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A landscape ecological approach to private woodlot planning in New Brunswick

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Abstract: A large proportion of forest land in New Brunswick (~50%) and eastern North America as a whole exists in small private holdings. If biodiversity is to be conserved at the landscape and regional level, it will be critical to develop tools for involving these many landowners in large-scale conservation planning. The purpose of this project was to initiate a community forestry project for small private woodlots that encourages the implementation of landscape ecological objectives. To accomplish this, the Greater Fundy Ecosystem Research Group (GFERG) and the SNB Wood Coop Ltd. (SNB) cooperated with local communities in the Fundy Model Forest, New Brunswick to create landscape ecological management plans for two watersheds. To initiate this landscape ecological project, five steps were undertaken: (1) Develop criteria for selection of candidate watershed, (2) Apply criteria to all watersheds of the FMF and select priority watershed(s), (3) Organize public meetings in candidate watersheds to develop community priorities for landscape planning, (4) Develop a landscape-level watershed management plan. Important components of this plan included the maintenance of large contiguous patches of mature forest, special management areas, steep slopes, sensitive soils, wildlife corridors, and ecologically significant areas. (5) Encourage feedback on watershed plan from community. This landscape-level plan is being used as the context for finer scale woodlot management plans in both watersheds.

Keywords: Landscape ecology, woodlots, watershed planning, biodiversity

Introduction

The conservation of biodiversity requires forest planning at a variety of scales including the genetic, species, population, community and landscape levels (Wilson 1992). A common perceived barrier to the achievement of biodiversity conservation on small private woodlots is the fragmented nature of land ownership. It is often believed that multiple land ownership precludes planning for the large scale, landscape-level spatial objectives that are an essential component of sound forest management. Landowners with diverse management goals may be less likely to cooperate to the degree necessary to protect trans-boundary features such as wildlife habitat or water quality (Woodley and Forbes 1997, FSC Canadian Maritime Regional Initiative 2000). However, a large portion of the total forestland in New Brunswick (~50%) and eastern North America as a whole exists in small private holdings. Further, in southern New Brunswick, forest fragmentation is occurring most rapidly on small private woodlots (Betts and Taylor *In Review*). If biodiversity is to be conserved at the landscape and regional level, it will be critical to develop tools for involving these many landowners in large-scale conservation planning. This paper describes an ongoing project, the purpose of which is to initiate community forestry on small private woodlots that encourages the implementation of landscape ecological objectives. To accomplish this, the Greater Fundy Ecosystem Research Group (GFERG) and the SNB Wood Coop Ltd. (SNB) cooperated with local communities in the Fundy Model Forest (FMF), New Brunswick to develop a landscape management plan for two third-order watersheds.

Methods

Project Area

The area of the Fundy Model Forest (4,500 km^2) extends north of the Bay of Fundy in New Brunswick, Canada (Fig. 1). The Greater Fundy Ecosystem Intensive Study Area (ISA) includes all watersheds that connect to Fundy National Park. Landownership in the FMF is 63% small private woodlots, 17% large private holdings, 15% provincial Crown (public) land, and 5% National Park. All of the Model Forest lies within the Acadian Forest Region (Rowe 1972). The FMF area is characterized by 89% forest cover, a maritime climate, and rolling topography (Woodley 1998). The forest cover is primarily intolerant hardwood or tolerant hardwood and mixedwood communities. However, pure softwood communities exist in low-lying areas and along the Bay of Fundy coast. Intensive forestry activities are common in all areas of the FMF except for Fundy National Park.

Developing Watershed Selection Criteria

We chose third-order watersheds as the logical unit for landscape planning in southern New Brunswick. Because watersheds are easily delineated and are ecologically based, they are superior to both political 'county' borders, and potentially ambiguous conceptions of "landscape" boundaries (Forman 1998).

The first challenge of the Watershed-based Woodlot Management Planning Project was to identify a candidate watershed that would serve as a pilot area for the testing of the landscape-level planning process. Members of the SNB Wood Coop and the GFERG jointly developed the following selection criteria:

1. **A high percentage of mature forest area**. We reasoned that watersheds with the greatest percentage of mature forest are the most likely to be characterized by high rates of timber harvest over the next decade. Such watersheds would allow the luxury of proactive rather than reactive planning thus minimizing the need for restoration practices.
2. **A high percentage of the Tolerant Hardwood (TH), Eastern Cedar (EC), Tolerant Mixedwood (MXWD), and Pine (PI) forest community groups**. These forest community groups are increasingly rare in the Fundy Model Forest. For this reason we felt that special efforts should be undertaken to encourage sustainable forestry practices in these forest communities.
3. **A high percentage of private forestland**. In order to develop an effective spatial management plan it is necessary for a land base to cover a sufficient enough portion of a watershed to be able to exert an influence on landscape-level processes.
4. **A large number of GAP sites (ecologically significant areas)**. In 1995 an initial ecological inventory of the Fundy Model Forest was conducted (MacDougall 1995). This inventory identified 106 small (<100 ha) sites that were of particular ecological interest. These areas are likely to contribute to biodiversity conservation at the landscape scale by serving as sources or at least refugia for increasingly rare species. Creating a watershed management plan that included a maximum number of these areas would also increase the likelihood of their protection.

Together, these criteria were developed to quantitatively evaluate FMF watersheds with respect to ecologically uniqueness and therefore how urgently they required some degree of planning and protection.

Selection of Priority Watershed from FMF Watersheds

Criteria for each watershed were obtained with the use of a Geographic Information System (GIS). Each watershed was ranked according how well it met the criteria. Out of the 28 third order watersheds within the FMF two were similarly ranked at the top according to our criteria: the Washademoak and Pollett River watersheds.

Fifty-six percent of the 36,817 ha Washademoak watershed is owned by non-industrial woodlot owners. Of this 46% is categorized as old forest. The majority of the Washademoak watershed falls into the Grand Lake Ecoregion. This ecoregion is a low-lying flat basin surrounding Grand Lake. The moderating influence of the lake causes this to be the warmest ecoregion in the province of New Brunswick, and as a result, contains tree species such as bur oak (*Quercus macrocarpa*), green ash (*Fraxinus pennsylvanica*), butternut (*Carya cordiformis*), and silver maple (*Acer saccharinum*) (Zelazny et al. 1997).

Fifty-one percent of the Pollett River Watershed is in small private ownership. Of this 50% is old forest. The Pollett River Watershed surrounds Elgin, New Brunswick, 40km north of Fundy National Park (Fig. 2). This watershed is primarily in the Continental Lowlands Ecoregion. Portions of this ecoregion are characterized by a series of ridges and valleys, with high elevations (~500m) of the Fundy plateau to the south and the relatively low-lying flat Grand Lake ecoregion to the north. Tolerant hardwood stands

containing beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*) and yellow birch (*Betula* alleghaniensis) are common on higher ridges with more fertile soils. Softwood stands commonly made up of red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), and eastern hemlock (*Tsuga* Canadensis) are found mostly on sites with poorer soils (Zelazny et al. 1997).

Determining Community Planning Priorities

While SNB and the GFERG had broad objectives for the Watershed Projects, we felt that it was critical to determine the major concerns of local residents. If the project is to succeed, it is important for woodlot owners to understand that watershed planning is to be *directed* by them after the initial catalyst was provided.

All woodlot owners from within the boundaries of the watersheds were invited to initial meetings the purpose of which was to describe our broad objectives and to determine community goals. We provided a brief description of the importance of landscape-level planning to watersheds. For the Washademaoak watershed we drew upon past public participation exercises conducted in the area. Initial meetings were used to confirm this information. In the Pollett River watershed where no previous information existed, we facilitated small group discussions to determine major community concerns. Communities in both watersheds expressed very similar objectives, which were focused on water quality, wildlife habitat, job retention and aesthetics (Table 1).

Table 1. Objectives expressed by community residents of project watersheds.

Washademoak watershed	Pollett River watershed
Protect fish and wildlife	Protect wildlife habitat
Protect important habitats: deer wintering habitats	Limit large cuts and plantations
Establish presence of rare and endangered species	Protect clean water
Protect water quality: steep slopes and sensitive soils	Increase employment
	Protect scenery

Note: Objectives are not listed in order of priority

Landscape Ecological Planning

We developed a set of what we considered 'landscape scale ecological features'. These features are primarily based on *Forest Management Guidelines to Protect Native Biodiversity in the Fundy Model Forest* – a set of recommendations developed in 1997 by the GFERG for the Fundy Model Forest (Woodley and Forbes 1997). These landscape ecological features included old forest of critical forest community types, large contiguous forest patches, wildlife corridors, watercourse buffers, and sensitive soils. However, we included features that were not explicitly included in the guidelines that had particular relevance to the Washademoak community (deer wintering areas, sensitive soils and steep slopes). Our rationale for inclusion of each component in the landscape level plan were as follows:

Mature and Overmature Forest

Due to ever-increasing societal demand for forest products, mature and overmature forest is under intensifying harvest pressure (MacDougall and Loo 1996). If species that

depend upon old forest are to be conserved it is critical that amounts of these older age classes are maintained. We mapped all mature forest of four critical community groups that exist in the Washademoak and Pollett River watersheds.

Critical Forest Community Groups

(a) Tolerant hardwood (TH),

(b) Eastern cedar (EC),

(c) Tolerant mixedwood (MXWD), and

(d) Pine (PI)

The community groups listed above are under some degree of threat due to the poor regenerative capacities of their component tree species. In harvest types that favour complete canopy removal most of the shade-tolerant species do not regenerate effectively. By actively planning for these community groups by encouraging more appropriate harvest types, it may be possible to maintain sustainable amounts of each type within the watershed.

Large Patches

Certain species require large areas of mature forest (they are "area sensitive") (Robbins et al. 1989). As large patches of mature forest are fragmented by roads, urban development or timber harvesting, an appropriate forest type may decline in habitat quality for many species. For example, research has shown that many species of forest birds decline in abundance and reproductive success in small patches (Robinson et al. 1995). For this reason, we mapped all forest patches in the watershed that are greater the hypothesized minimum size requirements of native bird species (Beaudette 2000).

Deer Winter Habitat (DWH)

Research in the Fundy Model Forest has shown that the mild winters of the area usually allow deer to move freely. However in winters with deep snow deer movement may be limited. Large areas of coniferous and mixedwood forest serve as refuges with shallower snow depths (Sabine et al. 2001). Cedar and eastern hemlock areas are particularly valuable for DWH as these tree species also serve as food. The habitat areas were mapped by applying the yield curves used in SNB's forest development analysis to the spatial forest inventory, applying the age class distribution to the forest stands and then applying the New Brunswick Department of Natural Resources' habitat definitions to each of these curves. This allowed SNB to select the stands that currently qualify as deer winter habitat and map them spatially using the GIS.

Wildlife Corridors

The GFERG has recommended that strategically placed corridors are one possible solution to the risks caused by fragmentation (Woodley and Forbes 1997). Corridors are strips of native vegetation that 'connect' patches of habitat. These can serve many purposes such as: increasing gene flow by allowing interaction among wildlife in separate patches, providing seasonal migration routes, and providing paths for dispersing young in search of prospective habitat (Forman 1998). We adopted the present GFERG guideline for corridors of 300-meter width. Only areas with *existing* mature forest in the configuration necessary to connect large mature patches were delineated.

Watercourse Buffers

Forest harvest activities have the potential to significantly affect the quality and quantity of freshwater systems. The proximity and extent of harvests near waterways can alter the

amount of coarse woody debris, water temperature, siltation levels, nutrient availability, and stream hydrology. In turn, these abiotic factors have been shown to affect the abundance and functions of fish, amphibians, invertebrates, and vegetation (Woodley and Forbes 1997). For the purposes of this plan we simply identified all areas that fall within 30m of watercourses. However, in areas with steep slopes, buffers were mapped from the top of the slope. As individual plans are developed it will be necessary to tailor buffer widths to site-level considerations such as slope, soil type and forest cover type.

Sensitive Soils and Steep Slopes

These are two of the most critical factors to maintaining water quality in the Washademoak watershed. At a coarse-level we identified all steep slopes with the use of digital elevation maps. "Steep" was defined in two categories: (1) 20-30% (2) >30%. The majority of the soil types in the Washademoak watershed can be considered "sensitive" due to high erosive capacity.

Results

Watershed Plans

All of the ecological features described above were mapped for both watersheds using SNB's Geographic Information System, which is based upon 1993 photo-interpreted data. In so doing, we developed landscape level watershed management plans. Of the 20,617 ha land occupied by small private woodlots in the Washademoak, watershed 11,757 ha were categorized as one of our defined landscape ecological features (Table 2). In the Pollett River, of 9433 ha of 15,998 ha private woodlots was classified as important to the landscape ecology of the watershed (Fig. 3). No corridors were

identified in this watershed because of the inherent connectivity of mature forest that had already been identified as landscape ecological features.

Table 2. Areas (ha) of landscape ecological features delineated in the Washademoak Watershed Plan

Ecological Feature	**Classification**	**Pollett River Area (ha)**	**Washademoak Area (ha)**
Total Watershed (all land tenures)		31,369	36,817
	30% +	1271	176
Forest Dev. Stage	Mature	13,141	8219
Forest Community Group	Tolerant hardwood	1033	792
	Tolerant mixedwood	2146	4418
	Eastern Cedar	0	486
	Pine	2340	1019
	Spruce/ Fir	2203	4036
	Black spruce	132	946
	Balsam fir	908	1948
Gap Sites		305	77
Deer Winter Habitat	Moderate	785	1273
	Severe	1036	199
Large Patches	Tolerant hardwood	871	156
	Tolerant mixedwood	352	1570
	Eastern Cedar	0	58
	Pine	133	126
Corridors		NA	1173

Note: Some forest stands have been counted as more than one ecological feature. Unless otherwise specified, data are for private woodlots only.

Upon completion of watershed plans, we organized a second meeting in each watershed, the purpose of which was to present our results, to solicit community

feedback, and to determine the steps toward implementation. Our results were presented as a 'tentative' ecological plan. It was important to emphasize three realities to landowners. First, that the mapped areas were derived from GIS information only and therefore might be altered as 'ground-truthed' information became available. Second, many of the ecological areas that were mapped could be maintained with 'special management' rather than 'strict protection' approaches. For instance selection cutting is considered appropriate in wildlife corridors, stream buffers and deer wintering areas. Third, and most importantly, we emphasized that participation in implementing the plan was strictly voluntary.

Several incentives are provided to woodlot owners who are willing to participate in the planning process by incorporating the landscape features into woodlot plans. (1) SNB has recently developed a "Working Woodlot Program"(WWP). This program encourages woodlot owners to adopt woodlot management plans. Woodlot owners are provided with a woodlot management plan and updates on an annual basis. Members of the Program are offered a premium on each cord or wood sold to the Coop. We offered membership in the WWP to owners interested in the watershed projects. (2) Inexpensive woodlot management plans are provided to woodlot owners who agree to include landscape-level habitat objectives in their woodlot plans. In 2001 we received funding from the Fundy Model Forest and the Kendall Foundation (Boston Mass.) to enable us to provide this service. (3) To woodlot owners interested solely in non-timber values, we have suggested the possibility of conservation easements. These enable income tax breaks for woodlot owners with land considered to be ecologically unique (Nature Trust

of New Brunswick 2000). (New Brunswick developed conservation easement legislation in 2000).

Data and GIS layers that make up the watershed management plans were entered into SNB's GIS system. The plans are now available for all woodlot owners from the Washademoak and Pollett river watersheds. This incorporation of the plan into SNB's GIS system allows public access to the information, and easy use of spatial data by SNB technicians, who at the request of landowners, will use this information in the development and update of woodlot management plans for the watersheds.

Discussion

While the both watershed plans were well received by woodlot owners who attended the second meetings, several challenges must be faced before broad-scale implementation is possible. First, it will be crucial to solicit the participation of a larger number of woodlot owners. In both meetings it was clear that most attending woodlot owners already held a strong conservation ethic. In the future it will be important to involve woodlot owners who are less oriented toward conservation goals, even if it involves more actively soliciting their involvement. Second, self-perpetuating watershed committees need to be established. It is envisaged that communities will engage in a process of continual planning (adaptive management) even in the absence of SNB and the GFERG. SNB and GFERG will act as voluntary consultants for the watershed communities.

The involvement of New Brunswick provincial government and the local industrial timber company (J.D. Irving) would also increase the likelihood of project

success. Existing spatial plans for Crown land could be integrated with the plan for the woodlot portion of the watershed. This would increase options for large patch and corridor management. Further, it might increase the likelihood of woodlot owner participation if the provincial government was seen to be 'doing their part'.

While the challenges to developing an integrated plan on private woodlots for landscape-level biodiversity are many, the initial phase of this project indicates that they are not insurmountable. The right combination of incentives and education will allow the achievement of landscape plans based on ecological rather than political boundaries.

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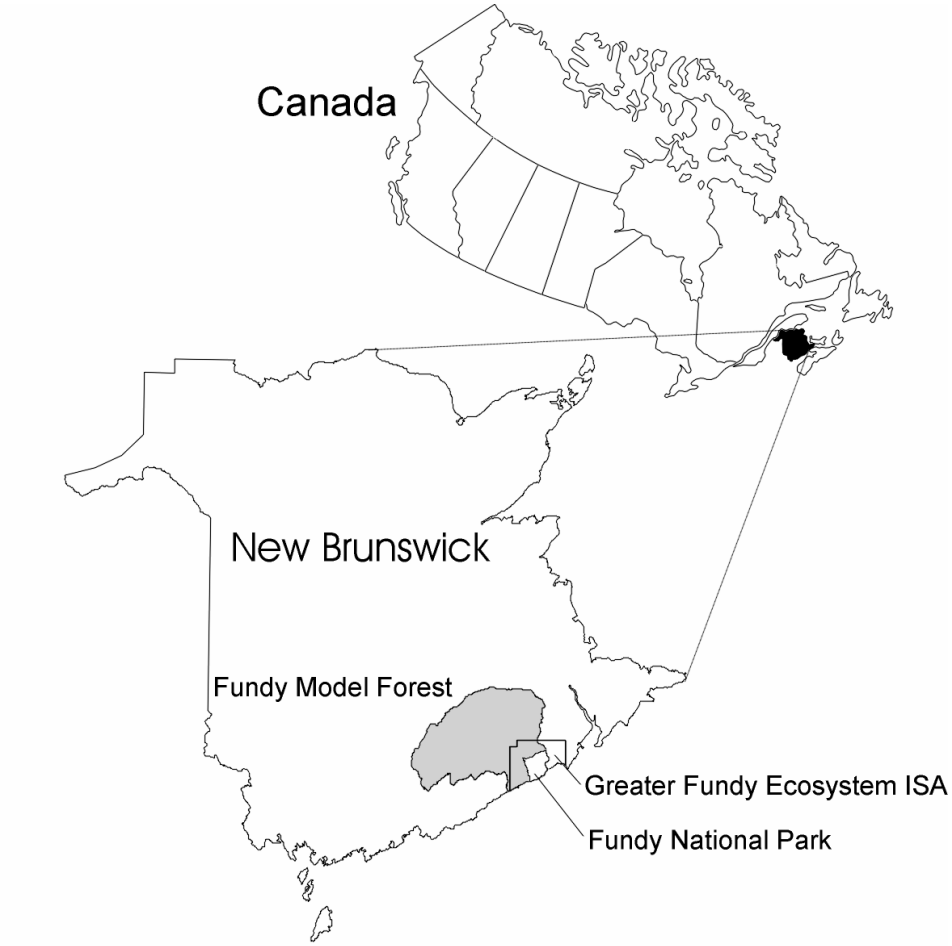

Fig. 1 Location of the Fundy Model Forest and the Greater Fundy Ecosystem Intensive Study Area (ISA) in southern New Brunswick.