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Synthesis of the model forest concept and its application to

Vilhelmina model forest

and

Barents model forest network

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Introduction

Scopes, purpose and objective

The scopes of this report are:

(1) To review the model forest concept as it has been adopted internationally;

(2) To outline the applicability of the model forest concept to a focal area within Vilhelmina Municipality, northern Sweden, which is under development towards a model forest along the guidelines that has been set by the International Model Forest Network; and

(3) To suggest a strategy for developing a network of model forests in the Barents region, i.e. the northernmost parts of Norway, Sweden, Finland and Russia.

The scope does not include an overview of potential financial resources, nor has any limitations been included to meet possible economic constraints.

The purpose was to synthesize existing knowledge and experiences, with emphasis on model forests in the boreal zone of the northern hemisphere. This was done by compiling information available on the internet and in printed publications. The following web pages have been the main sources of information:

www.idrc.ca/imfn – The International Model Forest Network;

www.modelforest.net – The Canadian Model Forest Network; and

www.wwf.ru/pskov – the Pskov Model Forest site provided by WWF.

These and other web pages are included in the reference list.

The objective was to outline how conceptual aspects – such as organizational structure, criteria and indicators, activities, geographical areas, etc. – have been implemented in existing model forests, and to elucidate how these aspects can be addressed within Vilhelmina Model Forest and the Barents Model Forest Network.

This report

This report includes five main chapters:

(1) Framework – the organizational background provided by the Forest Sector Task Force within the Barents Euro-Arctic Council;

(2) Model forest synthesis – a review of the model forest concept and existing knowledge and experiences;

(3) Vilhelmina project - a review of at hand information and documentation from the focal area in Vilhelmina Municipality;

(4) Vilhelmina Model Forest – a suggested strategy for model forest implementation, including suggested criteria and indicators;

(5) Barents Model Forest Network – a suggested strategy for developing a network of model forests within the Barents region; and

Following these chapters, references and appendices are given. References are not explicitly given in the running text.

The four appendices consider:

(1) Description of criteria, indicators and programs in Vilhelmina Model Forest;

(2) Tentative plan for accomplishment;

(3) Letter of intent;

(4) Sweden becomes first European country to join the International Model Forest Network.

The following abbreviations are frequently used in the text:

BEAC	Barents Euro-Arctic Council
BFSTF	BEAC Forest Sector Task Force
BMFN	Barents Model Forest Network
CMFN	Canadian Model Forest Network
EAI	Enhanced Aboriginal Involvement
EOMF	Eastern Ontario Model Forest
IDRC	International Development Research Centre
IMFN	International Model Forest Network
IMFNS	International Model Forest Network Secretariat
LAMF	Lake Abitibi Model Forest
MF	Model forest
VMF	Vilhelmina Model Forest
NDFSP	BEAC Northern Dimension Forest Sector Programme
PMF	Pskov Model Forest
SFM	Sustainable forest management

The background to this report was prepared in late 2002 and early 2003. Hence, the text may not be completely up to date in all aspects. Professional language service has not been employed. The authors are therefore responsible for linguistic deficiencies.

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Summary

Initiating model forests in the Barents region is viewed as a key approach for enhancing regional cooperation and development, as identified by the Barents Forest Sector Task Force within the Barents Euro-Arctic Council. In defining and applying model forests, this report follows the standards set by the International Model Forest Network. A model forest can be described both as a physical entity and as an organization: a demarcated land-base that is large enough to fully reflect the range of environmental and socio-economic values of natural resources, and an organization that is able to develop and direct an integrated package of projects that can lead to better understanding, conclusion, and decision-making on issues that concern the sustainable use of natural resources.

Achieving sustainable use of natural resources, mainly forest resources, is the most central idea. This is a complex challenge that requires balancing of social, economic, cultural, and environmental aspects. It also requires monitoring of the effects on these aspects which are caused by management activities. Six criteria for sustainable forest management have been outlined: (1) Conservation of biological diversity; (2) Maintenance and enhancement of forest ecosystem condition and productivity; (3) Conservation of soil and water resources; (4) Forest ecosystem contributions to global ecological cycles; (5) Multiple benefits of forests to society; and (6) Society's responsibility for ensuring sustainable development. A key prospect in model forests is to develop a set of indicators that provides a framework to describe and monitor the influence by forest management on the criteria, and hence on the sustainability of forest resources.

A demarcated land-base in Vilhelmina Municipality has been identified. It covers 120,000 hectares in the transition from boreal to alpine zones, whereof about 58,000 ha is forested land. As a model forest, this land-base will act as a full-scale laboratory where leading-edge techniques are researched, developed, applied and monitored, and where leading-edge forest management practices are demonstrated. In total 250 private land-holders, forest companies including state-owned companies, and Vilhelmina Municipality, share interest in the area, together with a magnitude of other stakeholders including reindeer husbandry by aboriginal Saamí people. The continuing route towards implementation of Vilhelmina Model Forest is to form a partnership among the stakeholders, to establish a forum where this partnership can meet to direct the model forest work, and to develop a list of criteria and indicators which allow for measuring of progress towards sustainable management.

The six criteria for sustainable forest management are applied. In total 23 indicators have been suggested. Each indicator is by nature a quantitative or qualitative measure, but reflects a too broad spectrum of issues to be adequately applicable. Hence, the structure of indicators has been broken down into a structure of in total 65 programs, where each program reflects one or a limited number of actual study projects. The central idea behind this outline is that a combination of programs together forms an explicit tool for determining if and how an indicator, in combination with other indicators, respond to the request of maintained or enhanced

sustainability in the view of a criterion. The programs reflect leading-edge approaches for ecology and management in the boreal zone of the northern hemisphere, as well as within the Barents region and locally within Vilhelmina Municipality. A certain emphasis is placed on the outline of criteria, indicators and programs, not to explicitly determine to future route in the model forest, but to review possibilities and to provide a rich array of potential ideas.

The suggested list of criteria, indicators and programs represent a framework which is supposed to enclose the strategic and operational direction of all work within Vilhelmina Model Forest. The criteria are shared by other model forests throughout the world, while the indicators and programs are specifically developed to fit the circumstances at hand in the demarcated land-base and among the stakeholders in question.

It is understood that model forests apply leading-edge management approaches and technologies, and hence, it is understood that a continuous dialogue with the scientific community is essential. Therefore, collaboration with Universities and other research organizations should be secured throughout the process of developing and maintaining the model forest.

The Barents Region is rich as far as forest resources are concerned. Forestry has a key position in the economic development in the region. The majority of the land belongs to the boreal conifer zone, whereas the Scandinavian mountain chain, the northern parts of the Kola Peninsula, the Nenets Okrug and the Novaja Zemlja, are part of the arctic tundra. The northern location with slow growth rates gives high quality timber which is highly desired on the international market. There are obvious similarities in forest ecosystems throughout the region, but there are also, however, a magnitude of natural gradients that cause steady changes in ecosystem attributes. These gradients, together with economic, social and political differences, offer excellent possibilities for a network of model forests which addresses economic, social, and ecological values of natural resources in forest-dominated landscapes. Developing common themes is the actual significance of a network of model forests throughout the Barents region. It is understood that taking on a current problems on sustainable use and management of natural resources across the Barents Region, creates excellent possibilities to provide high-quality scientific and practical solutions on local, regional, and global scales.

It is suggested that each country within the Barents Region should host at minimum one model forest. Each model forest should be controlled by a partnership of local stakeholders, which direct the work through a manager. The different model forests are ultimately connected to each other and to a common secretariat. The secretariat should have representatives from each country. It should provide financial and administrative guidance, supervise the strategic and operational planning of work within the different model forests, and encourage the continuous processing of documentation and evaluation of criteria and indicators. The secretariat is also responsible for ensuring good quality communication within the Barents Model Forest Network as well as with outside operators.

Each model forest should consist of a demarcated land-base, large enough in size to represent a range of forest uses and values in the surrounding geographic region. This is the core area. The core area may be complemented by satellite areas,

forest research sites or demonstration areas that already exists and that serve to increase the usefulness and applicability of the model forest. A scattered distribution of several areas within a model forest will better reflect a wider range of landscape-, ownership, and management-types, and will better reflect the regional vision.

A plan for accomplishment for Vilhelmina Model Forest and Barents Model Forest Network depends ultimately on the economic resources available. It is needed to secure governmental or regional long-term funding to provide the necessary organizational stability and the basic resources for the secretariat, and for establishing and maintaining the specific model forest sites. Possibilities for additional funding should be investigated in cooperation with universities and other research organizations, as well as with forest companies and other national, regional, and international organizations and agencies.

Framework

Figure 1. The Barents region with included provinces and the location of VMF.

Barents Euro-Arctic Council (BEAC) was established in 1993, for the purpose to improve economic and political stability in northern Europe. The BEAC Forest Sector Task Force (BFSTF) was established in 2000, with a general objective to create necessary conditions for development of forestry, environmental care and wood-based industries. The main initial activities were to establish three networks and implement a Northern Dimension Forest Sector Programme (NDFSP). The aim of NDFSP is to find ways to increase the overall well-being of the people in the Barents region, by promoting sustainable use of forest resources. The three networks handle 'logistic chain and trade of wood products', 'utilization of forest resources and wood-based energy', and 'cooperation between forest authorities', respectively.

The general objective for BFSTF (according to BEAC 1-year action plan for the Forest Sector Task Force, 2003) is:

"*To create necessary conditions for development of forestry, environmental care and wood based industries through co-operation, mutual concrete actions and projects and programmes within the forestry sector of the Barents region*."

This objective will be achieved by focusing the BFSTF work on five specific tasks:

- To initiate model forests to develop sustainable forest management, including management of carbon flow and sequestration, and conservation of biological diversity;
- To facilitate access to up-to-date technologies for sustainable use of natural resources, and to prepare guidance on multi-purpose management and land use;
- To collect, provide and continuously update key policy information for the forest sector;
- To consolidate and refine national and local multi-stakeholder forest programs; and
- To strengthen principles, institutions, and methodologies for democratic decision-making and communication between local, national and global actors.

Initiating model forests in Barents is viewed as one approach for enhancing regional cooperation and development. It is stated that the model forests should emphasize the following key issues:

- Identifying criteria and indicators for sustainable forest management;
- Optimizing management strategies by linking field-level practices with policies and policy makers;
- Developing and demonstrating efficient multi-objective forest management planning;
- Presenting methods for utilization of wood and non-wood resources which are appropriate with respect to local circumstances;
- Supporting forest research and GIS development and application;
- Providing extension and training for professionals and for the public;
- Strengthen mechanisms and methodologies for local decision-making;
- Promoting human resource development on a socio-economic and cultural basis; and
- Addressing conflict management.

The above listed issues are collected from the BEAC 1-year action plan for the Forest Sector Task Force, 2003. In the continuation, this report attempt to meet these issues as far as possible.

Model forest synthesis

Background

A model forest (MF) is originally defined as a working scale forest-dominated land-base, where the most appropriate sustainable forest management practices are developed, tested, and shared in a partnership with local stakeholders and others who might benefit from the gained experiences. The concept emerged in Canada in 1991 when 10 Canadian forest-experimental sites were connected in a network. The original objective was to meet an environmental concern on forestry practices and preservation of the natural environment. This concern rose from the 1987 Bruntland Commission, which specifically addressed sustainable development and sustainable forest management (SFM).

At the June 1992 Rio Earth Summit, in conjunction with the launch of Agenda 21, Canada announced the intention to support the development of an International Model Forest Network (IMFN). The incitement was to elucidate how forests can be managed in a sustainable way to safeguard the economic, environmental and social needs of current and future generations. It was assumed that an inclusive partnership of all stakeholders – companies, institutes, agencies, organizations, communities, individuals – who use the forest resource, each having their own specific understanding and appreciation of it, together can create the conditions that will lead to sustainable use of all forest resources and forest values. IMFN initially invited Mexico, Russia and Malaysia to develop MF's and to link with the Canadian Model Forest Network (CMFN).

In 1995, an IMFN Secretariat (IMFNS) was created, housed at the International Development Research Centre (IDRC) in Ottawa, Canada. The objective of the Secretariat, and hence the overall objective of IMFN, is (www.idrc.ca/imfn – Annual report 1996-1997):

"*to foster cooperation and collaboration in advancing management, conservation, and sustainable development of forest resources through a worldwide network of working model forests*."

According to this vision, a MF is viewed as a tool to find local solutions to global challenges, solutions that can be replicated in other MF's and applied for increasing the knowledge and perspectives among all stakeholders in a given land-base. When this report was prepared, in December 2002, IMFN included 22 MF's in Canada (12), USA (3), Mexico (3), Japan (2), Russia (1), and Chile (1), totally covering over 12 million hectares (Table 1). A recent (March 2004) annotation states that 31 MF's are included at present.

Table 1. Some facts on model forests

Model Forest	Network	Country	Area (ha)	Region / Location
Foothills	IMFN/CMFN	Canada	2,750,000	Boreal/montane/subalpine. W Alberta
Eastern Ontario	IMFN/CMFN	Canada	1,530,000	Great Lakes–St Lawrence Forest Reg.
Manitoba	IMFN/CMFN	Canada	1,050,000	Southern boreal forest. SE Manitoba
Lake Abitibi	IMFN/CMFN	Canada	1,100,000	Mid-boreal. NE Ontario
Western Newfoundl.	IMFN/CMFN	Canada	923,000	Southern boreal. W Newfoundland
Ishikari Sorachi	IMFN	Japan	806,000	Boreal. Hokkaido, N Japan
Priluzie	SDCA*	Russia	800,000	Boreal. Komi Republic
Monarch Butterfly	IMFN	Mexico	795,000	Central inland Mexico
Nova Forest Alliance	IMFN/CMFN	Canada	458,000	Acadian Forest Region
Fundy	IMFN/CMFN	Canada	412,000	Acadian Forest Region
Long Beach	IMFN/CMFN	Canada	400,000	Pacific coast. SW BC
Gassinski	IMFN	Russia	385,000	Ussurian/boreal. Pacific Russia
Calakmul	IMFN	Mexico	380,000	Tropical rainforest. SE Mexico
Prince Albert	IMFN/CMFN	Canada	367,000	Mid-boreal. Central Saskatchewan
Shimanto-qawa	IMFN	Japan	296,000	Shikoku, S Japan
Waswanapi Cree	IMFN/CMFN	Canada	201,000	Mid-boreal. SW Quebec
Hayfork	IMFN	USA	203,000	Mountainous. NW California
McGregor	IMFN/CMFN	Canada	181,000	Boreal/montane/subapline. Central BC
Chiloe	IMFN	Chile	173,000	Temperate rainforest
Applegate	IMFN	USA	115,000	Siskiyou Mountains. SW Oregon
Bas-Saint-Laurent	IMFN/CMFN	Canada	113,000	Southern boreal. Quebec
Chihuahua	IMFN	Mexico	110,000	Temperate mountain. W Sierra Madre
Cispus	IMFN	USA	60,000	Mountainous. SW Washington
Pskov	WWF	Russia	46,000	Southern Boreal. W Russia

* Swiss Development Co-operation Agency.

The model forest philosophy

A MF has been described both as a physical entity and as an organization: a demarcated land-base that is large enough to fully reflect the range of environmental and socio-economic values of natural resources, and an organization that is able to develop an integrated package of projects and studies that can lead to better understanding, conclusion, and decision-making on issues that concern the sustainable use of natural resources.

A MF in practice is a working-scale model that represents a transition from conventional forest management to ecologically sound forestry practices and environmental conservation, where sustainable and integrated forest management is demonstrated, where knowledge is transferred to forest managers and to the public, and where innovative technology is applied operationally as far as feasible. Further statements on the MF role are overwhelming, and includes for instance that MF's are seen as means for:

- letting people with interest participate in decisions about use and management;
- diffusion and sharing of knowledge;
- connecting and respecting ideas and concerns;
- financial aid and administrative guidance to communities concerned with their environment;

- efficiently apply up-to-date knowledge and coordinate further achievements;
- optimizing economic resources by reducing duplication in research and monitoring;
- identifying site specific and target-oriented strategic and operational objectives; and
- ensuring sufficient and cost-effective funding.

Coming this far, it is evident that the MF concept is terrifically ambitious, and terrifically optimistic. It can be viewed as a holistic philosophy. The consensus of the MF philosophy may be outlined by the following four main statements:

- A partnership between local stakeholders sharing the common goal of SFM;
- A forum where the partnership gain understanding of conflicting views, share knowledge, and combine expertise and resources to develop innovative and local approaches to SFM;
- A land-base which acts as a full-scale laboratory where leading-edge techniques and forest management practices are researched, developed, applied, monitored, and demonstrated; and
- A concept that allows monitoring of progress towards SFM, while acknowledging the balance of interconnecting ecosystems and interconnecting demands on natural resources.

The overall target in the MF philosophy is to address SFM. SFM means that the use, development and protection of forest resources should be done (www.wwf.ru/pskov):

"*in a manner or at a rate that enables people and communities to provide for their social, economic, and cultural well-being, and for their health and safety while (1) sustaining the potential of forest resources to meet reasonably foreseeable needs of future generations; (2) safeguarding the life-supporting capacity of air, water, soil and ecosystems; and (3) avoiding, remedying, or mitigating any adverse effects of activities on the environment*."

The MF should address and overcome three basic challenges to achieve SFM:

- To recognize all values that are represented by forest ecosystems, and to develop an integrated, long-term approach to manage for the conservation and maintenance of these values;
- To create a common vision and a set of objectives and goals that are shared by all stakeholders; and
- To address the attitudes and knowledge in the public by recognizing that better understanding of the use of forest resources in the long term must be achieved through education and broadened awareness.

A MF should be managed through a partnership of local stakeholders. While sharing a common view, different MF's have different sets of activities to address questions which relates to forest management practices, conservation of biodiversity, cross-cultural awareness, economic diversification, public education, etc.

Each MF is a unique example of circumstances with respect to given stakeholders and natural conditions. Priorities may vary substantially between different MF's, but the common thread running through the MF philosophy is that the priorities are set by the local partnership, which is familiar with and constrained by the local circumstances.

It needs to be stressed that the MF is an institution of partnership-building, research, education, lobbying, etc., rather than a management institution. In Canada, the MF's do not have management authority over the forests in their land-base (P.N. Duinker, personal comment).

The MF philosophy is built on the principle that people should have a say in the management and use of natural resources. The focus on people and people's need has had an increasing trend throughout the short history of the MF philosophy (www.idrc.ca/imfn – Toward a framework for the new international model forest network – Armstrong 2002):

"*Model forests are about people ... including how people use forests and forest resources and communities that depend on the forest for their livelihood …* "

Certain attention is given to indigenous people, to their traditional use of natural resources, and to give them a voice in the decision-making process. The Canadian network, CMFN, runs a specific program – EAI, Enhancing Aboriginal Involvement – within their 12 MF's. A further evident trend is the broadening of the concept from the use of forests to all kinds of natural resources, and into nature which originally have not been regarded as forests (Ibid.):

"… *they* [means MF] *include forests, conservation areas, parks and non-forested areas*…"

Therefore, it should be understood that a MF address the use of all natural resources, including agriculture, hydro-electrical power plants, windmills, mineral excavation, tourism, aboriginal culture, etc. In practice, however, such a broad application is not happening in existing MF's (P.N. Duinker, personal comment).

Several MF's recognized by the IMFN includes huge human populations and major cities. The Ishikari-Sorachi MF in Japan covers 806,000 ha and includes 30 municipalities with a total population of 2,390,000 people, including the city of Sapporo whose population is 1,790,000. Nevertheless, MF's are established in forest-dominated landscapes. Despite its large human population, natural forests cover 64 % of the Ishikari-Sorachi MF land-base. Likewise, the focus of activities in the MF concerns the use of forest resources.

A MF is arduous to establish. It is based on a regional partnership between stakeholders who might have divergent views and interests, and sometimes have distrust of each other's motives in the utilization of natural resources. Securing the support of the appropriate national, regional and local governments also takes considerable effort. There is a concern that the criteria for MF's, as set by IMFN, might be too stringent to be useful for adopting the concept globally. IMFN is currently working to develop a more flexible approach to these criteria. According to IMFN, two main issues have been raised. The first issue is that the model forest

approach is very demanding on the capacity of local organizations and communities to manage resources and to work collaboratively. IMFNS provide assistance in this process and seek to find solutions that are optimal in each particular case. The second issue concerns the minimum size of the geographic area. The large areas of the Canadian MF's, ranging from 2.75 million ha in Foothills MF to 113,100 ha in Bas-Saint-Laurent MF, have influenced the size requirement. The smallest-sized MF included in the network in 2000 was Cispus MF, USA, covering 60,000 ha.

It is concluded by IMFN that the definition of MF's needs to be adapted to include smaller geographic areas, and/or geographically scattered areas. This would increase the number of candidate MF's and the membership in IMFN. An example is the Pskov MF in western Russia, not a member in IMFN at present, which consists of numerous areas of different size that are scattered around the Strugo-Krasnenskiy management unit of Pskov region, totally encompassing 46,000 ha. The scattered design has the benefit that the MF incorporates a wider range of landscapes and forest community types.

The geographical size criteria have been modified by IMFN to be more flexible, but still (www.idrc.ca/imfn – Model forest development guide):

"*a model forest must be of a size that includes the full range of forest uses and values in the surrounding geographic region*."

The optimum size will depend on the specific local combination of geographic, demographic, environmental, and other factors. In some cases, a watershed area or other natural boundaries have been used to define the land-base of the MF (www.idrc.ca/imfn – Spreading the seeds for a sustainable future).

A promising approach is the twinning of MF's. IMFN has launched three twinning programs between Canadian MF's and MF's in other countries: McGregor with Gassinski (far-east Russia); Eastern Ontario with Calakmul (Mexico); and Foothills with Chihuahua (Mexico). These arrangements have had significant impact to the benefit of increasing knowledge and understanding.

Table 2 summarizes some of the key attributes, actions and experiences in the Model Forest program this far.

Criteria and indicators of sustainable forestry

The sustainable use of natural resources, mainly forest resources, is the most central idea in the MF philosophy. Achieving SFM is a complex challenge that requires balancing of social, economic, cultural, and environmental aspects on forest-dominated landscapes. It also requires monitoring of the effects on these aspects which are caused by management activities. To demonstrate maintenance or enhancement of sustainability, the combined effect of management activities on these different aspects must be determined.

Six criteria for SFM, defined by CCFM (Canadian Council of Forest Ministers) and outlined for measuring and monitoring effects of management (Table 3), have

been used by each MF within the CMFN as a common fundament. The criteria reflect the range of values that need to be considered when asking the question – Is the way we use and manage the forest sustainable? The first four criteria are biological by nature, while the latter two also incorporate socio-economic concerns.

Table 2. Key model forest attributes, actions, and experiences (adopted from www.idrc.ca/imfn – Spreading the seeds for a sustainable future)

Key attributes	Key actions	Key experiences this far
- Partnerships among a range of stakeholders. - Commitment to SFM. - A land-base large enough in size to incorporate the full range of forest uses and values. - A range of activities reflecting the values and addressing the community needs. - An organizational structure which allow partners with different views to meet. - Building and sharing knowledge through network activities.	- Conserving and protecting forest resources through sound development initiatives. - Identifying opportunities for economic diversification of forests through alternative uses. - Education, training and capacity development. - Supporting forest research. - Developing meaningful ways to measure progress towards SFM. - Using networks to exchange information, knowledge and expertise in identifying, developing and applying new technologies.	- MF's are low-cost, practical tools for economic diversification and productivity improvement while developing SFM. - MF's are centers for applied management and policy research. - MF's provide huge spin-off benefits from the process of collaboration, consensus building and community development. - MF's are inclusive and give traditionally marginal groups of people a voice in decision-making. - MF's are viable in a wide range of social, political, and economic settings throughout the world.

Table 3. Outline of six criteria, defined by CCFM to monitor sustainable management, and their operational target (adopted from www.modelforest.net)

Criterion	Operational target
1. Conservation of biological diversity	- Ensuring the continued survival of a diverse range of species in the forest
2. Maintenance and enhancement of forest ecosystem condition and productivity	- Ensuring that forest ecosystems remain healthy and productive
3. Conservation of soil and water resources	- Maintaining the quality of the resources that support the forest
4. Forest ecosystem contributions to global ecological cycles	- Concern for global-scale environmental pressures that may have influence on forests (essentially only carbon sequestration)
5. Multiple benefits of forests to society	- Forests should provide a variety of benefits, including forest products, recreational, environmental, and spiritual experiences
6. Society's responsibility for ensuring sustainable development	- Ensuring that all people can be involved in decision-making on the use of forests

Each MF within CMFN has developed a set of indicators, suited to its particular socio-economic, cultural, and environmental circumstances. The indicators are specific means for providing a framework to describe and monitor the influence by management activities on the criteria, and hence on SFM. The indicators are also used as guidelines for developing plans and policies for forest management,

and for ensuring that multiple forest values are acknowledged during forest operations. MF's represents a broad partnership base and a range of forest values, and are therefore well suited for developing and applying indicators of SFM at the local level.

The different Canadian MF's have utilized a variety of approaches in the identification, selection and assessment of indicators. The indicators can be quantitative (measurable) or qualitative (descriptive), and provide information about the present conditions of forests, their use, and their change over time. All model forests within the CMFN have been working for a number of years on the development and application of indicators, and CMFN is currently documenting the process that each model forest follows with respect to identification and selection of indicators, and their usefulness for describing changes in the six criteria.

The primary use of indicators is to measure progress towards the achievement of SFM. It therefore stands that reporting on that progress is important to illustrate the advances that are being made. A number of MF's are developing 'State of the Forest' reports. These reports provide a review of the overall status of the forest, and give information on how various indicators are collected and used. Data collection is obviously an essential component of work on developing indicators, vital both for initial inventory and reporting, as well as for ongoing monitoring. CMFN is therefore exploring ways to collect and analyze data to efficiently monitor the indicators.

An example is provided in a report from the Lake Abitibi Model Forest (LAMF): Local Level Indicator Status Report 2000 (www.modelforest.net – Griffin 2001). This report describes the LAMF process of indicator development, outlines the list of indicators that have been implemented, and provides baseline measurements for a subset of the identified indicators. LAMF has chosen to outline criteria and indicators in a three-step scheme, where indicator subsets represent actual study approaches. The list of indicator subsets is too long to be reviewed here (Table 4), but a few examples are given.

LAMF recognizes two types of indicators: 'Local indicators' which are restricted to certain components of forest communities, such as lichens or vascular plants; and 'Landscape-scale indicators' which have broader application, such as birds. Four strategic directions are identified by LAMF for developing their list of indicators:

- Setting targets and thresholds for the indicators;
- Filling gaps in data and measurement methodologies;
- Implementing, monitoring, and data storage programs to enable future reporting;
- Meaningful involvement of indigenous people in an indicator development process that is sensitive to their needs and views of the forest.

Table 4. Lake Abitibi Model Forest. Selected indicators and examples of indicator subsets within the six different criteria for sustainable forest management (adopted from www.modelforest.net – Griffin 2001)

Criterion	Indicator	Examples of indicator subsets
1. Conservation of biological diversity	- Ecosystem diversity	- Forest composition and structure
	- Species diversity	- Status of species at risk
	- Genetic diversity	- Implementation of genetic conservation strategy
2. Maintenance and enhancement of forest ecosystem condition and productivity	- Disturbance and stress	- Level of disturbance
	- Processes and functions	- Changes in forested area
	- Ecosystem productivity	- Tree growth and productivity
3. Conservation of soil and water resources	- Biophysical environment	- Soil chemistry and physical structure
	- Policy and protection	- Soil and water protection
4. Forest ecosystem contributions to global ecological cycles	- Carbon cycle	- Net primary productivity
	- Energy use	- Fossil fuel consumption in forest management
5. Multiple benefits of forests to society	- Timber	- Timber production
	- Non-timber goods and service	- Extractive goods and recreational / subsistence activities
	- Community sustainability	- Population and employment profile
6. Society's responsibility for ensuring sustainable development	- Investment in the forest resource	- Investments in forest based research and development
	- Public participation and decision-making	- Public education and participation in decision-making
	- Criteria and indicator process	- Availability of information required for evaluation of criteria and indicators

A second example is provided in a report from the Eastern Ontario Model Forest (EOMF): 1998-1999 State of the forest report (www.eomf.on.ca – Johnson 1999). The report presents information on the set of six criteria presented above, and eighteen indicators that cover a range of environmental, socio-cultural, and economic concerns. The eighteen indicators represent a starting point, and new or modified indicators will be added over time (Table 5).

Table 5. Eastern Ontario Model Forest. Indicators within the six different criteria for sustainable forest management (adopted from www.eomf.on.ca – Johnson 1999).

Criterion	Indicator
1. Conservation of biological diversity	- Percentage and amount of forested area
	- Percentage and amount of interior forest space
	- Protection of sites of biological significance
	- Number of known species at risk
	- Population levels and changes over time of selected species
2. Maintenance and enhancement of forest ecosystem condition and productivity	- Natural disturbance and stress by type and severity
	- Forest stand health
3. Conservation of soil and water resources	- Percentage of riparian area with natural vegetation cover
	- Buffering capacity and soil acidification
4. Forest ecosystem contributions to global ecological cycles	- Ground level ozone and pollution deposition
	- Climate trends
5. Multiple benefits of forests to society	- Production of timber forest products
	- Regional wood prices
	- Employment in forest related sectors
6. Society's responsibility for ensuring sustainable development	- Community involvement in sustainable forest management
	- Implementation of integrated resource management plans
	- Private land management and conservation programs
	- Mutual learning mechanisms

The examples above show that different MF's build different indicator-structures from a common fundament provided by the criteria. Obviously, the list of indicators is designed to reflect the main objectives outlined by the partnership of stakeholders to meet the needs from the community, and to support a movement towards SFM, based on the given environmental and natural resources for the particular geographic land-base.

A somewhat different approach to identify strategic and operational directions has been launched by WWF in the Pskov Model Forest (PMF). They have identified three major objectives and listed a number of actions to deal with questions which are related to each objective (Table 6).

Table 6. Outline of Pskov Model Forest objectives (adopted from: www.wwf.ru/pskov)

Economic objective: To ensure economic stability of the forest complex:
- Cooperation with regional and local administrations to improve the system of forest taxes;
- Analyzing advantages and shortcomings of different forest-use methods (e.g. leasing, auctioning);
- Improving marketing of forest products for small logging businesses;
- Establishing mechanisms to balance mutual economic interests of forest management unit (Leskhoz), enterprises, logging companies, state bodies and local self-government;
- Developing forestry methods that allow forecasting of forest fund dynamics for the optimal combination of economic requirements and ecological restrictions;
- Introduction and promoting modern machinery and technology
Social objective: To promote community involvement in forestry decision-making:
- Determining forms of involvement of local community and public in the forestry decision-making process;
- Creating a system of public access to information on forest management, forest use and the share of income;
- Increasing public awareness of SFM;
- Supporting public participation in the solution of forest problems
Ecological objective: To ensure and support environmental functions of forests, including conservation of biodiversity:
- Monitoring impact of different forestry practices on the condition of forests;
- Developing systems of activity in forestry aimed at maintaining biodiversity and stability of ecosystems, including water resources and soils;
- Establishing criteria and indicators of biological diversity;
- Developing and applying landscape planning methods.

Hence, in PMF, WWF view criteria and indicators as a more limited, and hence a more focused mean to set specific operational targets and tools. Furthermore, PMF outlines four main mechanisms through which SFM will be established (Table 7). It is evident, however, that the differences in the strategic outline between the two Canadian MF's – LAMF and EOMF – and the Russian MF – PMF – is a question of semantics rather than reflecting any fundamental disagreement about how the MF concept should be addressed and implemented.

Indicators are being designed to facilitate the process of forest certification, through which a forestry company or organization undergoes an independent assessment of its forest management system. Although MF's are not directly involved in certification process, they act in the development of a number of tools which make certification systems more workable. These tools include the development of indicators to measure progress towards SFM.

It should be stated that the Canadian approach will be used hereafter in this report – i.e. criteria stands for the main strategic objectives, whereas indicators stand for more operational tools to address specific questions. It is intended that tables 3 to 6 should serve as a catalogue of suggestions for outlining how the MF concept can be applied in Vilhelmina MF and in the Barents Model Forest Network.

Table 7. Establishing mechanisms of sustainable forest management in Pskov Model forest (adopted from: www.wwf.ru/pskov)

Upgrading forest inventory planning systems:
- Developing criteria and indicators of SFM for management-unit (Leskhoz) levels;
- Determining target-oriented forest structures according to SFM requirements;
- Developing GIS-based management systems for the Leskhoz and the forest-inventory enterprises;
- Establishing systems to forecast forest change depending on alternative scenarios of management, and to assess the acceptable amount of forest-use based on specific scenarios.
Increasing the effectiveness of forest management and forest-management systems:
- Set requirements and regional standards of local forest inventory planning and forest management operations;
- Developing harvesting plans that are based on landscape planning.
Establishing a personnel training center on the model territory:
- Creating demonstration areas for different types of forest operations, in accordance with the local conditions and prerequisites;
- Demonstrating GIS-technologies;
- Teaching principles of landscape planning to the forest inventory staff;
- Teaching landscape-level forest management to the forest management staff.
Promoting innovative activities and initiating the process of certification:
- Analyzing current standards and criteria of voluntary forest certification;
- Informing stakeholders about goals and objectives of voluntary forest certification;
- Conducting voluntary forest certification of non-timber resources and forest management on the territory;
- Promoting programs of developing forest strategies on the regional level

We have chosen to use the term ‘indicator’ to refer to the components of a ‘criterion’. This approach may be questioned. Duinker (2001) prefer the term ‘element’ to refer to these components of criteria, and propose that the term ‘indicator’ should be reserved to denote a direct measure or descriptor of a forest value. Further achievements in the process of developing model forests in the Barents Region should address such questions.

Criteria and indicators in Vilhelmina Model Forest and Barents Model Forest network

Criteria and indicators represent an excellent tool in the process of developing a MF. Experiences gained from other MF’s facilitate the strategic and operation planning of activities, as well as how to boarder the land-base, how to address public relations, education and training, and other fundamental aspects.

The criteria represent a top – down approach to design the MF program. It is understood that the six criteria listed in Table 3 are applicable to frame development towards SFM in Vilhelmina MF (VMF), and also for developing the strategy for Barents Model Forest Network (BMFN).

The indicators represent a bottom – up approach to the MF program. By defining specific needs, questions, operational objectives, etc., it is possible to develop a set of indicators which can act as the main tool for implementing, monitoring, and

advancing towards SFM, for a particular location and region. The selection of indicators should be done according to the experiences from other MF's, preferably those located in the boreal part of the northern hemisphere, and according to the Indicator Database provided by CMFN.

The Indicator Database is designed to assist forestry professionals, community organizations, and other individuals and groups. Database options include:

- How to select and monitor indicators by learning from the experiences in Canadian MF's;
- How to integrate the unique needs of any land-base and partnership into an indicator process;
- Examples of criteria designed to screen indicators;
- How to collect data, monitor changes, and involve local communities in an indicator process;
- How to refine a list of indicators based on the availability of data and the feasibility of data collection;
- How to attain indicators for SFM; and
- Presentations of real-life examples of indicator reporting.

The Indicator Database User Guide describes each MF's approach to initiating an indicator program, selecting indicators, collecting data, and applying and reporting on indicators. There are lists of relevant publications, complete sets of indicators for each MF, a comparison of approaches to indicators across the MF network, and contacts for more information.

IMFN provides an evaluation of how criteria and indicators of SFM have been addressed in existing MF's (Model forests and local level indicators: Facing common challenges – M. Von Mirbach at www. Idrc.ca/imfn). There, it is stated that the MF approach to criteria and indicators contains three basic elements: Scale; Partnership; and Networking.

Scale implies that indicators should be operational on the local scale, and not on national, regional or global scales as the criteria usually are. MF's cover a geographical area which to some extent is based upon the size of management units for that particular area. Hence, a local level indicator will be able to reflect management decisions better than a broader-scale level indicator. In the process of selecting indicators, however, the continuum from global-level criteria (broad application), via local-level indicators, to site-level or specific study-level indicators, need to be recognized.

Partnership and collaboration is a central idea in the MF concept. The indicators selected for any particular MF reflect the need and questions identified within the local partnership and among the local stakeholders.

Networking, finally, is the mean for sharing knowledge and experiences. It is understood that different MF's collaborate to optimize research work and financial input, but also that MF's has a responsibility to share knowledge and experiences with external parties.

In the evaluation of how criteria and indicators of SFM have been addressed in existing MF's (Model forests and local level indicators: Facing common challenges – M. Von Mirbach at www. Idrc.ca/imfn), it is pointed out that it is critical to be absolutely clear about why, what and which (Table 8).

Table 8. The Why-What-Which approach to indicator development

Why selecting indicators	What characterizes indicators	Which question to address (ex.)
To increase knowledge and understanding	Must focus on key issues where further knowledge is required	Natural stand structure and composition
To guide the formation of forest management plans	Must relate to factors that the forest managers can influence	Natural disturbance regimes
To build broad partnership, support and cohesion	Must address the key concerns of individual stakeholders	Cutting cycle and harvesting techniques
To increase public understanding of SFM	Must be relevant to the public and understandable by them	Costs and incomes

The Why-What-Which approach to indicator development is essential to acknowledge in the process of developing VMF and BMFN. By addressing these questions, it is possible to outline a relevant approach with respect to specific needs and prerequisites for each particular MF location, as well as for a network of MF's within the Barents region.

Vilhelmina project

Project prospects

The Vilhelmina project, subtitled 'Diverse forest utilization in a landscape perspective' has been running since 1995. The background to this project is on the one hand a conflict where the desire to acknowledge environmental aspects in the use of forests opposed traditional forestry activities, and on the other hand an interest among local stakeholders in the western parts of Vilhelmina Municipality to understand and implement environmental aspects within forestry strategies, where this interest in fact rose from the conflict.

The conflict on how to manage the Blaikfjället and Njakafjäll areas in Vilhelmina Municipality received substantial public interest during the 1980th and early 1990th (Lisberg Jensen 2002). The main land-owner, Vilhelmina Municipality, had planned harvesting operations in the old-growth forests of Njakafjäll, but these operations was strongly opposed by massive actions from Greenpeace and other environmental organizations. The outcome of this conflict was that both areas became nature reserves through governmental decisions and an input of 29 million SEK, Blaikfjället in 1994 and large proportions (6,200 ha) of Njakafjäll in 1998.

The present forestry legislation (the Swedish Forestry Act; SVL 1994) made objectives in forest production and environmental considerations to stand on equal grounds. This legislation places great demands on forest owners and other stakeholders, demands that can be met only by extensive coordination across geographical areas that are larger than single stands or estates, and by active participation by stakeholders in policy-making processes.

Approximately half of the total forest area in Sweden is privately owned. According to the present legislation, the private landowners have the freedom to make decisions concerning management in forests on their own estates. A critical issue is that private owners until now have had no say in the making of forest management policy documents. This has placed great constraints on the progress of sustainable use of natural resources. To gain a greater understanding of this issue, The Board of Forestry in Västerbotten initiated the Vilhelmina project and acted as coordinator, assisted by a reference group including personnel from the Swedish University of Agricultural Sciences in Umeå, Grimsö, and Alnarp, Umeå University, Foresys AB, Satellitbild/SSC, World Wildlife Foundation, Västerbotten County Administrative Board, The National Swedish Environment Protection Board, and The National Board of Forestry. A continuous dialogue has been maintained with representatives from private land owners, forest companies, local Saamí groups, and idealistic organizations. The following key prospects have been outlined:

- To face ethical and moral responsibilities;
- To increase knowledge on the use of natural resources;

- To provide prerequisites for natural species to survive in vital ecosystems;
- To acknowledge market-economic circumstances; and
- To interact actively in political decisions, conventions and laws.

A certain emphasis has been placed on the landscape perspective and landscape planning. A three-level approach to landscape planning has been suggested: The detailed level encompass activities such as tree-species composition and structure of forest edges, and how to ensure continuous presence of large-sized trees and dead wood, i.e. activities that are directed towards specific tree individuals or objects. The stand level concern, for instance, quantity and quality of key biotopes and wetland forests, distribution of rare tree species, the size of clear-cut areas, prescribed burning of clear cuts, etc. The landscape level, finally, represents a comprehensive unit that allows broad actions to promote biological diversity and prerequisites for change and variability in time and space. Specific landscape planning objectives include:

- To develop a common basic view on how coniferous landscapes naturally appear, and how to use this perspective as guidelines for planning of forest activities;
- To create a thematic landscape using modern techniques;
- To create a network to gain knowledge and increase credibility;
- To help forest owners feel secure in their right to use and manage their own forests, and to assist them in active participation in policy-making processes;
- To suggest forestry methods that are functional and cost effective; and
- To promote an educational campaign (Greener Forest)

Project accomplishments

A large-scale study area was selected, in total 120,000 ha in the transition between the boreal and the alpine zones in western parts of Vilhelmina Municipality, County of Västerbotten. The area is a typical coniferous-dominated proportion of inland Northern Sweden. It is located on both sides of the lake Malgomaj. The landscape is variable in topography, from about 340 meters above sea level up to 1000 meters in the mountains. There is a great variation in tree species, natural habitats, and degree of disturbance by forestry. Some 58,000 ha is productive forest land, where the majority (64 %) holds old (80 years or more) forests. The amount of old forests increases westwards, and so does the proportions of forests with high natural values. In total 250 private landowners, divided into 17 government lots, hold about 12,000 ha. About 14,000 ha is commonly owned by Vilhelmina Community Forest, about the same amount is state owned, and about 10,000 ha is owned by forest companies.

In this demarcated land base, actions are developed, tested and demonstrated. The actions relate to the project objectives, which encompass production-oriented, environment-oriented, and operational targets:

- To ensure possibilities for long-term economic-sound forestry and liberty of action with respect to forest products;
- To safeguard survival and vitality among all species that naturally belong within the focal ecosystems; and
- To encourage innovative ideas on how to maintain natural ecological functions and processes during forest management regimes.

Work that has been conducted this far include:

- Interpretations and analysis of satellite photos;
- Comparative analysis of the fragmentation in forest landscapes;
- Experiments with selective forest management systems and alternative methods;
- Plans for road networks and development of a road data base;
- Survey of geology;
- Inventory of wetland forests and key biotopes;
- Studies of epiphytic lichens in coniferous forests;
- Studies of the effects of logging operations on bilberry;
- Analysis on the effect of forest management on the food chain bilberry – insect larvae – birds;
- Studies of retained snags and downed logs after logging operations;
- Inventory of leaf and bush lichens;
- Inventory of transects and key elements;
- Inventory of wood fungi and the occurrence old windthrows;
- Environmental consideration according to the Swedish Forestry Act;
- Studies of forestry, hydrology, and effects along stand edges;
- Reconnaissance of forest fire history and the general history of the forest landscape;
- Description of landscape identity, forest landscape appearance, and visual features;
- Inventory of reindeer pasture lands;
- Arrangement of frequent informative meetings;
- Planning for a forest-exhibition in Stalon;
- Establishing demonstration areas.

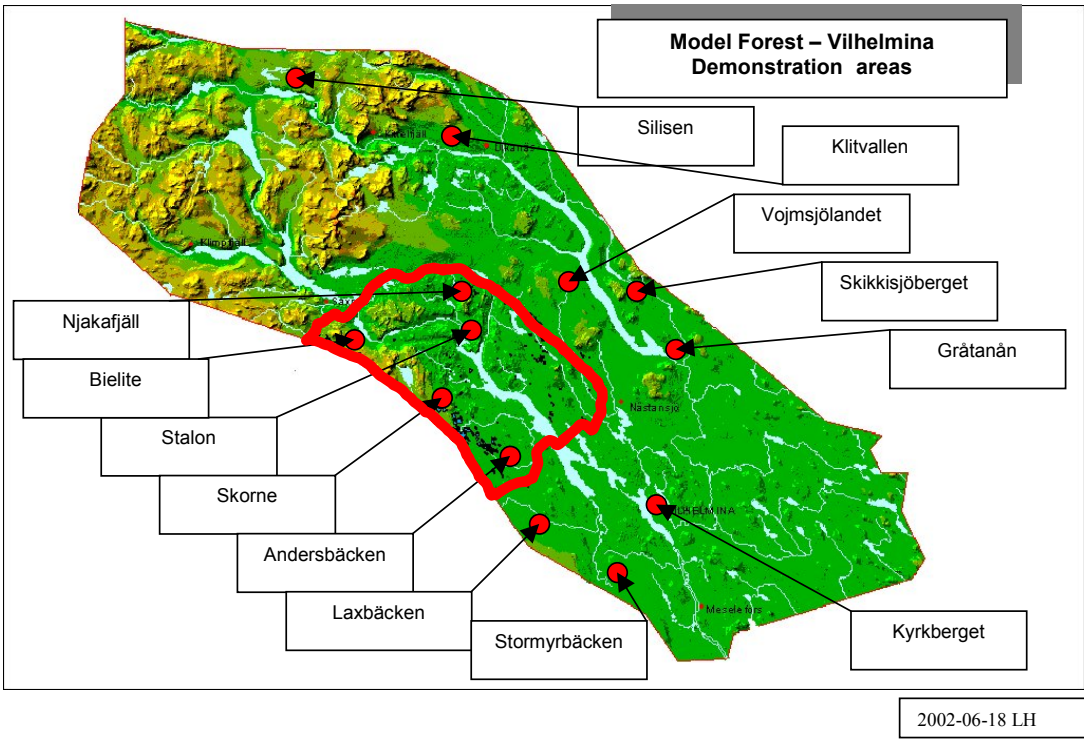

Figure 2. Demonstration areas within Vilhelmina Model Forest.

The demonstration areas cover a range of issues, including:

Njakafjäll	Old-growth Norway spruce forests
Bielite	Alternative forest management methods
Stalon	Forest history
Skorne	Landscape planning
Andersbäcken	Shelterwood management
Laxbäcken	Watershed management
Stormyrbäcken	Controlled burning
Kyrkberget	Information trail
Gråtanån	Cultural heritage
Skikkisjöberget	Thinning methods
Vojmsjölandet	Old-growth Scots pine forests
Klitvallen	Alternative forest management methods
Silisen	Reindeer husbandry

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Vilhelmina Model Forest

Requirements for establishing the model forest

To pursue the establishment of a Model Forest in Vilhelmina Municipality in accordance with the IMFN guidelines, the following requirements have to be met:

(1) To form a partnership between stakeholders that have demand on, and interest in, the use of natural resources in a given land-base, and that share the common goal of SFM;

(2) To establish a forum where the partnership can meet to gain greater understanding of conflicting views, share knowledge, and combine expertise and resources to develop approaches to SFM;

(3) To provide a land-base which acts as a full-scale laboratory where leading-edge techniques are researched, developed, applied and monitored, and where leading-edge forest management practices are demonstrated, with respect to progress towards SFM;

(4) To develop a framework of criteria and indicators, that balances different demands on natural resources, and that provides measures of the progress towards SFM.

The two former requirements is a matter of organization during the setting of VMF. The partnership should include representatives from different land-holders (private, company, community, government) and other parties (industries, forestry professionals, tourist organizations, nature conservation organizations, etc.). The forum should be organized in such a way that stakeholders representatives can meet regularly to direct the MF process.

The two latter requirements concern the implementation in practice. The land-base is set; there is at hand a demarcated land-base in Vilhelmina Municipality. It covers 120,000 ha in the transition from boreal to alpine zones, whereof about 58,000 ha is forested land. In total 250 private land-holders, the forest companies Scaninge, Svea Skog and Statens Fastighetsverk, and Vilhelmina Community Forest, share interest in the area, together with a magnitude of other stakeholders, including reindeer husbandry by native Saamí people, tourism, hydro-electrical power plants, fishing and hunting, etc. There is a common interest among the stakeholders to implement VMF. The continuing route towards implementation is to develop a list of criteria and indicators which allow for monitoring and analyzing the progress towards SFM. This list will point out the strategic and operational direction of all work within VMF.

Criteria and indicators

The six criteria for SFM, which have been defined by CCFM, are also applied for VMF. A number of indicators have been suggested for each criterion (Table 9). Each indicator is by nature a quantitative or qualitative measure, but may reflect a

too broad spectrum of issues to be adequately applicable. Hence, the structure of indicators have been broken down into a structure of subsets, termed ‘programs’, where each program is a more applicable measure; Each program reflect one or a limited number of actual study approaches. The central idea behind this outline is that a combination of programs together forms an explicit tool for determining if and how an indicator in combination with other indicators responds to the request of maintained or ameliorated sustainability in the view of a criterion.

The indicators and programs for VMF are chosen to:

- address the six criteria for sustainable management of natural resources;
- reflect current questions with respect to ecology and management of natural resources in the boreal zone of the northern hemisphere;
- emphasize specific conditions in the Barents region; and
- suite local prerequisites in the VMF area and nearby surroundings.

Thereby, the indicators can be applied on different scales; on local and regional levels, as well as within the boreal zone. It should be underlined that the indicators and their subsets of programs are mutually linked to each other; Inter- indicator and inter-program approaches are understood. With reference to the previous chapter, ‘Vilhelmina project’, it should be noted that information and knowledge about some of the programs and indicators may already be at hand.

As in other MF’s, the list of indicators and programs is not definitive. As new experiences and knowledge is gained, new indicators are developed and original ones are modified or excluded. It is underlined that the list does not represent an action schedule. It can not be expected that all programs and indicators are treated with the same intensity, precision and accuracy. Instead, the list should be viewed as a frame for the strategic and operational planning.

It should also be stressed that the presented outline of criteria, indicators and programs should be seen as an idea catalogue, that serves to review possibilities at hand in the demarcated land base, and to provide a rich array of potential approaches to sustainable use of forest resources.

Description of indicators and programs

Indicators and programs that are listed in Table 9 are described in Appendix 1. Information on certain fundamental aspects is needed as a basis for outlining the background for each criterion and for providing means for general comparison with other landscapes and other MF’s. Examples of such information are given for each of the six criteria under the heading ‘Background information’ in the appendix. Following this, the scope is given for each indicator, and its subset of programs is briefly described. The listed number (Table 9) for each criteria, indicator and program is given within brackets.

Table 9. Suggested criteria, indicators and programs (with numbers within brackets) in Vilhelmina MF

Criteria (6)

Indicators (23)

Programs (65)

1. Conservation of biological diversity
   - 1.1. Landscape-level biodiversity
     - 1.1.1. Landscape structure
     - 1.1.2. Patterns of natural diversity with focus on species-rich habitats
     - 1.1.3. Diversity gradients
   - 1.2. Ecosystem-level biodiversity
     - 1.2.1. Structure and diversity in natural forests
     - 1.2.2. Structure and diversity in managed forests
     - 1.2.3. Dead wood and biodiversity
   - 1.3. Species diversity
     - 1.3.1. Status and threshold-values for threatened and rare species
     - 1.3.2. Status and threshold-values for characteristic stationary species
     - 1.3.3. Status and threshold-values for characteristic mobile species
   - 1.4. Present and future conservation status
     - 1.4.1. Distribution of nature reserves and other protected areas
   - 1.5. Genetic diversity
     - 1.5.1. Patterns of *Picea abies* and *Picea obovata*, and autecology for *P. obovata*

2. Maintenance and enhancement of forest ecosystem condition and productivity
   - 2.1. Influence of forest management methods
     - 2.1.1. Influence of ownership on choice of forest management strategy and method
     - 2.1.2. Adapting management to natural structure and function, including natural disturbances
     - 2.1.3. Effect of forest management on natural food webs and ecological cycles
     - 2.1.4. Effect of forest management on threatened species and diversity
     - 2.1.5. Effect of forest management on long-term site productivity
     - 2.1.6. Innovative forest management methods
     - 2.1.7. Increasing broadleaf proportion and ensuring continuous presence of large trees
     - 2.1.8. Introducing fire in forest management
     - 2.1.9. Combining forest management and reindeer husbandry
   - 2.2. Drainage and ditching
     - 2.2.1. Effect of drainage and ditching on long-term site productivity and natural values
     - 2.2.2. Effect of abandoning drainage ways on long-term site productivity and natural values
   - 2.3. Natural function and ecology of boreal forests
     - 2.3.1. Carbon balance
     - 2.3.2. Nitrogen balance

3. Conservation of soil and water resources
   - 3.1. Aquatic and wetland habitats in the landscape
     - 3.1.1. Characteristics of lakes, rivers and streams, including characteristic species
     - 3.1.2. Natural dynamic and function in lakes, rivers and streams and their surrounding habitats
     - 3.1.3. Characteristics of wetlands, fens, and mires
   - 3.2. Influences on aquatic and wetland habitat
     - 3.2.1. Forest management in riparian ecosystems
     - 3.2.2. Other impact in riparian, aquatic, and wetland ecosystems
     - 3.2.3. Constraints for forest management, logging roads and drainage
   - 3.3. Site scarification
     - 3.3.1. Impact of scarification on long-term site productivity and natural values
     - 3.3.2. Innovative scarification methods

Table 9. Continued

- 4. Forest ecosystem contributions to global ecological cycles
  - 4.1. Balancing forest harvesting and forest growth with respect to carbon budgets
    - 4.1.1. Effect of different management strategies and silvicultural methods on carbon budgets
  - 4.2. Carbon balance in boreal wetlands
    - 4.2.1. Boreal wetlands as source or sink of atmospheric carbon
  - 4.3. Climate trends
    - 4.3.1. Effect of climate change on the altitude of the alpine tree-line and its species composition
    - 4.3.2. Effect of climate change on quantity and quality of reindeer browsing sites
    - 4.3.3. Effect of different forest management methods on stand-internal climate
  - 4.4. Pollution and non-natural acidification
    - 4.4.1. Long-term trends of the Chernobyl impact and its influence on the use of natural resources
    - 4.4.2. Impact of forest management on soil acidity trends
- 5. Multiple benefits of forests to society
  - 5.1. Forest resources
    - 5.1.1. Flow of forest products
    - 5.1.2. Importance for regional and local economy
    - 5.1.3. Local manufacturing
  - 5.2. Other natural resources
    - 5.2.1. Reindeer husbandry
    - 5.2.2. Recreation, hunting, fishing, berries, and mushrooms
    - 5.2.3. Bioenergy, including wood-based resources and *Phalaris arundinacea*
    - 5.2.4. Peat harvesting, mineral harvesting, and agriculture
    - 5.2.5. Hydroelectricity and windmills
    - 5.2.6. Ecotourism
    - 5.2.7. Cultural heritage
    - 5.2.8. Social and esthetic values
  - 5.3. Logging roads
    - 5.3.1. Distribution of roads in the landscape, including logistics and accessibility
    - 5.3.2. Environmental-friendly construction and maintenance methods
    - 5.3.3. Non-permanent winter-logging roads
- 6. Society's responsibility for ensuring sustainable development
  - 6.1. Criteria and indicators
    - 6.1.1. Evaluating selected indicators
    - 6.1.2. Adjusting selected indicators and development of new indicators
    - 6.1.3. Developing action plans for sustainability based on criteria and indicators
  - 6.2. Multiple-purpose forest-landscape management
    - 6.2.1. Developing multi-purpose management plans on landscape-, estate-, and stand-level
    - 6.2.2. Decision processes, dealing with conflicts and local management
  - 6.3. Education for forest-owners, professionals and the public
    - 6.3.1. Effect of accomplished campaigns, and plan for evaluation and coming actions
    - 6.3.2. Developing demonstration areas
  - 6.4. Research
    - 6.4.1. Evaluating accomplished research, and plans for coming research and coordination
  - 6.5. The Barents Model Forest Network
    - 6.5.1. Organizational development
    - 6.5.2. Developing common themes for sustainable management of natural resources
    - 6.5.3. Developing a common dictionary and adjusting the "Greener Forest" book
    - 6.5.4. Developing common education programs

The significance of Vilhelmina Model Forest

In implementing VMF, it is understood that there is a common interest among the stakeholders to form a partnership which regularly meet to agree upon approaches to sustainable management and use of natural resources, and upon how this should be researched, developed, applied, monitored, and demonstrated within the landbase. Thereby, it is required to apply leading-edge management approaches and technologies, and hence, it is required ensure a continuous dialogue with researchers and research organizations.

The MF philosophy presupposes that approaches to sustainable management of natural resources should be done by applying leading-edge knowledge and technology. Therefore, the MF work should be conducted in close conjunction with the scientific community. The Canadian Forest Service (CFS) has recently published an overview of the scientific involvement in Canada's MF's (CFS – Science in Canada's Model Forests, 2001). There, it is showed that involved scientists, in actual research projects and in committees, come from a large array of organizations, with CFS and Academia (Universities) being the major contributors. It is also showed that scientists have been involved in work which concerns all the six criteria of sustainable management. The evident link to research organizations, and hence to leading-edge knowledge and technology, may be one important explanation to why the Canadian MF's have been successful in establishing trust and confidence among the stakeholders. This, in turn, ensures fruitful work by the partnership and creates possibilities for progress towards sustainable management.

Science may be involved directly or indirectly in MF's. Direct involvement means that scientists conduct or participate in research projects on behalf of the MF partnership, and produce results that guide further decision-making. Indirect involvement means that scientists participate in the partnership or in other committees, and bring their perspectives into the MF governance. A third way is to involve the scientific community in external groups that can act as evaluation committees, with the purpose to bring in competent outsiders views and guidance. Direct and indirect scientific involvement in implementing real projects within MF's follows a sequence of seven steps (Fig. 3):

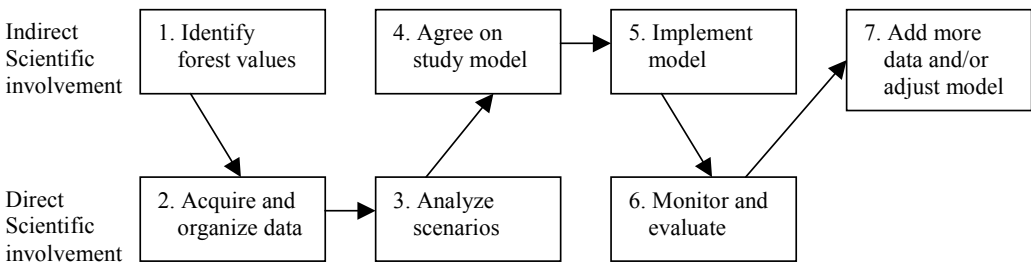

Figure 3. Direct and indirect scientific involvement in MF projects (adopted from CFS – Science in Canada's Model Forests, 2001).

CFS writes in their report that about 60 % of the activity during the initial phase of MF work in Canada may be classified as research, broadly defined. Approximately 57 % and 55 %, for direct and indirect scientific involvement respectively,

was allocated to the four biological criteria of sustainable management, and 43 % and 45 %, accordingly, to the two socio-economic criteria. The most frequent research areas were (in decreasing order): forest ecology; wildlife ecology; economics; silviculture; sociology.

Although the Canadian example may be used as a guide for the implementation of VMF, it can not be replicated in Sweden, or elsewhere in the Barents region, with respect to how to involve science in the MF work. Fundamental differences are obvious, in national and provincial structures of Universities and research organizations, as well as in economic circumstances. Natural Resources Canada and CFS recently announced (http.//mf.ncr.forestry.can, June 3, 2002) that the Government of Canada will support their model forest program by funding $8 million (Canadian $) annually for five years. Since its inception, the program has received $96 million.

It is essential, however, to reflect upon the collaboration with Universities and other research organizations in the initial stages of MF development. For VMF, it is natural to link with the Swedish University of Agricultural Sciences (SLU) and with Umeå University (UmU) in the province of Västerbotten, as the main scientific organizations. It is understood that collaboration with these, and other scientific organizations, throughout the process of developing and maintaining VMF, is necessary also for achieving financial support.

The suggested list of criteria, indicators and programs represent a framework which enclose the strategic and operational direction of all work within VMF. The criteria are shared by other MF's within IMFN, while the indicators are specifically developed to fit the circumstances at hand in the demarcated land-base and among the stakeholders in question. The programs are subsets of the indicators, and represent more applicable tools for measuring progress towards sustainable management. Some of the programs are of general interest to reflect leading-edge approaches for sustainable management in the boreal zone of the northern hemisphere, and some are area-specific approaches, developed to reflect local and regional needs, conditions, and other current issues. Examples of programs that fit to these two approaches are listed below (numbered according to table 9):

Leading-edge approaches (examples):

1.1.2. Patterns of natural diversity with focus on species-rich habitats

1.2.1. Structure and diversity in natural forests

1.2.3. Dead wood and biodiversity

1.4.1. Distribution of nature reserves and other protected areas

2.1.2. Adapting management to natural structure and function, including natural disturbances

2.1.3. Effect of forest management on natural food webs and ecological cycles

2.3.1. Carbon balance

2.3.2. Nitrogen balance

4.2.1. Boreal wetlands as source or sink of atmospheric carbon

4.3.1. Effect of climate change on the altitude of the alpine tree-line and its species composition

5.3.2. Environmental-friendly construction and maintenance methods

Area-specific approaches (examples):

1.3.2. Status and threshold-values for characteristic stationary species

1.3.3. Status and threshold-values for characteristic mobile species

1.5.1. Patterns of *Picea abies* and *Picea obovata,* and autecology for *P. obovata*

2.1.7. Increasing broadleaf proportion and ensuring continuous presence of large trees

2.1.9. Combining forest management and reindeer husbandry

3.1.2. Natural dynamic and function in lakes, rivers and streams and their surrounding habitats

4.4.1. Long-term trends of the Chernobyl impact and its influence on the use of natural resources

5.3.1. Distribution of roads in the landscape, including logistics and accessibility

6.2.1. Developing multi-purpose management plans on landscape-, estate-, and stand-level

Barents model forest network

The Barents Region

The Barents region is an interconnected geographical area. It covers about 755,600 km^2 across 13 provinces in four countries (Nordland, Troms and Finnmark in Norway; Västerbotten and Norrbotten in Sweden; Kainuu, Oulu and Lappland in Finland; Karelen, Murmansk, Archangelsk, Komi, and Nenets in Russia) (see Fig. 1). The human population density is low; it averages 3.5 inhabitants per km^2 and ranges from 0.3 in Nenets to 8.0 in Oulu. The region shares a common history. The indigenous Saamì people are at home in all four countries, and east-west crossing trade and relations go back to the Stone Age. Archaeological findings indicate periods of most intensive exchange, which has resulted in a common culture from many points of view. Except from the Saamì people, the Nenets and the Vespians have been recognized as original people.

A range of natural resources are of utmost economic importance. Kola Peninsula has some of the most important mineral deposits in Russia, and Norrbotten has deposits of iron ore of international significance. The Norwegian Sea, the Barents Sea, the Kara Sea and Archangelsk Province are rich in oil and gas. The main part of the nature- and energy resources in the Region has not yet been explored.

The Barents Region is Europe's richest region as far as forest resources are concerned. The majority of the land belongs to the boreal conifer zone (taiga) whereas the Scandinavian mountain chain, the northern parts of the Kola Peninsula, the Nenets Okrug and the Novaja Zemlja, are part of the arctic tundra. Forestry has a key position in the economic development in the region. The most significant tree species are Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*) and birch (*Betula* sp.). The northern location with slow growth rates gives high quality timber which is highly desired on the international market.

There are obvious similarities in forest ecosystems throughout the region, as within the boreal zone as a whole, with respect to tree production potential, natural diversity levels, and species composition. There are also, however, a magnitude of gradients that cause steady changes in ecosystem attributes, from west to east for instance: a change in geological layer from the ancient Fennoscandian bedrock to outwash plains and alluvial sediments; changing macro-climatic conditions from maritime to continental; a gradual increase in abundance of larch (*Larix* sp.), aspen (*Populus tremula*) and birch; decreasing human population density, infra structure, and overall anthropogenic influence on forests. The east to west direction also offers economic, social and political differences. Some of these gradients are also evident in the south to north direction. These circumstances offer excellent possibilities for a network of MF's, which addresses economic, social, and ecological values on natural resources in forest-dominated landscapes. The overall objective for BMFN is summarized in the following vision:

To foster sustainable use, management, and development of natural resources within the Barents region, through locally anchored multi-purpose approaches which has been shaped by inter-regional collaboration, understanding, and share of knowledge and expertise.

Organizational development

(cf. program 6.5.1.) Networking is the mean for sharing knowledge and expertise, for coordinating activities and economic funding, and for identifying target-oriented strategic and operational objectives. Hence, networking is a central issue in the MF philosophy. The immediate question which has to be solved in order to ensure that networking is efficient is how to secure communication. The communication, in turn, is ultimately dependent on the visibility of the organizational structure. The following organizational structure is suggested for BMFN (Fig. 4):

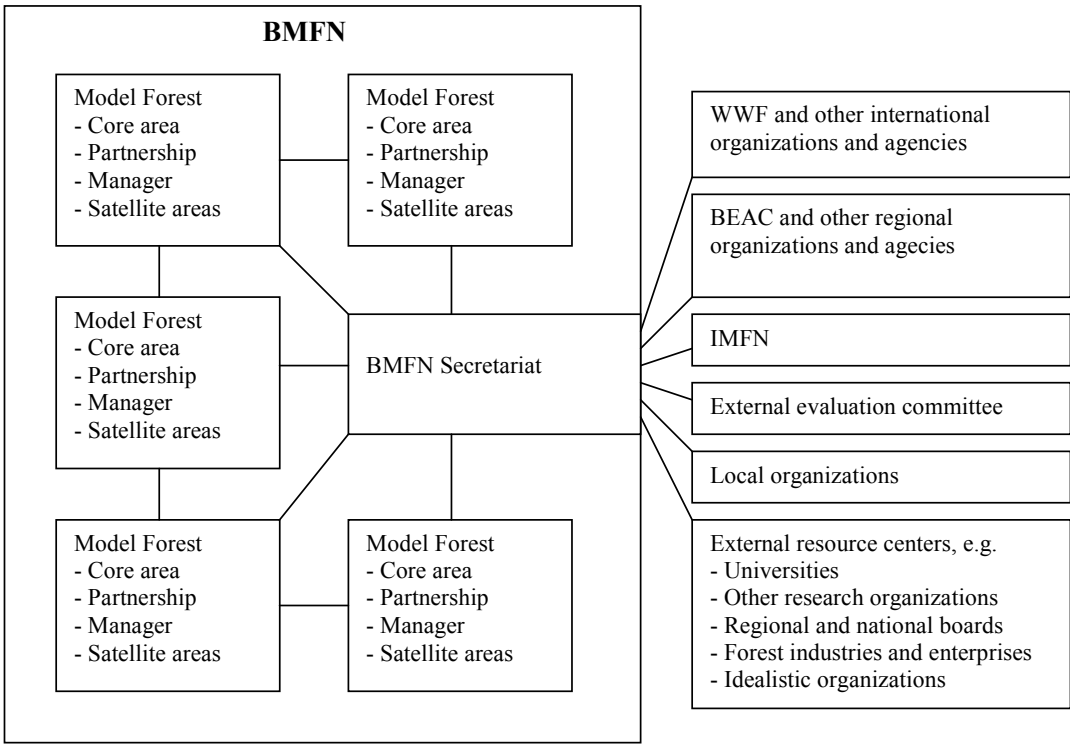

Figure 4. Schematic outline of suggested BMFN organizational structure.

BMFN is an inter-regional collaboration between four countries and 13 provinces. As a minimum, each country should host one MF. To strengthen local impression, however, a more ideal situation is that each province hosts one MF. The MF's within BMFN are ultimately connected to each other and to a common BMFN secretariat.

Each MF should consist of a demarcated land-base, large enough in size to represent a range of forest uses and values in the surrounding geographic region. This is the core area, where the majority of MF actions take place. Local stakeholders form the partnership, which direct the MF work through the manager. Satellite

areas are situated outside the core area. It may be forest research sites or demonstration areas that already exists, and that serve to increase the usefulness and applicability of the MF work. It is understood that including satellite areas within the MF should be of mutual interest and benefit for BMFN and for the other party in question. A scattered distribution of several areas within a MF will better reflect a wider range of landscape-, ownership, and management-types, and will better reflect the BMFN vision. Moreover, by applying the combination of one core area with several satellite areas for each MF, the geographical size requirements by IMFN is not critical. Instead of providing one large, single area, a number of smaller areas together build up the total MF size. The minimum size for a MF within IMFN is 60,000 ha at present. This should be used as a guide, however, for a minimum total size for each MF within BMFN.

The BMFN secretariat should have representatives from each country. It should provide financial and administrative guidance to the MF's. The secretariat should also encourage and guide the strategic and operational planning of work within the MF's, as well as supervise the continuous processing of documentation and evaluation of criteria and indicators.

The secretariat is responsible for ensuring good quality communication within BMFN as well as with outside operators, including: WWF and other international organization; BEAC, BFSTF, and other regional organizations; IMFN; the external evaluation committee; local organizations; and external resource centers. The external evaluation committee plays an important role in guiding the scientific and practical approach within BMFN. It should be composed of professionals in topics which relates to management and use of natural resources, who are not directly involved in BMFN. Local organizations, e.g. municipality boards, local tourist organizations, etc., are commonly involved in the MF partnerships, but it is important to secure the direct link to the secretariat, as well, to strengthen the importance of local decision-making and local influence.

Developing common themes

Developing common themes is the actual significance of developing a MF network throughout the Barents region, and a continuous process within BMFN (see program 6.5.2.). It is understood that taking on a current problem on sustainable use and management of natural resources across the Barents area, creates excellent possibilities to provide high-quality scientific and practical solutions on local (specific MF's), regional (Barents), and global (boreal zone of the northern hemisphere) scales. Three themes are suggested initially, because they are of fundamental importance to ensure good quality communication and mutual understanding, and may thus serve to aid the BMFN establishment phase by adding actual and useful tasks:

1. Program 'Developing a common dictionary and adjusting the "Greener Forest" book' (program 6.5.3.) is essential to ensure good quality communication within the BMFN, and to communicate with external networks and organizations. The "Greener Forest" campaign has had major influence on the view on forest management and use of forest resources, for professionals, forest owners, and the public. The textbook (Pettersson 1999) includes a range of issues

that relates to ecological, practical, social and economic aspects. A Barents-version of this campaign will serve as a fundament for further achievements.

2. Program 'Developing common education programs' (6.5.4) is also of ultimate importance to ensure good communication, to create a common understanding, and to serve as a fundament for further achievements.

3. A theme, 'People to people exchange of experience', including several programs within criteria 5 and 6, is valuable to create common visions based on experiences of a range of issues which relate to use and management of natural resources within the Barents countries.

Examples of other and more process-oriented possible themes include:

4. Indicator 'Landscape-level biodiversity' (1.1.) is based on the east to west gradient from greater to lesser anthropogenic influence on the forest landscape, and on the gradual change in tree-species composition, as commented on earlier.

5. The programs 'Increasing broadleaf proportion and ensuring continuous presence of large trees' (2.1.7) and 'Introducing fire in forest management' (2.1.8), are based on the assumption that the lesser anthropogenic influence in the eastern proportion of the region provide higher frequency of these natural structures and functions.

6. The programs 'Combining forest management and reindeer husbandry' (2.1.9.), 'Reindeer husbandry' (5.2.1.), and 'Cultural heritage' (5.2.7.) bring together aspects which mainly concern the indigenous people. There are around 75 000 original inhabitants (Saamí, Nenets and Vepsians) in the region. Their rights and tradition should be acknowledged. The work within BMFN should be closely coordinated with the work of BEAC Working Group of Indigenous Peoples (WGIP).

7. Indicator 'Drainage and ditching' (2.2.) serves to elucidate economic gain and ecological consequences of this measure for increasing tree-growth potential.

8. Program 'Boreal wetlands as source or sink for atmospheric carbon' (4.2.1.) is an example of a leading-edge scientific area of global interest. The Barents region, with vast wetlands of different types, offers excellent possibilities for studies of this matter.

9. Indicator 'Logging roads' (5.3.) is based on the assumptions that more and better roads are needed, especially in the eastern proportion of the Barents region. Knowledge gained in building the road network in the western proportion is useful in preparing for improved infra-structure in the east. The indicator brings up aspects like distribution of roads, logistics and accessibility, environmental-friendly construction and maintenance methods, and non-permanent roads for winter-logging purposes.

10. Indicator 'Criteria and indicators' (6.1), where the list of indicators is evaluated and refined, is of fundamental importance for securing the scientific and practical applicability of BMFN.

11. Indicator ‘Multiple-purpose forest-landscape management’ (6.2.) focuses on how to deal with planning, decision-making, conflicts, and local management, with respect to diverging interests in using and managing natural resources. The Barents region, with its economic, political, and social differences, offer great opportunities to find local solutions which may be applied also on larger scales and on other parts of the world.

12. A theme, ‘Economy in land-use within the Barents region’, emphasizes economic aspects of biological or other constrains on the use of natural resources. The theme includes several criteria, indicators and programs.

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Appendix 1

Description of criteria, indicators and programs in Vilhelmina Model Forest

All numbers given refer to table 9.

Conservation of biological diversity (1.)

Background information:

- Landscape characteristics, including geology, climate, soils, topography, nature-types, water, etc;
- Landscape history, including available archeological and other reconstructions;
- Demands and interests, including ownership, industry, tourism, etc;
- Landscape structure, including overall patterns which depend on ownership, hydrology, topography, and other factors;
- Main disturbances, including natural wildfire frequency, other disturbances, and human impact;
- Present distribution of protected areas.

Landscape-level biodiversity (1.1.)

Scope: The potential diversity in the landscape and its patterning, and how this has been, and is, influenced by the use of natural resources.

The program 'Landscape structure' (1.1.1.) is descriptive by nature and of fundamental importance. It is aimed to reveal the patterning and distribution of nature-types, including different forest-types, open mires, the alpine tree-line, lakes, rivers, etc. With respect to forests, aspect such as proportions between forest edges and interior areas, corridors, connectivity, stepping stones, altitude zones, dispersion of different types, etc. are of utmost interest. The comprehensive differences between undisturbed and natural proportions versus disturbed and managed proportions of the landscape should be revealed. The program should not be limited to the demarcated land-base. Aspects of surrounding landscapes need to be taken into account.

The program 'Patterns of natural diversity with focus on species-rich habitats' (1.1.2.) focuses on γ-diversity, i.e. how diversity and species composition are distributed over the landscape. The emphasis is on naturally species-rich habitats and other habitats which are known to harbor threatened and rare species, how these are distributed over the landscape, and their connectivity.

The program 'Diversity gradients' (1.1.3.) focuses on β-diversity, i.e. how diversity and species composition change between ecosystems along large- and small-scale gradients across the landscape, e.g. from lake-shore to mountain summit,

along a stream from spring to lake, from wet to mesic to dry communities, and from natural to managed proportions of the landscape. The program should include a review of β-diversity indices and an analysis of their applicability.

Ecosystem-level biodiversity (1.2.)

Scope: Structure and diversity in natural and managed forests, natural species diversity in different forest ecosystems, and factors affecting this.

The indicator encompasses α-diversity, i.e. diversity within ecosystems, communities or stands, and should include a review and analysis of the applicability of α-diversity indices.

The programs 'Structure and diversity in natural forests' (1.2.1.) and 'Structure and diversity in managed forests' (1.2.2.) aim to determine effects of different management strategies and methods on species diversity. The focus is on the influence of structural composition – tree-species composition; stratification; age-heterogeneity; spatial patterns – on habitat diversity and hence on species diversity. Certain attention should be given to measures of structural composition as a parameter for predicting species diversity. Moreover, the frequency of specific structural features, such as large broadleaf and conifer trees (cf. eternity trees) should be revealed.

The program 'Dead wood and biodiversity' (1.2.3.) concern how both quantity and quality of dead wood influence species diversity. Quality implies tree-species, size and decomposition stages.

Species diversity (1.3.)

Scope: Status and threshold-values for threatened and rare species.

The program 'Status and threshold-values for threatened and rare species' (1.3.1.) is a general documentation of where threatened and rare species are found and of their status. A certain emphasis is given to species that have the potential to be present in the landscape, but that have not been found.

Regarding analysis on how to secure the long-term survival and vitality of such species, there are reasons to distinguish between species that are able to move across the landscape (birds, mammals, insects, fish) and species that are more stationary (vascular plants, mosses, lichens, mushrooms) and are dependent on externals mechanisms (biotic agents, wind, water) for their dispersal. These aspects are dealt with in 'Status and threshold-values for characteristic stationary species' (1.3.2.) and 'Status and threshold-values for characteristic mobile species' (1.3.3.).

Present and future conservation status (1.4.)

Scope: Distribution and patterning of protected areas to best secure the long-term survival and vitality of species-rich habitats and threatened and rare species.

The program 'Distribution of nature reserves and other protected areas ' (1.4.1.) is based, on the one hand, on the present distribution of protected areas in the landscape, and on the other hand on the knowledge gained in indicators 1.1. to 1.3. above. The analysis concern how the long-term maintenance and/or enhancement of biological diversity best can be met by the spatial distribution and patterning of protected areas, and how this places constraints on the management of natural resources in the landscape. Certain attention should be given to differences between natural and managed landscapes. Moreover, based on indicator 1.2., specifically, it should be questioned whether protected areas need to be completely left for natural development, or if some kind of management (e.g. selection thinning, fire) may be allowed or even preferred, and consequently to what extent and intensity.

Genetic diversity (1.5.)

Scope: Trend and ecology in *Picea abies* and *Picea obovata* distribution towards the alpine tree-line.

The program 'Patterns of *Picea abies* and *Picea obovata*, and autecology for *P. obovata*' (1.5.1.) focuses on the assumed change from *P. abies* dominance to *P. obovata* dominance along gradients from low to high altitudes approaching the alpine tree-line. Different kind of ecological and functional interpretations should be done, including changes in density, growth, regeneration success and regeneration traits, damage by wind and snow, etc. It should be questioned if natural behavior of these species has any significance for forest management in high altitude locations.

Maintenance and enhancement of forest ecosystem condition and productivity (2.)

Background information:

- Forest management methods used in the landscape;
- Forest-type productivity levels;
- Forest-type stocking and species composition;
- Extent and intensity of reindeer management;
- Draining and ditching in the past and at present.

Influence of forest management methods (2.1.)

Scope: Effects of forest management methods and strategies on natural structures, characteristics and functions; The combination of forest management and reindeer husbandry.

The program 'Influence of ownership on choice of forest management strategy and method' (2.1.1.) is aimed to reveal if there exists any significant differences between privately-owned and company-owned proportions of the landscape, with respect to preferred management methods and strategic planning (e.g. cutting cycles, size of harvest areas, regeneration method). If such differences exist, the

program should include an analysis on how this has influenced the structure and patterns in the landscape. Natural landscapes under control of natural disturbances should be used as references. The program is obviously linked to indicators 1.1., 1.2., and 1.4.

The programs 'Adapting management to natural structure and function, including natural disturbances' (2.1.2.), 'Effect of forest management on natural food webs and ecological cycles' (2.1.3.), 'Effect of forest management on threatened species and diversity' (2.1.4.), and 'Effect of forest management on long-term site productivity' (2.1.5.), focus on forest management under constraints of different kind. A common denominator is the desire to mimic natural features and to minimize the risk to upset natural ecological processes. These programs are by nature long-term experiments that require careful inventories, experimental set-ups, monitoring, and hypothesis testing and validation. The programs are linked to indicators 1.2. and 1.3., in particular, and to indicator 2.3. below.

The program 'Innovative forest management methods' (2.1.6.) ensures a broad approach to forest management. It is essential to encourage innovative ideas, not the least to raise questions and form hypothesis that may be applied to SFM.

Based on documentation of forests in the demarcated land-base in Vilhelmina Municipality, as in other parts of the Barents region, there is a certain need to introduce or strengthen natural features which at present is less frequent than what may be expected in comparable natural landscapes. The programs 'Increasing broadleaf proportion and ensuring continuous presence of large trees' (2.1.7.) and 'Introducing fire in forest management' (2.1.8.), focus on two such features. Especially in conjunction with indicator 1.2., above, other possible features which disserve attention may be identified.

The program 'Combining forest management and reindeer husbandry' (2.1.9.) focuses on a critical issue in Vilhelmina Municipality. A basic question is how forest management can be adjusted to meet the needs from local Saamí people, specifically concerning winter foraging. It is understood that the Saamí people have the right to use forests for foraging and passage. Note that a more comprehensive approach to reindeer husbandry is taken in indicator 5.2. and program 5.2.1.

Drainage and ditching (2.2.)

Scope: Effect of ongoing and abandoned drainage and ditching on long-term site productivity and natural values.

Northern Sweden has a long tradition of drainage and ditching on low-lying and wet sites, for the purpose to increase tree growth. Questions have been raised concerning the benefit, from the tree-production vs. operational-cost point of view, and the consequences on natural values including biodiversity. Because of this, drainage and ditching actions have been very limited during the past decade or so.

Two programs, 'Effect of drainage and ditching on long-term site productivity and natural values' (2.2.1.) and 'Effect of abandoning drainage ways on long-term site productivity and natural values (2.2.2.), are proposed to sort out these questions.

Certain attention should be given to how to address nature conservation and the public opinion. Hence, there is an evident link to indicators within criteria 5. and 6. below, in particular with program 6.2.2.

Natural function and ecology of boreal forests (2.3.)

Scope: The characteristics of carbon and nitrogen balances within forest ecosystems of different composition, structure and degree of natural and anthropogenic disturbance.

Science is continuously gathering new information and knowledge on function and ecology of forest ecosystems. This indicator is intended to be broad and flexible with respect to included programs, to ensure the leading-edge and up-to-date approach. Two programs are suggested initially; 'Carbon balance' (2.3.1.) and 'Nitrogen balance' (2.3.2.). The programs should focus on net primary production and allocation of carbon, and on nitrogen budget and balance, respectively, within forest ecosystems of different composition, structure and degree of natural and anthropogenic disturbance.

Conservation of soil and water resources (3.)

Background information:

- Distribution and characteristics of lakes, rivers, streams and wetlands in the landscape;
- Characteristics of riparian habitats;
- Mammals and fish in aquatic habitats.

Aquatic and wetland habitats in the landscape (3.1.)

Scope: Ecology and function of aquatic and wetland habitats.

The program 'Characteristics of lakes, rivers and streams, including characteristic species' (3.1.1.) is descriptive by nature and intended to provide basic information about the water component in the landscape, and characteristics of aquatic ecosystems from spring and watershed to lakes and rivers. Certain attention should be given to the status among characteristic species such as otter (*Lutra lutra*), beaver (*Castor fiber*), muskrat (*Ondatra zibethica*), the mussel *Margaritana margaritifera*, and the fish *Salmo trutta*. It serves as a fundament for the program 'Natural dynamic and function in lakes, rivers and streams and their surrounding habitats' (3.1.2.). This program is more process-oriented, and intended to outline the natural dynamics in water-level, spring-flood characteristics and natural flooding, the influences on surrounding habitats, acidity fluctuations and seasonal patterns in acidity-levels, nutrient conditions, etc.

The program 'Characteristics of wetlands, fens, and mires' (3.1.3.) encompasses forested and open wetlands on peat soil and paludified mineral soil with substantial organic surface. Distribution of different wetland types and their basic ecology

should be outlined. The possibilities to study palsa-development should be investigated.

Influences on aquatic and wetland habitat (3.2.)

Scope: The impact of forest management and other anthropogenic actions on aquatic and wetland habitats, and how negative impact on natural values may be reduced.

The indicator is based on information and knowledge gained in indicator 3.1. above. The program 'Forest management in riparian ecosystems' (3.2.1.) is evidently linked to several indicators within criteria 1. and 2. It is assumed that forest management actions must be constrained in riparian ecosystems, with respect to both intensity and technology use. Consequences of different forest management methods on natural values within riparian habitats and on conditions in aquatic and wetland habitats should be outlined. Certain attention should be given to erosion and outflow of organic and mineral matter into aquatic habitats.

The program 'Other impact in riparian, aquatic, and wetland ecosystems' (3.2.2.) includes features such as pollution from the Stekenjokk Mine, damming for hydro-electrical power plants, roads and logging.

The program 'Constraints for forest management, logging roads and drainage' (3.2.3.) focuses specifically on how negative impact of forest management, logging and drainage can be reduced in riparian, aquatic and wetland habitats.

Site scarification (3.3.)

Scope: The impact of different scarification methods on long-term site productivity and natural values.

The programs 'Impact of scarification on long-term site productivity and natural values' (3.3.1.) and 'Innovative scarification methods' (3.3.2.) aim for determining impact of existing and new scarification methods on forest regeneration success, on nutrient balances and site conditions in the long term, and on natural values such as disturbance on established plant communities.

Forest ecosystem contributions to global ecological cycles (4.)

Background information:

- Ownership structure;
- Distribution of wetland types;
- Anthropogenic disturbance in wetlands (drainage, logging roads, damming, etc.);
- Macro-, meso- and micro-climate;
- Altitude position and species composition of the alpine tree-line;
- Quality and quantity of reindeer foraging sites.

Balancing forest harvesting and forest growth with respect to carbon budgets (4.1.)

Scope: Adjustments of management strategies and methods to balance harvest and growth with respect to local carbon budgets.

The program 'Effect of different management strategies and silvicultural methods on carbon budgets' (4.1.1.) aim for determining how carbon flow on the local scale depend on factors such as size of harvesting unit, cutting cycle, and harvesting intensity. Local implies here an area which is equivalent to the average size of privately-owned estate. It should be questioned if balancing annual harvesting with annual growth on local scale is a measure to balance carbon flow also over larger scales. Certain attention should be given to enhanced carbon release by enhanced decomposition of humus and other organic matter as a result of site scarification. The program is linked to several programs within indicators 2.1., 2.2., and 3.3.

Carbon balance in boreal wetlands (4.2.)

Scope: Boreal wetlands as source or sink for atmospheric carbon.

In the program 'Boreal wetlands as source or sink of atmospheric carbon' (4.2.1.), it is questioned whether peatlands (fens and mires) contribute to raised atmospheric carbon-levels by release during decomposition of organic matter, or if they act as carbon-sinks by growth and accumulation of carbon dioxide into the active plant community on the peat surface. Ecological factors involved should be elucidated. The program is by nature a long-term experiment that requires careful experimental set-ups, monitoring, and hypothesis testing and validation. It should be questioned if there exist any significant differences between natural and disturbed (drainage, logging roads, damming, etc.) wetlands. The program is linked to program 3.1.3.

Climate trends (4.3.)

Scope: Effects of climate change (macro-level) on the alpine tree-line position and composition, and on reindeer foraging conditions; Influence on stand-level meso- and micro-climate by forest management methods.

The programs 'Effect of climate change on the altitude of the alpine tree-line and its species composition' (4.3.1.), and 'Effect of climate change on quantity and quality of reindeer foraging sites' (4.3.2.), are based on the assumption that a climate change on macro-level is in fact occurring. If this is the case, then there should be effects on the tree-line position and species composition, and on reindeer foraging conditions. Possibilities to reconstruct historical references and to predict future situations should be stressed.

The program 'Effect of different forest management methods on stand-internal climate' (4.3.3.) focuses on the effect of different forest management methods on stand-level meso- and micro climate. The program is linked to indicator 2.1.

Pollution and non-natural acidification (4.4.)

Scope: The long-term trend in contamination-levels by the Chernobyl incident; Forest management influences on ecosystem-level soil-acidity.

The indicator may encompass a large number of programs, and should therefore be flexible to meet the current need for new knowledge and information. Initially, 'Long-term trends of the Chernobyl impact and its influence on the use of natural resources ' (4.4.1.) and 'Impact of forest management methods on soil acidity trends' (4.4.2.), are suggested. These two programs address current problems in the focal area.

The former program is intended to follow the contamination trend in mushrooms, berries and game, and is linked to program 5.2.2. below. The latter program focuses on how different forest management strategies and methods affect shorter- and longer-term soil-acidity trends on ecosystem- or site-level, and on how to distinguish between natural and non-natural acidification. An obvious question to raise is how well natural acidity trends in undisturbed ecosystems can be maintained under a management regime. The program is linked to indicators 2.1., 2.3., and 4.1.

Multiple benefits of forests to society (5.)

Background information:

- The local society's need and demands;
- Potential and availability of natural resources;
- Traditional land-use and culture.

Forest resources (5.1.)

Scope: The flow of forest products with respect to local manufacturing and local and regional economy.

The programs 'Flow of forest products' (5.1.1.), 'Importance for regional and local economy' (5.1.2.), and 'Local manufacturing' (5.1.3.), are ultimately interconnected. Their common objective is to secure an optimal flow of forest products with respect to the need for local manufacturing and to the benefit for the local and regional economy, as a complement to exporting to the national and international markets. A range of factors need to be taken into account, including logistics and distribution of logging roads, certification of forest products, up-to-date management strategies, cooperation among land-owners, etc. A central issue is to explore ways to manufacture forest products locally as far as possible, and to find means for ensuring innovative ideas for use and trade of forest products. Links to indicators 5.3. and 6.2. are evident.

Other natural resources (5.2.)

Scope: Use and management of diverse resources which are complementary to wood-based resources.

A range of programs focuses on resources which are complementary to wood-based resources. In 'Reindeer husbandry, (5.2.1.), the emphasis is on the traditional reindeer husbandry by indigenous Saamí people. Measures to combine maintained traditional culture with economic sound land-use should be outlined. The program is linked to program 2.1.9. above. The program 'Recreation, hunting, fishing, berries, and mushrooms' (5.2.2.) aims for multiple-use values in forest-dominated landscapes. The programs 'Bioenergy, including wood-based resources and *Phalaris arundinacea*' (5.2.3.), and 'Peat harvesting, mineral harvesting, and agriculture' (5.2.4.) focus on harvesting of non-wood resources. Finally, 'Hydroelectricity and windmills' (5.2.5.), 'Ecotourism' (5.2.6.), 'Cultural heritage' (5.2.7.) and 'Social and esthetic values' (5.2.8.) bring in aspects on other important demands on the landscape.

It should be understood that conflicts may occur between use of different natural resources and between different types of demands. Therefor, it is essential to link indicators 5.1. and 5.2. with program 6.2.2. below.

Logging roads (5.3.)

Scope: Landscape accessibility and distribution of the road network, construction and maintenance of logging roads in an environmental-friendly way.

The focus is on transportation of wood-based products and the accessibility of the landscape for other purposes (tourism, etc.). Three programs are suggested: 'Distribution of roads in the landscape, including logistics and accessibility' (5.3.1.), 'Environmental-friendly construction and maintenance methods' (5.3.2.), and 'Non-permanent winter logging roads' (5.3.3.).

The former program is descriptive by nature, and aims for determining the current network and status of roads in the landscape. The latter two programs aim for solving future needs in an optimal way, with respect to environmental-friendly construction and maintenance of a road network. The potential in using non-permanent, winter-logging roads, should be considered for sensitive habitats (e.g. wetlands and riparian areas), and for proportions of the landscape where accessibility should be restricted (e.g. key biotopes and reserves).

Society's responsibility for ensuring sustainable development (6.)

Background information

- List of criteria and indicators;
- Ongoing and planned types of management;
- Realized forest-management campaigns;

- Communication with the scientific community, with IMFN, and within the BMFN.

Criteria and indicators (6.1.)

Scope: Development and evaluation of indicators to measure sustainable use of natural resources, and to guide MF action plans.

The process of developing, evaluating and adjusting indicators is a central issue in the MF philosophy. The programs 'Evaluating selected indicators' (6.1.1.) and 'Adjusting selected indicators and development of new indicators' (6.1.2.), are suggested to ensure that this process is continuously in progress. As well, evaluating selected indicator with respect to how well they work as a measure for sustainable development according to the criteria, form a background for 'Developing action plans for sustainability based on criteria and indicators (6.1.3.). This program is essential for securing the up-to-date approach concerning current research, monitoring methodology, and management technology.

Multiple-purpose forest-landscape management (6.2.)

Scope: Scale-flexible and long-term planning for multi-purpose management.

One of the fundaments in the MF philosophy is to ensure possibilities for multiple-purpose management. This is the focus in 'Developing multi-purpose management plans on landscape-, estate-, and stand-level' (6.2.1.). Key issues are how to allow a scale-flexible planning approach – from single management units on the stand-level, to several and ecologically diverse management units on the estate- and landscape-levels – and how to integrate different types of management (e.g. forestry, reindeer management, conservation of species diversity) in this planning process. The program is obviously linked to indicator 5.2. above.

A multi-purpose approach to landscape management may result in conflicting views on strategic and operational objectives. This is dealt with in the program 'Decision processes, dealing with conflicts and local management' (6.2.2.), where the emphasis is on how to find local solutions to potential and real conflicts.

Education for forest-owners, professionals and the public (6.3.)

Scope: Public and professional accessibility to the MF area and program.

The emphasis in the programs 'Effect of accomplished campaigns, and plan for evaluation and coming actions' (6.3.1.) and 'Developing demonstration areas' (6.3.2.), is how to address public and professional interest in the MF program and area, and in sustainable forest-resource and nature-resource management as a whole.

The main campaign to be evaluated is the "Greener forest" campaign launched by the National Forestry Board. Based on experiences from this campaign, the need for following-up actions and complementary work should be analyzed. The latter program is practical by nature, and includes work that makes the MF area and

program available and informative for the public and for professionals, such as advertising and public relations, information-folders, sign-boards, trail development, construction of bridges and walking-boards, etc.

Research (6.4.)

Scope: Communication and cooperation with the scientific community.

The program 'Evaluating accomplished research, and plans for coming research and coordination' (6.4.1.) concerns the communication with the scientific community. It is required by the MF program to apply and evaluate up-to-date management approaches and technologies, and this requirement is met by ensuring a continuous dialogue with researchers and research organizations. This issue is further developed in chapter 4.4.

The Barents Model Forest Network (6.5.)

Scope: Organizing, developing, and run BMFN

Four main programs can be distinguished: 'Organizational development' (6.5.1.); 'Developing common themes for sustainable management of natural resources' (6.5.2.); 'Developing a common dictionary and adjusting the "Greener Forest" book' (6.5.3.); and 'Developing common education programs' (6.5.4.). The second program (6.5.2.) concerns the actual significance of the underlying purpose of developing a network throughout the Barents region. The two latter programs are examples of more solid actions that may play an important role in initiating BMFN. This indicator is further outlined in chapter 5.

Appendix 2

Tentative plan for accomplishment

The following plan concerns the establishment phase of developing BMFN, i.e. the first three years.

1st year:

- Finalize and publish a revised version of this report;
- Publish a shorter version of this report, to address specifically the reasoning behind and approach to BMFN;
- Publish a short information pamphlet in native languages for distributing to the public.
- Arrange meeting with participant countries to evaluate the report and to survey BMFN options;
- Establish the organization and ensure good quality communication within BMFN;
- Ensure good scientific quality by arranging meetings with research organizations;
- Launch Vilhelmina Model Forest and submit application for membership in IMFN;
- Publish report on BMFN program declaration (based on evaluated report);
- Start work on themes/programs 6.5.3. and 6.5.4.

2nd year:

- Conduct field reconnaissance for MF sites in Norway, Finland and Russia;
- Select MF sites in Norway, Finland and Russia;
- Select list of criteria and indicators for each site;
- Establish BMFN Secretariat;
- Continue work on developing themes for BMFN and collaboration with IMFN;
- Continue work on ensuring communication and scientific quality.

3rd year:

- Launch model forest sites in Norway, Finland and Russia;
- Evaluate and revise BMFN;
- Submit proposal of long-term action within BMFN;

- Publish progress report.

Following this, the plan for accomplishment ultimately depends on the economic resources available. It is needed to secure governmental or regional long-term funding to provide the necessary organizational stability and the basic resources for the secretariat and for establishing the specific MF sites. Possibilities for additional funding should be investigated in cooperation with universities and other research organizations, as well as with forest companies and other national, regional, and international organizations and agencies.

Appendix 3

Letter of intent

REGERINGSKANSLIET

Ministry of Industry, Employment and Communications

Division for Energy and Primary Industries

Vilhelmina Municipality

6 February 2004

Mr. Peter Besseau
Executive Director
P.O. Box 8500, 250 Albert Street, Ottawa, ON
Canada, K1G 3H9

Swedish participation in the International Model Forest Network

With this letter we would like to inform you of the Swedish intention to work with the International Model Forest Network Secretariat with the purpose of preparing and accomplishing participation in the International Model Forest Network. The Ministry of Industry, Employment and Communications, the National Board of Forestry, the Regional Board of Forestry in Västerbotten, and Vilhelmina Municipality are participating in the process. Representatives from these bodies have investigated the model forest concept and have initiated contacts with the IMFN Secretariat. A model forest site covering 120,000 hectares has been prepared in Vilhelmina Municipality, northern Sweden.

Sweden also intends to participate in the process of establishing a network of model forests within the Barents Region, the Barents Model Forest Network, to which the Vilhelmina Model Forest will be connected. The Barents region, encompassing the northern parts of Sweden, Finland, Russia and Norway, is an interconnected region which provides excellent opportunities to develop sustainable use and management of forest resources. The purpose is to develop the Barents Model Forest Network into a sub-network within the IMFN. The lead agency in this process is the Barents Euro-Arctic Council.

The Vilhelmina Model Forest site, the strategy for adopting the model forest approach, as well as groundwork for the Barents Model Forest Network, is further outlined in the appendix.

Linda Hedlund
Responsible for forestry
Ministry of Industry, Employment and Communications

Åke Nilsson
Municipal Commissioner
Vilhelmina Municipality

Swedish participation in the International Model Forest Network - Appendix

The Barents Region

The Barents region is an interconnected geographical area. It covers about 755,600 km^2 across 13 provinces in Sweden, Finland, Russia, and Norway. The region shares a common history. The indigenous Saamì people are at home in all four countries, and east-west crossing trade and relations go back to the Stone Age. Except from the Saamì people, the Nenets and the Vespians have been recognized as original people.

The Barents Region is Europe's richest region as far as forest resources are concerned, and forestry has a key position in the economic development in the region.

The Barents Euro-Arctic Council (BEAC)

The BEAC was established in 1993 for the purpose to improve economic and political stability in northern Europe. BEAC is the forum for intergovernmental cooperation on issues concerning the Barents Region, and operates on the Foreign Ministry level. The activities have expanded into a number of working groups with representatives from each country. The purpose is to deepen cooperation on relevant issues. The Working Group on Economic Co-operation (WGEC) has created the Barents Forest Sector Task Force (BFSTF).

Ongoing work on model forests is managed by BFSTF under WGEC. The time frame for the initial phase in developing model forests in the Barents Region is a three year period. Within this period of time, criteria should be agreed upon and model forest sites should be identified.

The Barents Forest Sector Task Force (BFSTF)

The BFSTF was established in 2000. The main objective is to create necessary conditions for the development of forestry, environmental care, and wood-based industries through cooperation, mutual concrete actions, projects and programs within the forest sector. One of the focal areas to develop in order to meet this objective is to initiate further development of integrated model forests for sustainable management and conservation of biological diversity.

To strengthen the model forest approach within BFSTF, the Council of the European Union has decided to list this issue as one of the specific priorities and objectives for the period 2004 to 2006, in the second Action Plan for the Northern Dimension.

The Second Northern Dimension Action Plan

In the second Action Plan for the Northern Dimension, model forests are considered under the headings 3.3 (Environment, nuclear safety and natural resources) and 3.3.1 (Natural resources). There, it is stated that the Barents Region is rich in natural resources, and that these natural resources are of crucial importance for the economical development, although they are under significant pressure. Sustainable use of natural resources is vital to ensure the long-term economic potential

and ecological balance of the region and its indigenous communities. Forests in the region have vast global importance because of their broad expanse, their bio-diversity, their role in the global carbon cycle, and their actual influence on national, regional and international trade in forest products. The following key objective has been agreed upon:

"To help ensure that Northern and Arctic eco-systems and their bio-diversity shall remain viable, vigorous and able to sustain human socio-economic needs, and to encourage the responsible and sustainable utilisation of forests and fish stocks, with the active participation of local actors, communities, SMEs and indigenous peoples in the decision-making process." (SME is small and medium-sized enterprises).

The priority actions include the development of model forests:

"Development of model forests in the Barents Region for a holistic approach to forestry, including economic environment, and social dimensions. The Barents model forests would be connected to the International Model Forest Network."

The Vilhelmina Model Forest (VMF)

Sweden as a country has decided to promote VMF as a step towards the implementation of a network of model forests throughout the Barents Region. A background is formed by the Vilhelmina project, subtitled 'Diverse forest utilization in a landscape perspective', which has been running since 1995. This project is based on the one hand on a conflict where the desire to acknowledge environmental aspects in the use of forests opposed traditional forestry activities, and on the other hand on the interest among local stakeholders to understand and implement environmental aspects within forestry strategies. A continuous dialogue has been maintained, with representatives from private land owners, forest companies, local Saamí groups, and idealistic organizations.

Initiating a model forest is a natural extension of the Vilhelmina project. In defining and applying the model forest concept, the standards set by the IMFN will be acknowledged: A model forest can be described both as a physical entity and as an organization: a demarcated land-base that is large enough to fully reflect the range of environmental and socio-economic values of natural resources, and an organization that is able to develop and direct an integrated package of projects that can lead to better understanding, conclusion, and decision-making on issues that concern the sustainable use of natural resources.

To pursue the establishment of a VMF in accordance with the IMFN guidelines, the following requirements have to be met:

1. To form a partnership between stakeholders that have demand on, and interest in, the use of natural resources in a given land-base, and that share the common goal of sustainable forest management (SFM);

2. To establish a forum where the partnership can meet to gain greater understanding of conflicting views, share knowledge, and combine expertise and resources to develop approaches to SFM;
3. To provide a land-base which acts as a full-scale laboratory where leading-edge techniques are researched, developed, applied and monitored, and where leading-edge forest management practices are demonstrated, with respect to progress towards SFM;
4. To develop a framework of criteria and indicators, that balances different demands on natural resources, and that provides measures of the progress towards SFM.

The two former requirements is a matter of organization during the setting of MFV, and have already been prepared. The partnership should include representatives from different land-holders (private, company, community, government) and other parties (industries, forestry professionals, tourist organizations, nature conservation organizations, etc.). The forum should be organized in such a way that stakeholders representatives can meet regularly to direct the MF process.

The third requirement has already been met. A demarcated land-base in Vilhelmina municipality, northern Sweden, has been identified. It covers 120,000 ha in the transition from boreal to alpine zones, whereof about 58,000 ha is forested land. As a model forest, this land-base will act as a full-scale laboratory where leading-edge techniques are researched, developed, applied and monitored, and where leading-edge forest management practices are demonstrated. In total 250 private land-holders, forest companies including state-owned companies, and Vilhelmina municipality, share interest in the area, together with a magnitude of other stakeholders including reindeer husbandry Saamí people.

The final requirement concerns the most central idea in the model forest concept, i.e. to achieve sustainable use of natural resources, mainly forest resources. This is a complex challenge that requires balancing of social, economic, cultural, and environmental aspects. It also requires monitoring of the effects on these aspects which are caused by management activities.

Six criteria for sustainable forest management have been outlined: (1) Conservation of biological diversity; (2) Maintenance and enhancement of forest ecosystem condition and productivity; (3) Conservation of soil and water resources; (4) Forest ecosystem contributions to global ecological cycles; (5) Multiple benefits of forests to society; and (6) Society's responsibility for ensuring sustainable development. A key prospect in model forests is to develop a set of indicators that provides a framework to describe and monitor the influence by forest management on the criteria and hence on the sustainability of forest resources.

The six criteria for sustainable forest management are applied in preparing the VMF. In total 23 indicators have been suggested as an initial step in the process of developing the model forest site. The set of indicators has been broken down into 65 programs, where each program reflects one or a limited number of actual study approaches. The central idea behind this outline is that a combination of programs together forms an explicit tool for determining if and how indicators in combina-

tion with other indicators respond to the request of maintained or enhanced sustainability in the view of a criterion. The programs reflect leading-edge approaches for ecology and management in the boreal zone of the northern hemisphere, as well as within the Barents region and locally within Vilhelmina municipality.

The indicators and programs for MFV are chosen to:

- address the six criteria for sustainable management of natural resources;
- reflect current questions with respect to ecology and management of natural resources in the boreal zone of the northern hemisphere;
- emphasize specific conditions in the Barents region; and
- suite local prerequisites in the VMF area and nearby surroundings.

Thereby, the indicators can be applied on different scales; on local and regional levels, as well as within the boreal zone. With reference to the 'Vilhelmina project', it should be noted that information and knowledge about some of the programs and indicators may already be at hand.

The suggested list of criteria, indicators and programs represent a framework which enclose the strategic and operational direction of all work within VMF. The criteria are shared by other model forests throughout the world, while the indicators and programs are specifically developed to fit the circumstances at hand in the demarcated land-base and among the stakeholders in question.

As in other model forests, the list of indicators and programs is not definitive. The list should rather be viewed as a frame for the strategic and operational planning. As new experiences and knowledge is gained, new indicators will be developed and original ones will be modified or excluded.

It is understood that model forests apply leading-edge management approaches and technologies, and hence, it is understood that a continuous dialogue with the scientific community is essential. Therefor, collaboration with Universities and other research organizations should be secured throughout the process of developing and maintaining the model forest.

The Barents Model Forest Network

The Barents Region is rich as far as forest resources are concerned, and forestry has a key position in the economic development in the region. The majority of the land belongs to the boreal conifer zone, whereas the Scandinavian mountain chain, the northern parts of the Kola Peninsula, the Nenets Okrug and the Novaja Zemlja, are part of the arctic tundra.

The northern location with slow growth rates gives high quality timber which is highly desired on the international market. There are obvious similarities in forest ecosystems throughout the region, but there are also, however, a magnitude of natural gradients that cause steady changes in ecosystem attributes in the west – east direction. These gradients, together with economic, social and political differences, offer excellent possibilities for a network of model forests which addresses economic, social, and ecological values of natural resources in forest-

dominated landscapes. Developing common themes is the actual significance of a network of model forests throughout the Barents region. It is understood that taking on a current problems on sustainable use and management of natural resources across Barents, creates excellent possibilities to provide high-quality scientific and practical solutions on local, regional, and global scales.

It is suggested that each country within Barents should host at minimum one model forest. Each model forest should be controlled by a partnership of local stakeholders, which direct the work through a manager. The different model forests are ultimately connected to each other and to a common secretariat. The secretariat should have representatives from each country. It should provide financial and administrative guidance, encourage and guide the strategic and operational planning of work within the different model forests, supervise the continuous processing of documentation and evaluation of criteria and indicators. The secretariat is also responsible for ensuring good quality communication within the Barents Model Forest Network as well as with outside operators, and with IMFNS.

Each model forest should consist of a demarcated land-base, large enough in size to represent a range of forest uses and values in the surrounding geographic region. This is the core area. The core area may be complemented by satellite areas, forest research sites or demonstration areas that already exists and that serve to increase the usefulness and applicability of the model forest. A scattered distribution of several areas within a model forest will better reflect a wider range of landscape-, ownership, and management-types, and will better reflect the regional vision.

A plan for accomplishment for Vilhelmina Model Forest and Barents Model Forest Network depends ultimately on the economic resources available. It is needed to secure governmental or regional long-term funding to provide the necessary organizational stability and the basic resources for the secretary and for establishing and maintaining the specific model forest sites. Possibilities for additional funding should be investigated in cooperation with universities and other research organizations, as well as with forest companies and other national, regional, and international organizations and agencies.

Process this far

A report has been prepared by the Regional Forestry Board of Västerbotten, entitled “Synthesis of the model forest concept and its application to Vilhelmina Model Forest and Barents Model Forest Network”. This report will be published early in 2004, and serves as groundwork for further actions. The report focuses on VMF and the background for this model forest site.
Barents Model Forest Network has been prepared and discussed continuously in meetings and study tours arranged by BFSTF. Two potential model forest sites in Russia, Onega leskhoz and Kovdozero leskhoz, have been visited.

Planned activities during 2004

March 22–26 (tentative): Visit of Canadian indigenous peoples to the Vilhelmina region to meet with Saami counterparts.

June 2–3: Presentation of the Vilhelmina Model Forest for local people, including bus tour. Some demonstration sites will be visited.

June 22–24 (tentative): Model Forest workshop. Local stakeholders and national level representatives from the Barents countries will be invited, as well as Canadian experts. The focus will be on the Vilhelmina Model Forest project and the proposal to participate in the IMFN. Indicators and programs will be addressed, such as:

- Landscape-level biodiversity, mimicking natural disturbance regimes;
- Influence of forest management methods, managing uneven aged forests for multiple values;
- Aquatic and wetland habitats in the landscape, watershed management;
- Involvement of indigenous people, combining forest management and reindeer husbandry;
- Local participation, education for forest-owners, professionals and the public.

Other model forests in Sweden – the old Swedish mining district 'Bergslagen'

The Model Forest concept has made also other regions in Sweden interested in joining the international network. 'Bergslagen', the boreal forest region with the longest history of sustained wood production in the world, with a network of municipalities, large forest companies and other actors encouraging sustainable forest management is one example. In contrast to Vilhelmina the issues of concerns in 'Bergslagen' are quite different and include:

- Handling competition among users of both wood and non-wood resources including tourism
- Landscape scale restoration of biodiversity and cultural values
- Managing interactions between forest damages, abundant moose, returning wolves and people
- Handling negative effects of anthropogenic pollution including acid compounds and nitrogen
- Development of co-management and participatory planning where there are many land owners
- Urban and social forestry issues related to the vicinity to large urban centers

BorNet – a network of scientists and managers in the boreal forest

Initiated at the Canadian Sustainable Forest Management network's meeting in Edmonton in 1999, researchers and managers in Canada, Sweden, Scotland, Finland and Russia have now established international co-operation to address the issue of quantitative management targets and tools for the maintenance of forest

biodiversity. The aim of the network is to exchange knowledge and experiences for the development of sustainable management of boreal and mountain forests. Several international workshops have been held in Canada, Sweden and Finland, and one international meeting was held in Uppsala in 2002 (see report on www.BorNet.org). A book with 40 articles will be published in spring 2004 (Angelstam, P., Dönz-Breuss, M., Roberge, J.-M. (eds) 2004. Targets and tools for the maintenance of forest biodiversity. Ecological Bulletins 51). Based on this foundation an education material is being developed with case studies such as Vilhelmina and 'Bergslagen' as examples of challenges and solutions. An international conference is planned in 'Bergslagen' in spring 2005. Sweden will also host the International Boreal Forest Research Association (IBFRA) secretariat from July 2004 to July 2008. The dean of the Swedish University of Agricultural Sciences' Faculty of Forest Science, Jan-Erik Hällgren, is Sweden's contact person.

Contacts

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Appendix 4

Sweden becomes first European country to join the International Model Forest Network

The following is the article which can also be found on the IMFN site:
http://web.idrc.ca/en/ev-56126-201-1-DO_TOPIC.html

First European Country Joins IMFN

Sweden has become the first European country to join the International Model Forest Network, extending the IMFN's presence to five continents.

Leif Jougda, a land-use expert with the National Board of Forestry in Sweden, submitted a proposal to the IMFN Secretariat in May of 2003 on behalf of a stakeholder group in Vilhelmina municipality. The ambitious plan outlines a long-term strategy to establish model forests in each of the Barents Region co-operant countries (Finland, Sweden, Norway and Russia), eventually forming a regional network through which participants will share common experiences in support of sustainable forest management.

"[Model forests] are a good way to explain sustainable forest management concepts already underway in Sweden," said Jougda. "There is already a tradition to work in partnerships, but now there is pressure to see the forest socially, not just economically."

"In our review of the Swedish proposal we were struck not only by the quality of the submission, but particularly by the similarity of the management challenges being experience by Sweden with those being experienced throughout the IMFN," noted Peter Besseau, Executive Director of the IMFN Secretariat.

"I have no doubt that the decade-long experience of the IMFN in model forest development, and particularly that of Canada, will prove invaluable to our Swedish colleagues. Of course, it goes without saying that the IMFNS is delighted at the opportunity of working with our Swedish counterparts on this initiative."

How much is enough?
Swedish authorities introduced a new forest policy in 1993 and a new forestry act in 1994. The goal was to achieve a balance between timber production and the preservation of biodiversity through the voluntary participation of forest-land owners. Because forests are a dominant feature covering most of Sweden's landscape, their use and management affects just about every inhabitant. Therefore, this new vision of forest management was for the benefit all people.

By 1995, 120 000 hectares of land had been set aside in the municipality of Vilhelmina in northern Sweden to be managed as a landscape partnership. Private landowners, government representatives, academics, communities and Aboriginal peoples were all involved in the study.

"But how much is enough," asked Joudga. "When do we know we have preserved enough land or that we're cutting the right amount?"

Benefits of Networking

Jougda first heard of the model forest approach in 2002 when Ken Macartney, Counsellor at the Canadian Embassy in Stockholm, introduced him to the concept. The idea appealed to him because, as part of an international network, Sweden would be able to draw from the challenges and successes others have had in areas such as harvesting techniques, GIS, managing competing land-use interests, and others.

Indigenous partnerships and land use are another area of intense interest. In Sweden, about 2 500 indigenous Saamí people have the right to raise reindeer, yet the forested land that provides the lichen and water they need to survive during the winter months is mostly in private hands. The needs of the Saamí and those of the private landowners are therefore frequently in conflict. Once part of the Network, Sweden plans to look to the Canadian Model Forest experience in search of a working solution to this pressing issue.

Based on their experience with landscape partnerships, Vilhelmina became the obvious place to test the model forest approach in Sweden. The Vilhelmina Model Forest will come on-line later this year. Establishment of the Barents Model Forest Network is planned for 2005.

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A Model Forest is a working scale forest-dominated land base where the most appropriate forest management strategies are developed, tested, and shared in a partnership with local stakeholders and other actors. The ultimate goal is to address and apply sustainable forest management.

This report provides the fundaments for Vilhelmina Model Forest, a 120,000 ha site in northern Sweden, the first European Model Forest to be admitted into the International Model Forest Network. Thereby, Vilhelmina Model Forest becomes the 32nd Model Forest, in the network across five continents and 15 countries. The report also outlines a strategy for developing a network of Model Forests in the Barents Region.

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