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Evaluation of the “Echo” System and Scenario Planning for Sustainable Forest Management

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EXECUTIVE SUMMARY

The objective of this project was to evaluate a particular suite of analytical forest planning models, combined with scenario planning techniques, applied in a unique University/Aboriginal co-management environment. In the course of this research, the investigators developed local-level Criteria and Indicators (C&I) of sustainability, based upon the values and needs of the members of the Tl'azt'en Nation. Extensive time was spent in the communities of Tache Village, Binche Village, and Fort St. James by the research team, and numerous focus groups and workshops were held to solicit community input to defining sustainability criteria from the community perspective. Special access to Traditional Use Study (TUS) and other information was granted to the investigators by Tl'azt'en Nation. Content analysis was conducted for purposes of extracting relevant natural history, historical resource management, and community values information. This information remains the confidential property of Tl'azt'en Nation. Local-level C&I were developed which were designed to be shared with resource management professionals to facilitate resource planning, while protecting confidential archaeological, cultural, and intellectual property information. Based upon requests from the community, additional research was conducted on the identification and analysis of information sources, which can be used to characterize historical forest conditions.

After data collection and analysis was complete, a presentation by 4th-year Natural Resource Management students from UNBC introduced the community to the concept of scenario planning using a C&I approach at a well-attended public meeting. Basic resource management issues on JPRF were introduced and discussed at this time. Two subsequent meetings were held in Tache Village in which the investigators reported their results to the community and discussed the C&I results. By using C&I, scenario planning techniques, and an advanced analytical forest planning tool, the investigators and the Forest Manager were able to engage community members in constructive dialogue regarding important resource management and participatory planning issues.

Consensus was reached at community meetings held in Tache Village and Fort St. James that the analytical planning tools and approaches which were employed and evaluated in this project were valuable, and can be useful in facilitating community involvement in sustainable forest management planning. It was the investigator's observation that some elements of the community, particularly the elders, seemed somewhat intimidated by the technology, although they readily understood the planning concepts involved. A repeated observation throughout the research was that the use of technical terminology and jargon was perceived by the community members as impeding communication of important ideas. Elders seemed particularly pleased that their concerns were being listened to, and that specific measures were being developed to help them understand the issues and participate in the planning process. Youth and individuals with higher education and technical background were most comfortable with the computer modeling approach.

ACKNOWLEDGEMENTS

This research would not have been possible without the active participation and support of Tl’azt’en Nation members from the villages of Tache and Binche. Extremely valuable support was provided by the Tl’azt’en Nation Education Department, Natural Resources Department, Treaty Office, Chief, and Band Council. This research was conducted as the inaugural research project on the John Prince Research Forest, co-managed by Tl’azt’en Nation and the University of Northern British Columbia. Susan Grainger, RPF, and her staff provided invaluable assistance and support for this research.

INTRODUCTION

Generally, First Nations have not been a part of resource management decision-making processes in Canada (Bombay 1992, Notzke 1994, Sherry 1999). This has lead to conflict between native and non-native use and management of forest resources, particularly in British Columbia. Existing approaches to participatory planning, such as multi-stakeholder processes, do not serve the needs of Aboriginal communities (NAFA 1997), therefore appropriate methods and tools for integrating Aboriginal community interests at all levels of forest management planning are needed. Meaningful involvement reduces conflict, preserves traditional ties to the land and promotes the social, economic, and ecological sustainability of forest ecosystems.

The purpose of this research was to document the process of integrating Aboriginal values into a model-based scenario planning approach (Dewhurst et al. 1999), and to assess whether advanced analytical planning approaches could facilitate Aboriginal community participation in resource management decision making. This was accomplished in collaboration with Tl'azt'en Nation using the co-managed John Prince Research Forest (JPRF) in central interior British Columbia as a case study. This project, as originally proposed, was comprised of three research objectives:

1) Evaluation of the "Echo" planning system, a product of the collaborative research conducted between the MacGregor Model Forest Association (MMFA) and UNBC, based largely upon technical criteria,

2) Application of the "Echo" system to the integration of Tl'azt'en values and perspectives into sustainable forest management planning for the JPRF, and

3) Evaluation of the effectiveness of the Echo-assisted scenario planning approach to achieving meaningful participation of Tl'azt'en community members in sustainable forest management.

Research and analysis for this project was organized along four thematic lines. The first component of the research involved calibration of the "Echo" planning system used in the research. The development of local-level C&I of sustainability based upon interviews, focus groups, and analysis of archival information followed this. The third theme was the identification and assessment of information sources, which could be used to develop C&I for the characterization of "natural" forest conditions, for purposes of setting management goals and assess alternative management scenarios. The fourth thematic area involved using and assessing the "Echo" planning system and related tools to incorporate these C&I, and facilitate the development of Sustainable Forest Management (SFM) plans with active Aboriginal community involvement.

The newly established John Prince Research Forest (JPRF) near Fort St James, British Columbia, provided a unique environment for conducting this research, due to it's Aboriginal co-management mandate, management history, and extensive historical associations between Aboriginal people and the land.

RESEARCH METHODOLOGY, DATA COLLECTION, AND ANALYSIS

Project Theme 1: "Echo" Technical Design and Application

The Echo planning system was calibrated using the JPRF landscape. In addition to technically evaluating the models, this permitted the investigators to prepare and refine GIS and other necessary input data and to train a graduate student (Melanie Karjala) on the function and application of the system. As proposed, this planning system had the following general design characteristics:

1) A 3-level hierarchical design using non-integer goal programming at the strategic and tactical planning levels, and a stochastic heuristic optimization technique based on the simulated annealing algorithm at the operational level. The strategic model employs a Model II treatment-scheduling approach, while the tactical level employs a Model I approach. The operational planning model is structured similarly to a Model I formulation;
2) A strata-based approach to landscape representation at all levels; the strata defined by systematically collapsing areas of similar habitat type, cover type, management options, and spatial considerations. Progressive refinement of spatial, temporal, and entity representation takes place between planning levels;
3) The capability to plan for a regulated forest simultaneously managed for multiple objectives, while supporting maintenance and restoration of gross forest structural attributes. This includes the management of conversions between cover types and management regimes based on habitat types and geographical location, explicit incorporation of patch (e.g. harvest unit) size distributions and adjacency restrictions, and the estimation of sustainable harvest levels which incorporate spatial context and additional non-timber management objectives;
4) A design based upon the presumption that the system will be used in an interactive and adaptive fashion, with the objective of developing strategies which balance competing management objectives based on priorities established in a participatory planning process;
5) An objective-driven, simulation-through-optimization approach is employed, using a management science model to simulate the evolution of forest conditions under management, with explicit mathematical linkages between planning levels based on the systematic exchange of forest state and generalized management goals between levels; and
6) The use of advanced mathematical programming matrix-generation techniques based on object-oriented programming methods.

In both the Strategic planning and Tactical planning models, non-preemptive linear goal programming techniques are combined with mathematical simulation to find optimal policies for achieving multiple simultaneous management objectives over space and time. Both planning models perform their analysis using management strata. For this analysis, management strata were developed using the following primary criteria for stratification:

- Analysis Unit (AU) composition, based on the AU's used in the *Prince George TSA Timber Supply Analysis* (MOF 1995) as they pertain to the Fort St. James District

- Membership in a Particular Resource Management Zone (RMZ), the RMZ's having been previously define by the Forest Manager based on multiple resource criteria

In Echo, strata are composed of multiple age classes, so particular management strata as used in this analysis would be composed of all of the area within a particular RMZ, which is of a particular AU. In this analysis, Strategic planning focuses on general trends in AU distribution and age class composition over long periods of time. Tactical planning looks at specific resource values and their distribution over space and time.

Input Files and Management Indicators

In order to provide the requisite flexibility in allowing users to address specific resource values in Tactical planning, an adaptable yield table format (the Multi-indicator Yield table, or MYT) has been defined. MYT files contain information on the states and yields of individual strata at various ages. Each yield table within an MYT file refers to a single potential stratum management option. For example, the treatment could consist of a thinning at age 3, an overstory removal at age 6, or a pre-commercial thinning at age 4. Or if the stratum is uneven-aged, the stratum treatment variable could represent an uneven-aged treatment, which would be accomplished every period. Other data in the yield table would reflect the consequences of these treatments with respect to the indicators defined by the analyst.

An important feature of MYTs is their ability to incorporate a wide range of potential resource information, since they describe additional management indicators beyond those considered in the Strategic Planning Model. This additional material includes information on the development of volume, forest structure, stand density, management costs and revenues, and volume yields by product class. As well, users can define their own additional indicators. All MYT indicators, whether user-defined or not, are related to the age of the strata in particular periods of the analysis under alternative management and trajectories. Specific resource values defined in the MYT for this analysis included seral stage distribution, AU distribution, a visual disturbance estimator based on Visual Quality Objective (VQO) criteria, and harvest volumes in cubic meters per planning period.

The Planning Structure

In Echo, management planning and harvest scheduling is based on a planning horizon, which is composed of planning periods. The planning horizon is the length of time (from decades to centuries) considered in a particular analysis. The planning horizon is divided into planning periods, which are the time intervals tracked by the model. Up to 20 planning periods are supported in the Strategic-planning model, and up to 4 periods in the Tactical-planning model. The user may redefine the length of each planning period (in years) as necessary.

For this analysis, the length of each planning period was established 20 years, a 15 period (300-year) Strategic planning horizon is used, with a 4 period (80 year) Tactical planning horizon.

The Strategic Planning Model

The Strategic-planning model was used for long-term (100-500 year) planning. Strategic planning is oriented towards developing a long-term management strategy for the forest, designed to achieve a desired future forest condition - the "legacy" forest. The legacy forest is the forest left behind to future generations as a result of cumulative management activity, and may be used as a measure of the sustainability and cumulative effects of forest management practices and strategies (Wood and Dewhurst 1998). The Strategic-planning model is based upon a Model-II formulation (Davis and Johnson 1992), using goal-programming techniques, and supports analysis of both even-aged and uneven aged silvicultural systems. For this technical analysis, only even-aged silvicultural systems are included, for purposes of comparability with previous analyses conducted by the Ministry of Forests. It is anticipated that significant future effort will be devoted to exploiting the potential for uneven-aged management on the JPRF.

In the Echo Strategic planning model, a harvest and treatment schedule is developed using mathematical optimization, with the user responsible for setting management goals and adjusting preference weights as necessary to achieve the desired balance of resource values. The Strategic-planning model supports simulation of up to 3 harvest entries per management strata over the planning horizon. The mathematical objective of the Strategic-planning model is to find the optimal feasible solution, which minimizes the following function:

$$\sum_{i=1}^{g}(((P_i^+)(D_i^+))+((P_i^-)(D_i^-)))$$

Where:

g = the number of goals in the analysis

D^+_i= the deviation above goal *i* in the legacy forest

D^-_i = the deviation below goal *i* in the legacy forest

P^+_i = the preference weight associated with deviation above goal *i* in the legacy forest

P^-_i = the preference weight associated with deviation below goal *i* in the legacy forest

The primary function of the Strategic-planning model is to develop a strategic plan to achieve a designated legacy forest condition by the end of the Strategic-planning horizon. A characteristic of Model II formulations such as that used in Strategic planning is that all objectives are set with respect to the legacy forest (e.g. 300 years). The internal mathematics of the model track the effects of harvest entries, re-entries, and conversions on the state of the legacy forest. The Strategic-planning model attempts to achieve area regulation of harvest levels and managing towards achieving the desired legacy forests state specified by the user. The outputs from the Strategic-planning model include a non-spatial harvest and treatment schedule for the entire strategic planning horizon, the AU and age class distribution of the legacy forest, and the area harvested by AU by period. The Strategic planning model has the additional feature of allowing for more sophisticated planning and analysis which includes management of site type/AU relationships over time. Due to the small size of the JPRF, the limited detailed information available, and the interim nature of this analysis this feature was not exploited for purposes of this analysis.

The Tactical Planning Model

The Tactical-planning model was used to develop a more detailed integrated resource management plan for the first few periods of the planning horizon. This includes volume regulation of timber harvest levels, as well as analyst-defined management indicators such as seral stage, beetle risk, and visual disturbance. To accomplish this, the Strategic planning and Tactical planning models are analytically linked, such that the strategic planning results are used as the basis for subsequent Tactical planning model analyses. This ensures that the 80-year integrated resource management plan is compatible with the strategic strategy for achieving a defined legacy forest condition. The mathematical objective of the Tactical-planning model is to find the optimal feasible solution, which minimizes the following function:

$$\sum_{i=1}^{g}\sum_{j=1}^{p}(((P_{ij}^{+})(D_{ij}^{+}))+((P_{ij}^{-})(D_{ij}^{-})))$$

where:

g = the number of goals in the analysis
p = the number of periods in the analysis
D^{+}_{ij}= the deviation above goal *i* in period *j*
D^{-}_{ij} = the deviation below goal *i* in period *j*
P^{+}_{ij} = the preference weight associated with deviation above goal *i* in period *j*
P^{-}_{ij} = the preference weight associated with deviation below goal *i* in period *j*

Linkage Between the Strategic and Tactical Planning Models

Once a Strategic-planning run has been developed and accepted, the next step in Echo analysis is to link the Strategic planning results with the Tactical-planning model. This is accomplished automatically by calculating, based upon the scheduled harvest entries and treatments generated by the Strategic planning model, what state the forest should be in at the end of the Tactical planning horizon if management is "on trajectory" towards achieving the legacy forest targets. This future state of the forest is described by factors such as AU composition, age class distribution, etc. This calculated state of the forest is automatically installed as management goals for the Tactical-planning model for the end of the Tactical-planning horizon. This establishes the state of the landscape, which must be achieved by the end of the Tactical-planning horizon if the path towards the legacy forest is to be achieved.

Additional management goals may now be specified by the analyst, including management goals for the user-defined indicators. Using the facilities of the Tactical-planning model, the feasibility of achieving near term management objectives for specific management indicators can be assessed, and tradeoffs between near-term objectives and the achievement of the legacy for can be explored. The Tactical model also provides the harvest volume and economic information for the tactical planning horizon.

Application of JPRF Results

A modified scenario planning approach was employed to evaluate these models through the development of a 5-year management-working plan for the JPRF[1]. These results were accepted for implementation as the basis of the first legal management plan for the JPRF by the Forest Manager, the JPRF management advisory board, Tl'azt'en Nation, and the BC Ministry of Forests. Emphasis in this exercise was on using British Columbia Ministry of Forests (MoF) mandated indicators and criteria, combined with a spatial zoning scheme using Resource Management Zones (RMZs) to reflect identified issues and concerns on the landscape including wildlife, forest health, recreation, and Aboriginal issues. The combination of the Strategic and Tactical planning models allowed for a 300-year strategic management vision to be reconciled with specific RMZ management targets during the first 80 years. These models proved capable of representing most of the management indicators and criteria which are required by the MoF, and reconciling achievement of legislatively mandated management objectives with local resource management plans.

The Operational Planning Model

The Operational planning model, to be developed primarily by the MMFA, was critical for engaging the Tl'azt'en community in scenario planning on the JPRF for the following phase of this project. This model was to have several key design features to facilitate this participation:

- Scheduling of management actions, and the mapping of indicator outcomes, to the level of individual harvest blocks or sub-blocks. This is critical for being able to effectively visualize the near- and long-term consequences of proposed courses of action.
- Real-time feedback on the tradeoffs between competing resource management objectives. While the Strategic and Tactical models provide analysts with some sense of these tradeoffs, these models require many time-consuming iterations and are not suitable for facilitating public involvement or understanding.
- The Ability to reconcile long-term harvest schedules with proposed near-term operational decisions. Development plans and silvicultural prescriptions are very site-specific, and the ability to show how these decisions fit into the "big picture" is critical to building understanding and consensus behind operational decisions as a means of achieving long-term objectives.

1 JPRF. 1999. John Prince Research Forest Management Plan, 1999-2000. Unpublished.

Unfortunately, the Operational model was not made available to the investigators, and therefore could not be evaluated as part of this project. The Strategic and Tactical models were inadequate to facilitate meaningful community participation in the planning process for two reasons:

1) The abstract, quantitative (e.g. charts, graphs, and numbers) results from the Strategic and Tactical planning models, although sufficient for complying with MoF planning requirements, would present a barrier to communicating resource values with most Tl'azt'en members, particularly elders.

2) These models lacked the necessary speed and interactivity to effectively convey important management concepts to community members.

Originally, the promised delivery date for Operational planning model software was summer of 1999, and with the failure to deliver that software, the collaboration between the project investigators and the MMFA effectively ended. In order to address the identified gaps in the Echo architecture while fulfilling the commitments made to Tl'azt'en Nation, the JPRF, and the project, Dr Dewhurst undertook to create a new planning model providing the essential functional elements of the missing Operational planning model. This effort began in the summer of 2000 under the project name "Lurch", and was completed successfully in May of 2001. This initiative required approximately 1000 hours of uncompensated time from Dr Dewhurst.

The Lurch System

Like the planned Operational Echo planning model, the Lurch Software is based on stochastic-heuristic optimization techniques, and a simulation-through optimization approach. The mathematical formulation used in the Lurch is identical to that used in the Echo Tactical planning model, however the actual optimization of potential management solutions is conducted using a "greedy" algorithm (see Kruskal, 1956). The Lurch architecture obviates the need for the Strategic and Tactical-planning components of the "Echo" system, however, as it combines the functionality of the Echo Strategic, Tactical, and Operational planning models into a single integrated system. This system provides:

1) Harvest block-specific harvest scheduling;
2) Support for single or multiple entries for each block within the planning horizon;
3) Support for both even-aged and uneven-aged management systems; and
4) Utilizes the same data schema and file formats as the "Echo" system.

Lurch has major advantages over the "Echo" system in that it is highly graphical and interactive, and provides real-time feedback to users regarding the spatial and temporal implications of alternative management goals and policies. The facilities provided for the user-definition of management indicators allows users to set management goals and assess the spatial and temporal implications of alternative management policies relative to measures which they have defined[2]. This provides excellent analytical support for the scenario planning process, allowing for rapid definition and evaluation of alternative management scenarios.

It is important to note that the investigators do not consider the Lurch software to be a "deliverable" under this project, as the development of complex software systems such as this were clearly not in the workplan for this project. Dr Dewhurst undertook the Lurch project on his own initiative, utilizing no SFMN resources. The software will, however, be made available to the public through release under the GNU Public License, simultaneous with publication in appropriate scholarly and technical journals. Preliminary arrangements to this effect have been made with the Intellectual Property Rights Manager at UNBC. Although functionally identical to software developed, but not made available, by the MMFA, Lurch contains no proprietary software, and is free of any intellectual property of the MMFA.

Project Theme 2: Development and Assessment of Local-Level Criteria and Indicators Reflecting Aboriginal Issues and Values

The next phase of the project was to engage community members in co-operative management by generating Tl'azt'en-based scenarios for the JPRF using technical tools to simulate various management alternatives. In order to generate MYT files that reflect a Tl'azt'en forest management perspective, community C&I had to be identified. The process for doing so will be described in three sections:

1) Information gathering and management methods:
    a) The Aboriginal Forest Planning Process (AFPP) framework for eliciting and translating community information into forest management criteria;
    b) Interview and focus group approaches for identifying C&I from Aboriginal participants
2) The use of scenario planning and criteria to represent a Tl'azt'en perspective on SFM;
3) The use of the Lurch model to interface traditional indicators of ecological sustainability with Western scientific indicators of sustainability.

Throughout the investigation, analysis results were summarized and presented to a scenario advisory team (SAT) consisting of 10-15 community members from a cross-section of Tl'azt'en society including administrators, elders, keyoh-holders (traditional land stewards), youth, and educators. The SAT provided feedback, comment and additional information on the interpretation of Tl'azt'en information. This group also selected the scenario topics to be analyzed.

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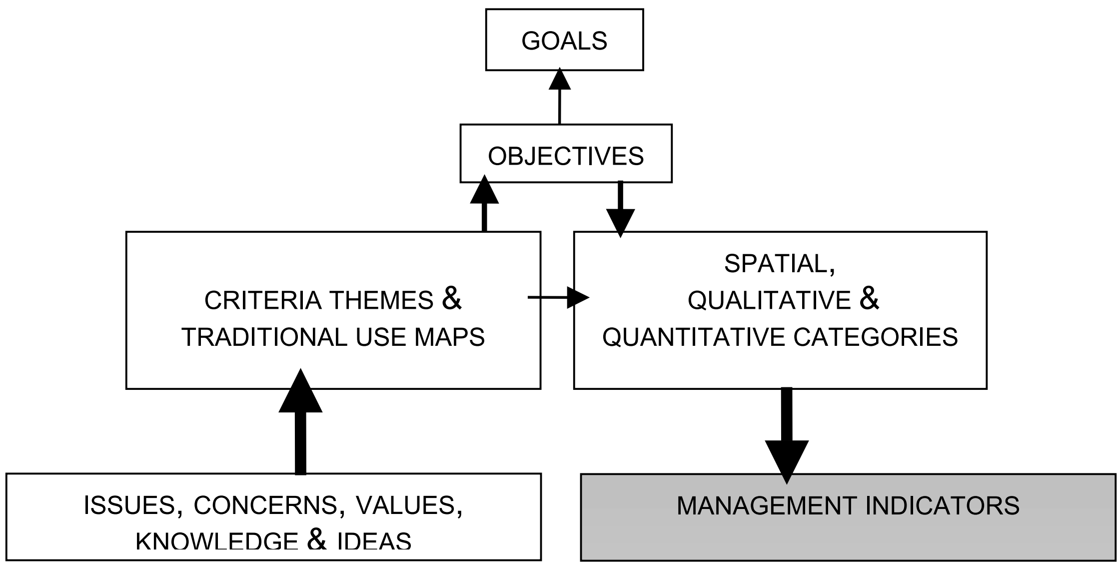
2 From: Dewhurst, S.M. 2001. A methodology for representing criteria and indicators for analytical decision support. In preparation.

Part 1 a): The AFPP framework[3]

The first step in developing community scenarios requires identifying forest values (MacLean et al. 1999), uses, and traditional knowledge. This information forms the basis for understanding the resource from a cultural perspective, developing planning goals, objectives, and criteria, and identifying forest management issues and solutions based on local experiences (Figure 1). Before conducting interviews and focus groups, preliminary information was acquired from existing community archives. The AFPP is the resulting method of selecting, classifying and organizing this information into forest management criteria, and indicators (C&I) for the JPRF.

Figure 1 Flowchart demonstrating the AFPP information management process. Descriptive information is aggregated and categorized to facilitate the development of forest management goals and strategies. The final step of identifying management indicators is shaded because the use of archival sources revealed few indicators.



Tl'azt'en Nation allowed the investigators to access archives stored in their Natural Resource and Administration offices. This information included:

1) *FRBC interviews.* These were a collection of interviews developed for a previous research project of Dr. Booth's examining the Tl'azt'en Nation's Tree Farm License.[4] This

3 From: Karjala, M.K. 2001. Integrating Aboriginal Values into Forest Management Plans on the John Prince Research Forest. MNRES Thesis, University of Northern British Columbia, Prince George, B.C. In preparation, and Karjala, M.K., E. E. Sherry and S.M. Dewhurst. 2001. Criteria and Indicators for Sustainable Forest Planning: A Framework for Recording Aboriginal Resource and Social Values. In preparation.

4 Forest Renewal British Columbia Research Grant. Annie L. Booth, Principal Investigator; Gail Fondahl, Co-Investigator. June 1997-May 1999 ($206,000). Title: Linking Forestry and Community in the Tl'azt'en Nation: Lessons for Aboriginal Forestry. Examines the history and present status of an aboriginal operated industrial forest tenure and efforts to integrate community values and needs into operations.

represented an extensive body of data as a large number of interviews were conducted with elders, Band Council members, individuals who had participated in setting up the TFL, TFL employees and other interested community members. Semi-structured interviews focussed on people's understanding of the history of the TFL and community values and desires reflected in forestry operations. While the focus of this research was on TFL 42, questions were included regarding the JPRF, and this source provided extensive data on community values and perceptions regarding forests and resource management;

2) *Traditional use study (TUS) documents.* This information was collected over the last several years by the Tl'azt'en Nation. The TUS contains interviews with elders to record where activities were conducted within Tl'azt'en traditional territory. The information was documented in map and database form. The project team was fortunate to be allowed access to this data as it represents a rich source of information, and is generally closely guarded by First Nations;

3) *Elders interviews.* These included transcripts of individual interviews and focus groups with elders conducted between 1978 and 1995. Interview questions were not transcribed, but appeared to be semi-structured and open-ended. The subject matter generally involved Aboriginal life before 1950; and

4) *Secondary sources.* including reports and publications on local Aboriginal history, anthropology, and ethnobotany found in the Tl'azt'en natural resources library.

Using these documents, the content analysis was conducted in three stages:

<u>Stage 1: summarization</u>

Each interview transcript was condensed into direct quotations and/or point form notes with a detailed description of the interview source (i.e., interviewer, interviewee, date, location of original copy etc.). Summaries were necessary because the archival sources were not directed specifically at identifying C&I. In the process of reviewing interviews; the investigators sought information that could be equated with possible management objectives and criteria. Three questions were used to guide the analysis:

- What is important to people in this community?
- What are their concerns?
- What ideas emerge as solutions to some of their resource and social problems?

The summarized information included subsistence resource uses and lifestyles; ecological and social change resulting from forest management; and recommendations or expectations for local forest, community and economic development. Traditional knowledge, including management practices, oral histories, legends, and ideologies were also included.

At the end of each summary, the information was condensed further into a table according to criteria themes (e.g., economy, resource and environmental concerns) and more detailed sub-themes (e.g., bush economy, wildlife). For each sub-theme, a statement or description of the value, concern or priority expressed in the interview was included to provide context for the criterion.

<u>Stage 2: compilation</u>

For each archival source, interview summaries were complied into a table according to criteria themes, sub-themes and descriptions. Each entry was labeled with the interviewee's name and transcript number and entries with the same or similar descriptions were grouped together. This table provided a comprehensive list of local needs, issues and concerns; an indication of common values held within the community; and the different perspectives between cohorts within the community.

TUS map data was also assembled at this stage. This information provided the basis for developing location-specific objectives on the JPRF. Four map themes were generated on Mylar: wildlife, hunting and trapping areas; fishing sites; cultural, spiritual and archeological sites; and plant gathering areas.

<u>Stage 3: categorization</u>

To facilitate data management for the analysis, summary information was divided into three C&I categories: spatial, quantitative and qualitative. These categories represent potential approaches for addressing forest management concerns based on the particular feature of the planning system.

1) *Spatial:* Values associated with a static location were addressed by segmenting the landscape into emphasis areas, and developing appropriate forest management options for achieving particular resource objectives. Consequently, it was necessary to isolate criteria associated with a particular place or feature that could be addressed using spatial indicators. These values were addressed through zoning and buffering.

Zoning involves partitioning the landscape into units that are reserved for a particular purpose. Using the four TUS Mylar maps and maps showing topographic and hydrologic features on the JPRF, resource management zones (RMZs) were delineated based on a combination of traditional use and natural boundaries (e.g., contour lines, streams, etc.). Each zone was assigned a management emphasis based on information revealed in community interviews and the TUS database.

Buffers are areas that are designated to separate sensitive, location-specific values from potentially damaging activities. Spiritual and archeological sites and waterbodies such as streams, lakes, and wetlands that required protection from forest management activities were addressed with protective buffers.

Spatial C&I are an important aspect of assessing plan sustainability. For example the criterion concerning water quality would be indicated by the amount of area protected in riparian buffers. Criteria that require the conservation of subsistence and traditional education opportunities are evaluated based on the percentage of forest zoned with a traditional use emphasis such as hunting or plant gathering.

2) *Quantitative:* Quantitative C&I relate to biophysical forest conditions, practices or yields such as leading tree species and ageclass distributions, habitat types, silvicultural systems and harvest volumes. These can be used to monitor or set targets for particular values. A broad range of community criteria can be addressed through forest conditions including habitat for key wildlife and plant species; yields such as forestry-related employment and training opportunities; or practices such as the use of lower impact silvicultural systems.

3) *Qualitative:* Qualitative C&I include traditional worldviews, philosophies, ethics, beliefs and rules of proper conduct on the land. Assessing qualitative criteria relies on experiential knowledge that uses intuitive and observational skills to assess sustainability. Qualitative criteria can also be address through operational level policies and guidelines.

Features of the AFPP approach

Archival sources proved to be an excellent approach to eliciting community information for the following reasons:

- Most of the major community criteria for sustainability (forest and community) were identified using archives. The archives provided a comprehensive list of community values relating to the forest resource and particularly the land base in question.
- Input from a large number of community members was attained with minimal time and cost to the community and to the research project.
- Important background information was provided, enhancing the investigators' knowledge, sensitivity, awareness, and appreciation for the Tl'azt'en people, their culture, history, and lifestyles, improving the researchers' ability to understand and articulate the community's primary concerns, needs, values and their underlying rationales.
- Identification of key community members for further interviews, knowledge gaps, and guidance for additional interview questions.
- The tabular format was easily understood, and transparent (i.e., it was obvious that the results were based on community information). Several SAT participants were able to immediately recognize key community values recorded from the archival sources.
- The framework facilitated the compilation and interpretation of the archival data, providing insights into similarities and differences among cohorts within the community.

- The process improved cross-cultural understanding of community needs, expectations and observations regarding forest management.

Implications for management and research

The AFPP framework was designed to address two major issues in collaborative forest management: confidentiality and transparency. Typically, traditional knowledge is treated as sensitive information and is protected from exploitation. This creates barriers for developing forest management strategies that address the needs of Aboriginal communities. The use of forest management C&I might provide a format for codifying this information, with enough detail to develop landscape level strategies.

Transparency is a primary concern when developing any participatory planning process. Enabling participants to trace the outcomes of the planning process is particularly important when cultural information is being interpreted and re-organized from archival sources. Openness enhances social capital between the community and decision-makers by building relationships based on trust.

AFPP is not a tool for researchers and non-Aboriginal decision-makers to gain access to community archives. The co-management circumstances under which this framework was developed is unique. Ideally, Aboriginal communities should develop the capacity to adopt or develop their own method of communicating their knowledge, uses and values, if they so choose. The AFPP provides a starting point for doing so.

Part 1 b): Interview Methodologies

Additional interviews and focus groups were conducted explicitly on the JPRF. This allowed the project team to validate the results of the AFPP analysis and afforded an opportunity to solicit additional information.

Interviews were conducted with JPRF keyoh-holders, the SAT members, elders, young people, and other interested community members. A focus group was held with young men aged 17-25, and a second focus group was held with young women in a similar age group. This was done to ensure this age group's perceptions were explicitly identified and incorporated. A series of focus groups were also held with community elders, allowing different elders to attend as they could, and providing them with an opportunity for reflection before returning to again participate. Furthermore, elders need repeated opportunities to fully tell their stories and perceptions. Additional interviews were conducted with community members including those interested in forestry issues, recreational and tourism development opportunities, and others who expressed an interest in the JPRF.

A key aspect of these interviews and focus groups were the use of a map to allow participants to correlate information on what and where traditional activities take/took place on the research forest specifically. This technique was adapted by our Tl'azt'en collaborators from the methodologies used for the Tl'azt'en traditional use study. People sketched out activity locations and areas of concern allowing us to collect data on general values verbally, and to identify specific locations of concern within the JPRF boundaries. Information collected on uses included the gathering of medicinal and sacred plants, hunting and fishing locations, wildlife habitat, traplines, berry picking areas, sacred sites, archaeological sites, traditional use sites, and potential recreational sites.

This information was transcribed and the transcriptions underwent content analysis using the AFPP framework. The maps were also collated and the information incorporated into the landscape-zoning scheme.

Implications for Management and Research

Ultimately, we found that the information requirements of the model's input data (i.e., MYT and map files) necessitated a combination of interview techniques. Both the map-interview approach and the open-ended questioning approach had features that addressed these specific information needs.

The map-interview technique was extremely effective for identifying spatial criteria. Acquiring good spatial information required conducting these interviews carefully. The following are suggestions for successfully carrying out this approach:

- Maps should be of a consistent scale for every interview;
- If mylars are used, record the map scale on the mylar;
- Clearly mark the values on the map, and digitise the information into a GIS while the interview is still "fresh";
- For transcripts, be sure to verbally describe the locations of values using names of known features.

Despite its strengths, this method was not effective for identifying quantitative and qualitative criteria, as the map distracted the interviewee away from expressing general forest values and traditional knowledge.

Open-ended questioning provided the most valuable information for quantitative and qualitative criteria. Permitting participants, particularly elders, to express their views through stories, oral histories, personal experiences and traditional knowledge resulted in a comprehensive and profound description of Tl'azt'en values.

Neither interview approach allowed the research team to adequately identify quantitative indicators (Figure 1). Two field excursions with elders demonstrated that the participants could better express these types of detailed aspects of their knowledge through example. Although we did not have the opportunity pursue this avenue, the field excursion approach should be further explored and documented in future projects. Studies on ethnobotany, traditional wildlife management etc., would also provide valuable sources for identifying community-defined indicators and would contribute to documenting traditional knowledge beyond historical land use.

Part 2: A Tl'azt'en Perspective on SFM[5]

Using the AFPP framework, Tl'azt'en values were grouped into four criteria themes and eighteen sub-themes. Shown in Table 1, these criteria outline the spectrum of values, areas of concerns, ideologies and priorities that Tl'azt'en community members associate with the forest.

Table 1. Tl'azt'en criteria for SFM

Criteria themes	Criteria sub-themes
1. Human Factors	1.1 Education
	1.2 Community
	1.3 Employment
2. Economics	2.1 Economic development
	2.2 Bush Economy
3. Land Management	3.1 Current Approach
	3.1 Alternative Approach
	3.3 Traditional Approach/Philosophy
	3.4 Legacy
	3.5 Knowledge/Research
	3.6 Communication
4. Resource/Environmental Concerns	4.1 Wildlife
	4.2 Fish
	4.3 Trees & Plants
	4.4 Access
	4.5 Water Quality
	4.6 Forest Health
	4.7 Climate

Landscape zoning

Many of the criteria listed above can be associated with place values on the JPRF landscape. Human places and natural features such as hunting areas, spiritual or recreational sites, and wetlands can be identified, delineated and appropriate treatments applied to realize objectives associated with both human and ecological uses, functions and values. JPRF was divided into resource management zones (RMZs) that represent Tl'azt'en traditional, cultural, historical and economic forest values. The Tl'azt'en RMZ scheme results in a considerable amount of the forest being excluded from timber harvesting, as protecting ecologically and culturally sensitive areas is an important issue for the Tl'azt'en community.

5 From: Karjala, M.K. 2001. Integrating Aboriginal Values into Forest Management Plans on the John Prince Research Forest. MNRES Thesis, University of Northern British Columbia, Prince George, B.C. In preparation, and Karjala, M.K. and S.M. Dewhurst. 2001. Exploring Aboriginal Forestry in Central Interior British Columbia. In preparation.

Scenarios

In addition to the RMZs, sufficient protection of riparian areas must also be addressed across the landscape. Although Tl'azt'en elders acknowledge that the current provincial riparian management standards are an improvement over past practices, many would like to increase the protective "buffer" on streams, lakes, swamps and cultural sites. Our analysis revealed a range of suggestions on how wide these buffer areas should be. Field excursions with elders to various sites revealed that appropriate buffer size is dependent on site-specific factors such as terrain features, and the type and distribution of plants. Given this variability, and lacking information on such specific stream characteristics on the JPRF, the SAT suggested that scenarios based on generalized riparian management options would assist the community in understanding their effect on other values. The SAT also indicated that an additional scenario based on provincial standards would provide an interesting contrast to the community scenarios. In total, five scenarios were developed (Figure 3):

1) Forest Practices Code of B.C. scenario;
2) Minimum Protection community scenario;
3) Moderate Protection scenario;
4) Enhanced Moderate Protection scenario; and
5) Maximum Protection community scenario.

Features of community-defined criteria

Landscape-level criteria need to have a social and ecological context in order to provide adequate information to implement SFM. Criteria take on a different meaning when they are used to describe community perspectives on SFM. If criteria represent a set of values that define the essential elements for good forest stewardship, then implementing those criteria on a particular land base requires a deep understanding of what those values are, why they are relevant and where they are impacted.

Generating the Tl'azt'en criteria using a bottom-up approach has revealed the following features:

- Locally relevant terminology is used. Values are discussed in the context of specific wildlife, fish and plant species, place-specific issues, first-hand observations, economics, human resources, industries, and history.

- The nature of the relationships between local values becomes apparent. Understanding criteria interdependencies provides an intuitive sense of complementary and conflicting values and the possible impacts of decisions on the community.

- Anecdotal information can reveal unique interpretations of the environmental impacts of forestry.

- Local information can provide ideas for mitigating values, conflicts and environmental concerns arising from forest management, and prioritizing management objectives based on local needs.
- The exercise can build relationships between managers and land-users, creating a conduit for bottom-up monitoring and reporting on sustainability indicators.
- Local expertise is valuable for identifying threshold (desirable or acceptable amounts of an indicator) levels for sustainability criteria.

Implications for management and research

These features can help managers and decision-makers to implement strategies that address the needs and aspirations of local forest-dependent communities; balance the economic, ecological and social components of SFM; and remain accountable to higher-level SFM initiatives.

Locally defined criteria could form a baseline for comparing cross-cultural perspectives using the scenario planning approach. Further research that identifies local non-Aboriginal criteria may provide some insight into reconciling Western and Aboriginal forest values.

Part 3: Forest Planning Models as Cross-Cultural Tools[6]

Decision support tools are built to promote learning and understanding about complex problems and the relationship between the variables involved. Conventionally, these tools are designed for technically trained, professional end-users such as planners and forest managers. Moreover, these tools are designed with a culturally specific perspective on how to describe forest features, attributes and characteristics.

With increasing emphasis on engaging local expertise for developing sustainable forest management strategies at the landscape level, modelers play an important role in bridging the technical/non-technical gap by considering a broader spectrum of end-users. Decision support tools in natural resource management are rarely designed to engage the layperson in determining the scope of possibilities in planning processes. It is usually left to the professionals to develop, analyze and present management options based on their own biases. This approach may place resource-dependent communities, particularly Aboriginal communities, at a disadvantage.

Forest ecosystem sustainability is commonly expressed in terms of landscape level indicators such as habitat classifications, seral stage, and leading species. These measures are based on Western, scientific approaches to resource management. In order to cross cultural boundaries, it is necessary to search for culturally appropriate ways of communicating local Aboriginal values.

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6 Karjala, M.K. 2001. Integrating Aboriginal Values into Forest Management Plans on the John Prince Research Forest. MNRES Thesis, University of Northern British Columbia, Prince George, B.C. In preparation, and Karjala, M.K. and S.M. Dewhurst. 2001. A Vision for the Future: Using an analytical tool to represent Aboriginal forest indicators in strategic-level plans. In preparation.

In this study, a coarse-filter approach was use to represent traditionally important wildlife and plant habitat, and to demonstrate tradeoffs between ecological and economic values. Indicators were selected for these criteria using ecological guidebooks and other secondary sources for the region. By incorporating these locally relevant indicators into MYT files, the Lurch system can be used to interface Aboriginal perspectives of the forest with conventional descriptions of ecosystem characteristics by tracking both traditional and conventional types of forest values.

Implications for management and research

Placing tools such as Lurch, with the appropriate design features, in the hands of Aboriginal communities could improve community participation in decision-making. The model has the characteristics to provide a "safe " venue for integrating sensitive traditional values and expressing them in Western terms, without compromising confidentiality.

Project Theme 3: Development and Assessment of Local-Level Criteria and Indicators of Historical Forest Conditions

An aspect of forest management that is of particular interest to the Tl'azt'en community is the issue of ecological restoration. Their concern stemmed from pressing issues in the community related to changes in the environment, linked in their minds to industrial exploitation of natural resources, specifically forestry and mining. The Tl'azt'en requested us to determine the positive and negative impacts of restoring the forest to a more natural state, akin to the historical (pre-industrial activity) state. The next phase of the project was initiated to address this concern

The JPRF is in many ways representative of managed forests within British Columbia, characterized by a complex land use and forest management history. Restoring natural forest conditions may enhance wildlife and biodiversity values, as well as aboriginal cultural and subsistence values on the research forest. The purpose of this report is to summarize the progress made on this theme of the project.[7]

Part 1: Reference Information

Reference conditions is the range of natural variability in ecosystems (structures and processes) reflecting the dynamic interactions between biotic and abiotic conditions and disturbance patterns (Morgan et al. 1994). Land-use history and recent management influence vegetative patterns, and therefore reference conditions, in forested ecosystems. Ecological change is natural in all systems, however changes resulting from resource use in recent decades may be beyond natural rates of change (Covington et al. 1994). Prior to European settlement, Aboriginals used, manipulated and impacted resources and landscapes (Notzke 1994). Over the last 100 years, however, larger scale commercial development of natural resources has lead to significant changes in British Columbia's forests. Commercial timber harvesting and fire

7 MacGregor, M.M. 2001. Defining Reference Conditions for Ecological Restoration on the John Prince Research Forest. MSc Thesis, University of Northern British Columbia, Prince George, B.C. In preparation.

suppression has altered the structure and composition of many of British Columbia's forest, and the records of these changes are important for characterizing and/or reconstructing historical forest conditions. Ecosystems which existed prior to this rapid change may be more representative of natural range of variability that those which exist today.

Step I: Archival Information[8]

The initial phase of this project involved uncovering ecologically relevant historical information to support ecological restoration on the JPRF. Networks were established with various organizations where historical forestry information might be located. Some of these organizations included: BC Archives, Royal BC Museum, BC Forest Service, BC Ministry of Forests, local museums and archives, community libraries, experiential knowledge holders, Tl'azt'en Nation Natural Resources Office, etc. The following is a brief outline of the sources of information uncovered during this process.

1. Historical Aerial Photography (1947)

Following World War II, most of the province of British Columbia was flown and aerial photographs were taken during this time. We retrieved 1947 aerial photographs of the JPRF. Some harvesting activity is apparent in the photographs, however there remain extensive tracts of undisturbed forest which current conditions may be compared with.

It is possible to combine historical aerial photography with current technology to create a database from information in the aerial photographs. The photographs can be digitized and the database created from the digital photos will be statistically compared will be made between the historical database and the most recent forest cover data using ArcView 3.x and SYSTAT. The goal of this portion of the study is to provide quantitative evidence of change in forest tree species and composition as a result of past management practices at a landscape level.9

2. Oral Histories and Interview Transcripts

Numerous individuals were located who hold experiential knowledge regarding forestry practices and forest ecology of the research forest from 1940 to 1970. As many sources of archival information focus solely on merchantable timber resources, the spoken word acts as an invaluable supplemental source of information.

Oral sources provide information on non-merchantable plant species ecology and distribution, provide a link to other sources of information, and provide guidance in respect to accuracy of conclusions made from historical documents and photographs. It is recommended that a wide range of views be represented, including traditional land users, forest workers, and residents.

8 MacGregor, M.M. 2001. Defining Reference Conditions for Ecological Restoration on the John Prince Research Forest. MSc Thesis, University of Northern British Columbia, Prince George, B.C. In preparation, and MacGregor, M.M. and S.M. Dewhurst 2001. Criteria and Indicators of Sustainable Forest Management Based on Historical Information. In Preparation.

9 MacGregor, M.M. 2001. Defining Reference Conditions for Ecological Restoration on the John Prince Research Forest. MSc Thesis, University of Northern British Columbia, Prince George, B.C. In preparation, and MacGregor, M.M. and Dewhurst, S.M. Using historical aerial photography and GIS to detect landscape-level changes in forest conditions resulting from land management. In preparation.

3. Timber Sale Files (government records and associated maps)

Commercial forest harvesting began in the research forest in 1940. Records of forest management activities from 1940 to 1960 for the JPRF have been recovered, which give information on harvesting practices, processing facilities, biotic and abiotic site information, licensees, etc. The files were cataloged chronologically and summarized to include ownership, harvesting practices, size of area, ecologically relevant information, etc.

4. Company Documents

A variety of documents created by companies harvesting in the area in the past have been located. These records give a more site-specific description of forest resources and other non-commercial resources, waste surveys, natural disturbance (fire and insect) history, maps, photographs and other relevant information.

Step II: Contemporary Data

Contemporary sources of data are used to compare data from the past to better understand changes and trends in management patters across the landscape. Several sources of contemporary data were used for analysis in this project. These sources are outlined as follows:

1. Forest Cover Data

The John Prince Research Forest is crown land, and as such forest inventory data, TRIM data, and forest development plans exist for the area.

2. Unmanaged tracts of forest land

Douglas-fir (*Pseudotsuga heterophylla*) is a culturally important tree species for Tl'azt'en Nation, and is at the northern extent of its ecological range in the research forest. Harvesting activities in the past focused on Douglas-fir as one of the merchantable tree species and therefore there is a difficulty finding representative tracts of undisturbed Douglas-fir forests in the JPRF. Several areas of old-growth Douglas-fir have been selected, however, and fieldwork commenced in the spring of 2001 to obtain contemporary reference information on unharvested areas of land which have a Douglas-fir dominated overstory.

Part II: Land Use History and Management Implications

The second portion of this theme was to create a land use history for the JPRF using archival information, and to develop local-level C&I of historical conditions based on the reference information collected in Part I.

Land Use History

A land use history was created for the JPRF using historical sources (land surveys, other documents, cruise reports, government documents, interviews and oral histories, aerial photographs, and published manuscripts). British Columbia Forest Service Timber Sale Files (government documents and associated maps) were examined to determine ownership patterns on the JPRF. Timber sale areas and licensees were recorded for each region where timber sale files were available. Where available, company documents were also examined for information. Additional information on ownership was determined by reviewing interview transcripts, conducting interviews and miscellaneous correspondence. Individuals holding experiential knowledge regarding land use practices on the JPRF were asked to review the land use history to ensure accuracy.

Criteria and Indicators

A broad set of C&I were developed to support ecological restoration on the JPRF based on historical and contemporary reference information. These indicators are of sufficient resolution to be used with the Lurch system to create an ecological restoration management scenario. Preliminary indicators include species composition, density, diameter, age, ecological associations with other vegetation, fragmentation and development (roads), and patch size distribution.

Ecological Restoration Management Scenario

It has been demonstrated through extensive research into historical sources of information that past harvesting and other management activities have altered the nature of the JPRF. Indicators developed from historical sources will be used to support an ecological restoration scenario for the JPRF using an adaptive, hierarchical and spatially explicit suite of models designed to support scenario planning. Impacts of a forest restoration plan on other indicators of Sustainable Forest Management will be determined using a multiple accounts analysis. The results of this scenario exercise will be presented to Tl'azt'en Nation upon completion for community feedback.[10]

Project Theme 4: Evaluation of the Planning System and Process

Community Extension and Feedback

Preliminary results from the community interviews, focus groups, analysis, and SAT meetings were made available to the broader Tl'az'ten community for feedback. Three approaches were used to elicit these responses.

1) Community displays

The first approach involved displaying results within in the community. For several months, preliminary maps showing the five riparian buffering scenarios on the JPRF were displayed in Tl'azt'en office lobbies, and comments were informally collected from individuals reviewing the maps. Reports from our Tl'azt'en associates indicated that these maps were considered to be clear, logical and of interest to community members.

2) Community presentations

The second approach was a simple survey distributed at formal presentation to community members by senior level undergraduate majors in Natural Resource Management.

10 MacGregor, M.M. 2001. Defining Reference Conditions for Ecological Restoration on the John Prince Research Forest. MSc Thesis, University of Northern British Columbia, Prince George, B.C. In preparation.

NREM 400 (Resource Planning) is a 4-credit 4th year lab course for majors in the forestry, fisheries, wildlife, and resource recreation degree programs. Neither the Echo nor Lurch software were utilized by the students in the 2001 offering of NREM 400, due to technical support issues and the lack of the Operational planning model. Instead, a "sharp pencil", multiple accounts analysis approach was used by the students to produce 12 management scenarios for the JPRF. Four of these were selected for presentation at the public meeting: Wildlife and fish emphasis, Biological diversity, Forest certification, and Research. The public presentation of "Scenario Planning: Options for the John Prince Research Forest" was held in Fort St. James on March 24, 2001. Approximately 40 community members attended, almost 2/3 of whom were from Tl'azt'en Nation. This was a very good turnout, considering that many of the attendees had to travel at least 45 minutes to reach the meeting location.

This meeting provided an excellent opportunity for the investigators to gauge the interest and ability of the community in understanding C&I and scenario planning. The following anonymous questionnaire was provided to members of the audience at the Fort St. James presentation:

If you could answer the following questions, it would help us assess if this work has helped the community better understand and participate in the management of the John Prince Research Forest.

1. Do you think that the scenario planning approach demonstrated this evening was helpful to you in better understanding management issues and options for the JPRF?

   YES NO

2. Do you think that scenario planning could help communities better participate in land management decision-making if it were applied more widely?

   YES NO

3. Did the scenario planning approach help you to better understand the different perspectives on how the JPRF could/should be managed?

   YES NO

4. Was the use of Criteria and Indicators helpful to you in better understanding the management issues and options?

   YES NO

5. Do you feel that the scenario planning approach increased your awareness of what constitutes "sustainable forest management"?

   YES NO

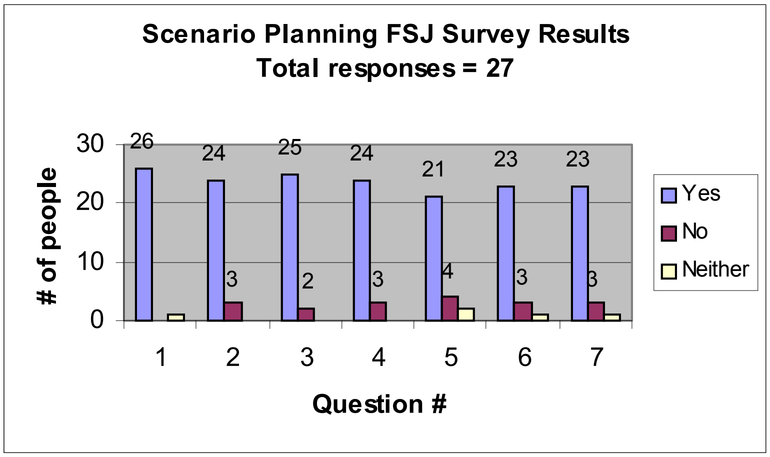
6. Do you feel as though the scenario planning presentation made you more knowledgeable about the forest, and the range of resource values it provides?

   YES NO

7. Do you feel that your interests and values were addressed in the scenarios you saw tonight?

YES NO

Figure 2. Results of the questionnaire survey distributed at the NREM 400, community presentation in Fort St. James.



While the community members were openly supportive of the students' efforts, and provided positive responses to the survey taken at the end of the presentation (Figure 2), several observations were made. First, the terminology used by the students was a definite communication barrier given the level of understanding of many Tl'azt'en members present. Language that is commonly used in academic and professional circles for describing features of SFM and integrated resource management was used, and consequently, it appeared members of the community seemed to find the scenarios very difficult to follow. Members of the audience commented to some investigators after the presentation that "all of the scenarios looked the same to us". Tl'azt'en members, however, did appear to relate well to the scenario emphasizing wildlife issues, and in fact inspired one audience member to share his personal experiences with forest management and moose habitat. This feedback was essential in structuring how we presented our final research results to the community.

3) Small community focus groups

The third source of community feedback was two small focus groups of SAT members conducted in May and June, 2001.

The first meeting, on May 31, was intentionally non-technical. Key C&I identified from the analyses were presented to the SAT using maps, quotes from community interviews, and appropriate language. Concepts relating to the forest planning model, such as visual representation of indicators and trade-off analysis, and balancing forest values were introduced. This presentation initiated an extensive and enthusiastic discussion of diverse resource management issues with all participants.

At the June 21st meeting the investigators reviewed concepts from the previous meeting and proceeded to demonstrate these concepts using the Lurch model. The audience included a mix of elders and youth. Terminology was defined, and the assumptions used for incorporating indicators into the development of MYT files were explained up front. The investigators proceeded to demonstrate the Lurch system using a 1.4 GHz Pentium 4 computer, which ran over 200,000 potential management scenarios per minute. Maps, graphs, and numbers were all changing in real time as the model discovered improved management options for achieving the proposed management objectives. Concepts such as establishing long-term planning goals, setting indicator targets, value tradeoffs and the spatial distribution of forest values were exhibited using the model. The community-defined indicators were used in this demonstration, included culturally important wildlife and plant habitats.

The Lurch interface is graphical, interactive, and animated. Consequently, the individuals more actively engaged at this second, Lurch-focused, meeting were the younger people, especially those with post-secondary education. These participants included forest technicians who readily understood what the model was doing and asked a host of insightful technical questions. Inevitably, the discussion proceeded to continue in this direction. Suggestions were made for re-defining indicators and making interface improvements. The elders, again, were less involved in the discussion although they had favorable comments about Lurch when asked. The point was raised at the end of this meeting about the importance of explaining technical terms for the benefit of elders, in order to avoid alienating them from the discussion.

Evaluation summary

This research revealed that there are both strong aspects of this model-based scenario planning process, as well as areas that require improvement or additional attention.

Strengths

Overall, people indicated that the process was sufficiently open enough that community members who wished to participate could participate. People also felt that the methodology was effective. The focus groups were particularly helpful for the elders and the young people, as people felt comfortable enough in groups to share their opinions without feeling singled out. The use of maps was helpful in focussing discussion and in making people feel that the research was grounded and applied. They were able to freely express their concerns about forest management and felt, and could see, that those concerns had been heard and addressed.

In terms of the range of people, people indicated they particularly appreciate the fact we had explicitly included opportunities for young people to be heard. Women also felt their opinions had been sought out and were appreciated. In terms of identifying and selecting C&I, our evaluation indicated that we had selected appropriate indicators that adequately reflected community values and that allowed meaningful planning for forest management. The indicators were easy for community members to comprehend and to see applied. They adequately covered off the largest community concerns. When presented with the maps on which the indicators were outlined, people indicated that manner of presentation was effective in terms of community comprehension. When shown how the indicators could be incorporated into a decision support software system (Lurch) and used to facilitate participation by community members in the forest planning process, the community members felt that the approach and the tools were effective.

Finally, people indicated that they felt both the topic of the research and the manner in which it had been undertaken had resulted in a genuinely co-operative, collaborative research process that permitted community investment in both process and results. They saw long term potential and benefits resulting from the research project, results which could be applied in other Tl'azt'en planning processes. As such, by their measurement, the research project was deemed a success.

Areas for improvement

The greatest challenge was attempting to communicate concepts using terminology that everyone was comfortable with. Language commonly used by forestry professionals (e.g. "sustainable forest management", "criteria", "indicators", "buffers", "seral stages", "age classes") were neither readily recognized or accepted by many community members. There were repeated complaints about excessive use of technical or scientific jargon, but when simpler substitute terms were used (e.g. "a vision for the future", "important values", "representing values" "leave something for future generations"), and relevant quotes taken directly from community transcripts, the concepts were readily understood and accepted. Presenting information in the form of maps proved to be the most effective tool for communicating management strategies. Addressing spatial C&I were an extremely important component of integrating Tl'azt'en values into strategic level planning.

The presence of the analytical tool and forestry-trained community members made it easy to forget to use appropriate language. A repeated challenge to the investigators in these mixed-audience circumstances, was using simplified terminology but not "talking down" to people, since there is not necessarily a link between vocabulary and intellectual understanding of ecological or management concepts. The investigators noted, for instance, that ecological information was often most comfortably expressed by elders in the Carrier language, rather than English, and oftentimes midway though a discussion of animal or plant issues an elder would shift into Carrier to explain their point. The ecological concepts of food chains and food webs were very well understood, although they did not call them that. Rather they would make such points such as "if you want to have martens, you need to have squirrels, so you had better have woodpiles for them to live in".

While terminology and technical jargon were a continuing problem when discussing technical topics with community members, it was evident that the community members readily understood the concept of local-level indicators, and many of them participated enthusiastically in the discussions once they got the idea. It was also apparent that the majority of community members understood and agreed with the concepts of integrated resource management and SFM. The concept of stewardship also resonated with many members of the community.

Other observations

Another feature noted by the investigators was the fact that, while technical and professional resource managers think readily in terms of animal habitat, many community members, and particularly elders, thought about animals from the perspective of their behavior. For example, when a question related to beaver habitat arose, an elder answered the question by telling a story about how the beaver sees the world, and by thinking about the question from that perspective was able to suggest what the beaver would want. It remained the task of the investigators to listen carefully and develop the specific numerical measures and criteria for use in the modeling exercise, for while community members were generally willing to share their views, they showed little interest in actively participating in numerical analysis or modeling.

It was difficult, in our experience, for community members to distinguish issues related specifically to the parcel of land in question (the JPRF) from those of the surrounding landscape. This seemed to derive from two sources: first, the recognition that the landscape was interconnected and resource and stewardship issues could not be viewed in isolation, and second, the community interest in treaty-related issues involving their entire traditional territory, which are certainly on the community's mind at this time. The opinion was expressed in a number of meetings that community members felt that the planning process should encompass a larger area, often expressed as their entire traditional territory. For instance, concerns were expressed that increased level of logging activity, combined with the current epidemic beetle outbreak, had led to uncertainties about environmental quality. Repeated reference was made to the issue of whether the Tl'azt'en were getting "their fair share" of economic and employment opportunities arising from the development and exploitation of natural resources in their traditional territory.

Indicators that seemed to be best and most willingly understood by community members seemed to involve wildlife, plant, and fish related indicators, along with readily understandable measures of community economic opportunity, such as jobs. This led to inevitable discussions having to do with the policies of the JPRF regarding Aboriginal hiring preference and employee selection criteria. While these policies are not within the scope of this research, this issue confirms the linkage between forest planning projects and the larger environmental, social, and economic context in which they occur.

From a technical perspective, existing traditional use study information provides an excellent basis for identifying Aboriginal community-level criteria for SFM. It became apparent, however, that aggregating and generalizing traditional knowledge must be done carefully so as not to compromise its integrity. Aboriginal communities must take a leading role in ensuring that this knowledge is represented accurately. Additional historical information is available from a range of sources, and is usable for purposes of characterizing historical forest conditions as well. This information can serve as an important reference point in management planning, or for purposes of defining scenario plans.

Recognizing that community values were being incorporated into the planning process seemed to motivate individuals at the meetings. For instance, the representative from the Tl’azt’en Nation Education Department noted that Lurch would be a suitable tool for use in the school curriculum. She also noted that it was her observation that the students in the local high school are very weak in science, and that a tool like Lurch could capture their imagination if designed and packaged properly. The opportunity to link the use of such a tool to other elements of the curriculum (e.g. biology, social studies, and Tl'azt'en history and culture) was noted. Furthermore, the need to encourage Tl’azt’en youth to pursue post-secondary degrees in forestry to prepare them for forest management decision-making after treaty settlements was noted after completion of these final presentations.

CONCLUSIONS

The full suite of Echo models, which was the original focus of this research, could not be fully evaluated, due to the fact that they were never made available to the investigators, despite the efforts of UNBC and other agencies. This severely limited the investigators’ capacity to fully develop and assess the community scenarios. The elements of the available models, which underwent technical evaluation, proved functional and effective, but lacked critical features necessary for effectively engaging community members. Ultimately, the Lurch software was more suitable for implementing participatory planning, and will be made available for public scrutiny and use upon publication of our research results. The Lurch design obviates the need for the Echo system, as it is functionally equivalent but much faster and easier to use, and it is unencumbered by intellectual property rights and other issues related to the MMFA.

In general, this research has shown that forest planning models that are designed for non-technical users and exhibit adequate flexibility can be used as tools to improve Aboriginal involvement in forest management decision-making. The model input data was the central driver for eliciting and formatting information from the community, and it is clear to the investigators that advanced forest management tools such as Lurch and the Echo system have a significant role in structuring planning processes for SFM. C&I provide a very useful framework for collecting and codifying information for use in conjunction with tools such as these, and a wide range of information sources are available to assist in the development of local-level C&I using the bottom up approaches. Community members seem willing and pleased to contribute to such efforts, at least in the specific context of the JPRF.

In the realm of Aboriginal, participatory research, this study was unique in that it was addressing a "real" management problem. Although the JPRF management board has equal representation from both UNBC and Tl'azt'en Nation, involving the broader Tl’azt’en community in decision-making is an essential part of planning long- and short-term forest activities. The model-based scenario planning approach was used to initiate community collaboration, stimulate interest, build trust, and instill a sense of ownership of the JPRF. The work of student investigators Karjala, Sherry, and MacGregor filled identified gaps in the available knowledge base for addressing specific community concerns. Melanie Karjala and Erin

Sherry developed and implemented a procedure for generating C&I to facilitate community participation in SFM planning. This work resulted in an innovative and effective methodology for codifying and utilizing archival information for use with the analytical tools being developed and tested. In a parallel effort, Michelle MacGregor addressed community concerns related to understanding historical conditions of the JPRF, and to develop management objectives and indicators to implement ecological restoration. These results will provide valuable information for the JPRF forest manager and the management board, and steps will be taken to implement these results in the near future. For instance, indicators based on natural history and Tl'azt'en values will be incorporated into the timber supply analysis for the next JPRF five-year management plan (effective in 2004). The significance of these results to the JPRF and the community is such that both are collaborating with UNBC on new studies that build upon the work presented here[11].

The co-management context of the JPRF provides an excellent case study for participatory forest planning research. The JPRF staff work closely with the community, providing liaison services to connect researchers with community members. This collaboration was essential for helping researchers build relationships with Tl'azt'en administrative staff and elders.

Overall, this project has demonstrated the strengths of conducting interdisciplinary research for contributing to SFM. The project team developed valuable cross-disciplinary skills, and excellent research and training opportunities were provided for both UNBC graduate students and for Tl'azt'en participants.

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11 A one-year project titled "A Guidebook for Improving Aboriginal Participation in Forest Management Decision-Making" funded by Forest Renewal BC was initiated in the spring 2001 by Stephen Dewhurst, Erin Sherry and Melanie Karjala to develop and evaluate a guidebook outlining the AFPP approach.

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