatter of points with sites having low social and economic scores generally on the left. However, where there are more than one representative of a site (e.g. Zachenberg, Cairngorms) the points are not particularly closely clustered. This confirms the divergence of views suggested by the data in Table 1. Another problem is that several network locations (Abisko, Faroes, Dovre) had only one representative voting, so there was no indication of the scatter of opinion for these sites.

Figure 1. Principal Ccoordinates Ordination of scores for all indicators for individuals from the eight Scannet network sites.



Risk assessment

Risk assessments were undertaken on Natural Capital issues using the electronic voting keypads. These assessments provide further insight into the relative importance of different drivers of change. Figure 2 shows mean impact and severity scores for each of the main issues (i.e all site votes combined.)

The highest risks were judged to be those associated with *Snow and ice* and *Climate change, Key species* and *Biodiversity. Pollution, Landscape appearance* and *Extensive land uses* were considered to have moderate risk. Other issues were generally low risk There was unfortunately not time to do assessments of economic or social issues

Figure 2. Risk assessment for issues related to Natural Capital based on votes of all the site representatives. Pink boxes: high risk, yellow moderate, green low

	Impact nil	Impact low	Impact medium	Impact high
Severity high			Key species Biodiversity	Snow & Ice Climate change
Severity medium		Water biology Cryoturbation Landscape fabric Water yield Erosion	Pollution Landscape appearance Extensive land uses	
Severity low		Water abstraction Agriculture	Minerals extraction Multi-use forestry	
Severity nil				

CONCLUSIONS AND WHAT NEXT?

This exercise appeared to have been a useful approach to help us compare our sites and the main factors relating to possible environmental change, and it provided a record of what our judgements were at that point in time. It is a fairly quick and efficient method of recording opinion and reaching some kind of consensus. The software worked tolerably well, although we have suggested a number of small improvements that the Software Developers are going to address. However, the results, although interesting represent only a preliminary evaluation. The large differences of opinion between individuals at some sites suggests that more discussion of issues may be needed, and that several people should to be involved for each site.

A second phase to this exercise will be to consult with stakeholders but it will probably be some time before our scientific evaluation is robust enough for wider consultation. The next step is that we will run some small internal workshops at

Banchory to explore the use of slightly larger teams from two or three of the sites using staff here who have worked at other sites as well as the Cairngorms. This will be a methodological study. Depending on the results we will then suggest some further evaluations that we might attempt when we next meet as a network. Alternatively it may be possible to do an exercise by email.

Neil Bayfield
Imogen Pearce
March 2001