The Scientific Panel
for Sustainable Forest Practices
in Clayoquot Sound

Progress Report 2:

Review of Current Forest Practice Standards in Clayoquot Sound

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Executive Summary

This document presents findings of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound from its review of forest practice standards in effect in Clayoquot Sound as of January 31, 1994.

The review assessed the adequacy of over 50 current standards documents to meet the Panel's Guiding Principles set out in its first report. These principles embody the Panel's belief that forest practices must not compromise ecosystem integrity, cultural values, or the options and opportunities of future generations.

Early in the review process the Panel found that the current approach to forest management did not meet the Guiding Principles. This finding changed the Panel's task from review and amendment of current standards to the task of creating standards for a different approach to forest planning and management in Clayoquot Sound. The new, holistic view of ecosystem management recommended by the Panel requires that forest practice standards consider ecosystem effects and cultural values, and that they be integrated.

Eleven general findings and 14 general recommendations from the review are presented. These signal the need:

- to recognize ecosystems as the base from which goods and services flow and to maintain ecosystem integrity in all management practices;
- to respect First Nations' values and to include First Nations in planning and managing resource use in Clayoquot Sound;
- to prevent loss of biodiversity, degradation of ecosystems, and damage to First Nations' heritage sites and areas; to restore areas damaged by past development;
- to preserve the options and opportunities of future generations;
- to produce adequate inventories of all resources in order to support sound decision-making and sustainable management practices; and
- to practice adaptive management so practices can improve as knowledge and experience are gained.

The Panel's general recommendations include the following:

- produce only the levels of goods and services that are sustainable within limits that maintain the integrity of ecosystems;
- increase the level of riparian protection by increasing streamside buffer widths, including headwater and intermittent streams, and identifying and protecting unstable land areas;
- broaden the silvicultural systems used in Clayoquot Sound beyond clearcutting;

- implement formal adaptive management in carefully selected areas to assess the effectiveness of new forest practices;
- provide education and training programs to upgrade the current workforce and increase the number of qualified workers;
- develop procedures for company or worker prequalification and disqualification to ensure high-quality practices.

The general findings and recommendations emphasize changes required in both the philosophy of forest planning and management, and the way that forest practice standards are created and applied. The Panel outlines the action required to make the transition from management of forests for products to management for sustainable ecosystems.

Specific findings note the extent to which current standards sustain watershed integrity, biodiversity, First Nations' interests, and scenic, recreation and tourism values. For each of these themes, goals and objectives are presented. Current forest practice standards are evaluated against the stated goals and objectives. Where current standards are found to be deficient, the Panel recommends changes to achieve sustainable forest practices. These changes will be reflected in the standards the Panel recommends for Clayoquot Sound in its final report.

Four key issues in Clayoquot Sound arising from the review are identified and discussed: inclusion of First Nations', forest planning, undeveloped watersheds, and Special Management Area boundaries.

Current standards do not adequately recognize First Nations values and perspectives. The Panel recommends ways of including First Nations values and obtaining First Nations participation in the inventory, planning, and management of resources in Clayoquot Sound.

Current planning procedures are inadequate for sustainable ecosystem management. The Panel recommends that planning in Clayoquot Sound be ecosystem-based and multidisciplinary; it should integrate the full spectrum of resource values. The Panel further recommends that planning be conducted at ecologically-relevant time and spatial scales.

Care is required in undeveloped watersheds. The Panel recommends delaying activity in undeveloped watersheds until adequate inventories are prepared, exemplary forest practices and silvicultural systems demonstrated elsewhere can be applied, and a prequalification procedure is in place.

Inaccuracies in the boundaries of Special Management Areas confirm problems associated with delineating land use boundaries before conducting adequate inventories. The Panel recommends that Scenic Corridor Areas be revised using more detailed information on resources.

These changes are major, and the Panel recommends an implementation plan be established and publicized for those steps requiring significant time to implement.

The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound

Progress Report 2: Review of Current Forest Practice Standards in Clayoquot Sound

1.0 Introduction

This is the second progress report on activities of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound.[1] It states the Panel's findings from the review of forest practice standards applicable to Clayoquot Sound as of January 31, 1994, and makes recommendations based on these findings.

In its first report (January 31, 1994), the Panel outlined Guiding Principles for forest management in Clayoquot Sound.[2] For this second report, the Panel used these Guiding Principles to evaluate current forest practice standards. Our recommendations seek to define forest practices that are scientifically sound, operationally achievable, measurable, enforceable, and safe.

This report includes our findings and recommendations related to forest ecosystem processes, such as watershed integrity and biodiversity, and cultural values, including First Nations, scenic resources, recreation and tourism. A subsequent report will address our findings and recommendations about transportation systems, silvicultural systems, and harvesting methods.

The Panel's final report will refine the preliminary recommendations from its second and third reports to produce recommended new standards for sustainable forest practices in Clayoquot Sound.

Supporting documents produced by Panel members will provide a more detailed look at specific aspects of ecosystems, values, and resource use considerations in Clayoquot Sound. Topics being developed include: watershed processes; Nuu-Chah-Nulth history, values, and perspectives; the scientific basis of managing for biodiversity; and an examination of the Panel's Guiding Principles relative to emerging international standards.

[1]The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound was announced by Premier Mike Harcourt on October 22, 1993. The Panel was established in response to a recommendation from the Commission on Resources and Environment following the provincial government's April 13, 1993 decision on land use in Clayoquot Sound. A list of Panel members is presented in Appendix II.

[2]The Panel's Guiding Principles are presented in Appendix I.

1.1 Terms of Reference of the Scientific Panel

The Scientific Panel is charged with scientifically reviewing current forest practice standards in Clayoquot Sound and recommending changes to existing standards to ensure that these practices are sustainable. The Panel's goal, as defined by Premier Harcourt, "is to make forest practices in Clayoquot not only the best in the province, but the best in the world."

The current approach to forest management does not meet the Panel's Guiding Principles.

The terms of reference called for the Panel to provide specific forest practice standards in its second report. If only an upgrade to current standards had been required, this would have been possible. Early in the review process, however, the Panel found that the current approach to forest management did not meet its Guiding Principles. This finding changed the Panel's task from reviewing and revising current standards to creating standards for a different approach to forest planning and management in Clayoquot Sound. The new, holistic view of ecosystem management[3] recommended by the Panel requires that forest practice standards consider ecosystem effects and that they be integrated. For this reason, this second report focuses on the findings from the Panel's review of current standards in Clayoquot Sound, and on recommendations to guide the development of new standards.

The terms of reference do not include issues of economic and community sustainability.

Although the terms of reference do not include issues of economic and community sustainability, these concerns are closely related to sustaining the area's forest ecosystems. It is the Panel's belief that forest practice standards that ensure the sustained health and productivity of forest ecosystems in Clayoquot Sound will provide the foundation for long-term economic and community stability in the area.

1.2 Context for the Review

Clayoquot Sound is a diverse environment with a rich history of settlement—first by the Nuu-Chah-Nulth people and then by non-aboriginals. Some areas of the Sound have experienced significant past disturbance; others remain virtually untouched. This condition provides an opportunity to learn from the past and apply that knowledge to the future. The presence of highly valued, undisturbed forest ecosystems is strong incentive to improve planning and management.

Clayoquot Sound is a difficult environment in which to harvest timber.

Clayoquot Sound is a difficult environment in which to harvest timber because of the severity of the terrain and the many valuable forest resources that must be taken into account. Much of the area is steep, perhumid, and underlain by thin soils. Mature and old-growth forests cover roughly 70% of the land base. Of these forests, approximately 39% fall within General Integrated Management

[3]Sustainable ecosystem management is discussed in Section 3.

Areas and 35% in Protected Areas as designated in the *Clayoquot Sound Land Use Decision* (1993).[4] Clayoquot Sound also supports major commercial and sports fisheries, world-renowned recreation activities, and sites of historic and cultural significance to the Nuu-Chah-Nulth. These conditions necessitate forest practice standards that are stringent and comprehensive.

The Panel's review focused on the science of sustainable forest practices.[5] We include in "science" the lived experience of the Nuu-Chah-Nulth people. Their direct observations over their long history in Clayoquot Sound have provided useful reference and context for recent field observations.

The Panel reviewed many documents that guide forest planning, management, and practices in Clayoquot Sound. This guidance takes various forms (e.g., written standards, standards of practice, guidelines, standard operating procedures, planning procedures, circular letters). For ease of discussion in this report we refer to all such guidance as "current standards."

The findings and recommendations contained in this document relate specifically to Clayoquot Sound. Forests outside the study area were not explicitly considered, although research and experience in similar British Columbian and U.S. Pacific Northwestern coastal environments were reviewed.

1.3 Communities Affected

Many communities have interests in Clayoquot Sound and its forest land use and management regulations. Employment levels in the forest industry, which strongly influence the communities of Ucluelet and Port Alberni, are directly affected by forest planning decisions in Clayoquot Sound. The interests of other residents in these communities and in Tofino—including fishery and tourist operators, craftspeople, and property owners—are also affected, because forest conditions affect their livelihood and quality of life.

The Panel recommends precedence be given to sustaining ecosystems and fulfilling the needs of local communities.

Interest in Clayoquot Sound extends well beyond the immediate region. Logging in Clayoquot Sound is an integral part of the corporate, export-oriented forest industry that is a mainstay of the provincial economy. Industrial jobs and investors' incomes elsewhere in the province (and beyond) are linked to commercial timber harvesting and fishing activities in Clayoquot Sound.

The area has significant natural values, and environmental protection of Clayoquot Sound has drawn attention across the province, the country, and the world.

[4]Whyte, B.D., Minty, D., and R.F. Gowan. 1994. Visible areas analysis and classified satellite image analysis in support of scenic corridor management for Clayoquot Sound. Unpubl. paper.

[5]While impacts on local, provincial, and world communities of implementing the Panel's recommendations are acknowledged, they are beyond the Panel's terms of reference and are not addressed in this report.

Regulations to improve forest land use will not serve equally well the interests of all communities. While recognizing the range of interests in Clayoquot Sound, the Panel recommends precedence be given to sustaining ecosystems and fulfilling the needs of local communities.

The long-term ability to sustain ecosystems and to achieve sustained, productive use of the forest will depend, in part, on other activities in Clayoquot Sound. The area's wild fishery is fully exploited. Tourism, wilderness and marine recreation, fish farming, and residential property development are growing. Consequently, the area's population is growing, and will continue to do so.

The quality of these and other of the area's activities depends on maintaining the integrity of the forest environment. Reciprocally, maintaining the integrity of the forest environment will require that these activities be constrained. The need for a clean water supply, the capacity of the environment to assimilate waste, the level of traffic disturbance, and the limited land base all will limit the degree of economic development that can be undertaken without threatening ecosystem health.

Standards proposed by the Panel will constrain timber harvesting and limit other activities.

These conditions mean that both the local communities and the world must recognize limits to the supply of resource goods from Clayoquot Sound. The standards proposed by the Panel will constrain the allowable wood harvest and will also limit other activities. These standards will influence certain job opportunities and returns on investment that may be expected from the region.

The transition from a history of managing for a few resources to managing for sustainable ecosystems will affect local communities whose livelihood depends on current levels of resource extraction. Equitably distributing the benefits and costs of resource use and environmental management will be made easier by maximizing the number of economically and socially acceptable jobs, and establishing industries that produce higher value-added products using local resources in sustainable ways. While these goals lie beyond the terms of reference of the Scientific Panel, they are nevertheless important to the success of its proposals.

1.4 Panel Activities and Progress

The Panel has met 11 times since its formation on October 28, 1993, on each occasion for two to four days. The Panel made its first field trip to Clayoquot Sound in early November. The seven meetings between October, 1993 and January, 1994 produced an operating protocol and set of Guiding Principles[6] for sustainable forest practices, which were presented in the Panel's first report.

In subsequent meetings, the Panel reviewed and evaluated current forest practice standards in Clayoquot Sound to identify the extent to which they meet the Panel's Guiding Principles. The Panel made a second field trip to the study area

[6]Appendix I of this report lists the Panel's Guiding Principles.

in early February to view practices carried out under previous and existing standards. Individual Panel members made other trips during this period to better understand the area's natural ecosystems, to determine requirements for sustaining them, and to understand how current standards are applied in the field.

In developing the philosophy that would guide its work, the Panel reviewed existing and emerging international standards and agreements. These included, but were not limited to, the *World Commission on Environment and Development;* documents from the United Nations Conference on Environment and Development (UNCED) 1992[7]: *Framework Convention on Climate Change, Convention on Biodiversity, Agenda 21,* and *Guiding Principles on Forests;* the *Forest Stewardship Council Principles and Criteria of Natural Forest Management;* and the *International Tropical Timber Organization Guidelines for the Sustainable Management of Natural Tropical Forests.*

The Panel's Guiding Principles provide a consistent and meaningful framework for evaluating current standards in Clayoquot Sound. They embody the Panel's belief that forest practices must not compromise ecosystem integrity, cultural values, or the options and opportunities of future generations.

1.5 Organization of this Report

Section 1 of this document describes the Scientific Panel's terms of reference and the context for the review of current forest practice standards.

Section 2 presents the Panel's general findings from the review. The Panel has made recommendations for change where existing standards have been found deficient.

Section 3 explains the changes needed to make the transition from forest products management to sustainable ecosystem management.

Section 4 presents findings and recommendations specific to Clayoquot Sound on four subjects:

- maintaining watershed integrity;
- maintaining biodiversity;
- recognizing First Nations' values and perspectives; and
- maintaining scenic, recreation, and tourism values.

[7]The "Earth Summit" at Rio de Janeiro.

This section introduces some of the ecosystem processes and the interrelationships between water, terrain, soil, flora and fauna in Clayoquot Sound. Goals and objectives to maintain these processes are presented, and current forest practice standards are reviewed against these goals and objectives.

Section 5 discusses four key issues in Clayoquot Sound arising from the review: including First Nations, forest planning, undeveloped watersheds, and Special Management Area boundaries.

Appendices to the report include: Scientific Panel Guiding Principles, a list of Scientific Panel Members, a list of the forest practice standards reviewed, and a glossary.

2.0 General Findings and Recommendations

The rules, procedures, and guidelines for the management of public forest lands are set down in a large number of documents issued by the provincial government—mainly through the British Columbia Ministry of Forests—under legislated authority. We refer to these rules, procedures and guidelines as "current standards." The Panel has closely examined the current standards for Clayoquot Sound as presented in the documents listed in Appendix III.

2.1 Scope of Review of Current Standards

The Panel reviewed over 50 documents that currently apply to Clayoquot Sound and classified them according to the type or level of planning to which they apply. (See tables 1 through 4 in Appendix III.) These documents are also identified as draft, emerging, interim, or established, in increasing order of force. The recent dates of most documents and the many draft, interim, and emerging standards reflect rapid changes in forest practices.

The Panel also reviewed two documents with specific reference to Clayoquot Sound: *Clayoquot Sound Forest Practices Standards* (June 1993) and the *Clayoquot Sound Land Use Decision* (April 1993).

The Panel's review of standards focused on documents pertaining to the subregional level, that were in place January 31, 1994. More recent versions of these documents will be addressed (if possible) in the Panel's final report.

2.2 General Findings

In its review of current standards in Clayoquot Sound, the Scientific Panel found many documents that reflect evolving approaches towards forest practices. Some of these standards are ecosystem-based and can contribute effectively to sustainable forest practices. Other standards, particularly those emphasizing a single resource, do not meet the Panel's Guiding Principles or do not contribute to sustainable practice.

The general findings reported here signal the need for change in both the philosophy of forest planning and management, and the way that forest practice standards are created and applied. These changes will be reflected in the standards the Panel recommends for Clayoquot Sound in its final report.

1 Current standards do not recognize sufficiently the physical and ecological connections among terrestrial, freshwater, and marine ecosystems. These connections are biologically and culturally important.

2 Current standards represent the protection of environmental and cultural values as constraints on managing the timber resource. Current standards do not effectively integrate ecosystem and cultural values. Nor do they adequately address requirements for ecosystem sustainability, harmonious stewardship of all resources, and the needs of future generations.

3 Current standards do not include First Nations' values and perspectives, and do not require participation by First Nations in planning and management.

4 There is no consistent requirement that long-term plans be developed for large areas before developing plans for smaller areas.

5 While many standards meet their individual objectives, collectively they do not prevent loss of biodiversity, degradation of terrestrial and aquatic environments, and damage to First Nations' heritage sites and areas. Nor do they ensure restoration of ecosystems damaged by past development activity.

6 Existing information and current requirements to collect information on forest, freshwater, marine, scenic, and recreational resources or heritage sites and areas are inadequate to meet ecosystem management objectives.

7 Clearcutting is the implicit silvicultural system in existing standards. Most existing standards do not require justification for clearcutting or a consideration of alternatives.

8 Current standards for Clayoquot Sound are scattered in many documents issued by different agencies in different formats, and with different authority. Some are applied as rules; others suggest possible practices. The result is conflicts in standards (e.g., fate of down wood) and inconsistencies in standards (e.g., rates of harvest, size of landscape planning units).

9 Existing documents reflect the B.C. Ministry of Forests' dual mandate: to maximize the revenues from timber extraction (proprietary), and to protect natural resources for the public good (regulatory). Because these goals are sometimes in conflict, current standards reflect differing objectives. Some standards are intended to protect non-timber resources (e.g., *British Columbia Coastal Fisheries/Forestry Guidelines*); others set operational standards to provide for the efficient extraction of timber (e.g., *Forest Road and Logging Trail Engineering Practices*).

10 Many standards are phrased in ways which make them difficult to apply and enforce easily, fairly, and consistently.

11 Field observations suggest that the workforce is not consistently informed of the rationale for specific standards.

2.3 General Recommendations

Based on the Panel's findings regarding current standards (Section 2.2), its Guiding Principles (Appendix I), and the belief that forest practices in Clayoquot Sound must be scientifically sound, operationally achievable, measurable, enforceable, and safe, the Panel makes the following general recommendations:

1 Manage the forests and waters of Clayoquot Sound to:

- maintain the productive capacity of the interlinked land, freshwater, estuarine, and marine ecosystems;
- maintain biodiversity of land and water ecosystems;
- include First Nations' spiritual and other values;
- maintain heritage, recreation and scenic values; and
- sustain levels of commercial resource use consistent with the preceding goals.

These goals define a strategy known as "sustainable ecosystem management"[8] which is based on our understanding of ecosystem function, and on principles of resource sustainability and intergenerational equity (our obligation to leave undamaged forests and water for future generations). Sustainable ecosystem management requires the participation of multidisciplinary teams representing First Nations, industry, governments, and the public.

2 Determine the levels of goods and services to be produced from Clayoquot Sound (e.g., cubic metres of wood, visitor days) through a comprehensive ecosystem assessment and planning process. Define outputs that are sustainable within limits that maintain the integrity of ecosystems.

3 Collect resource information that supports sustainable ecosystem management. Expand inventories to include the status, abundance, and distribution of resources and values in addition to the critical factors that restrict timber harvesting and other resource-extracting operations.

4 Develop a strategy to protect the full pattern of drainage through the landscape. Modification or disruption of subsurface drainage channels or small, non-fish-bearing streams can increase soil erosion and adversely affect fish or other components of biodiversity.

[8]Sustainable ecosystem management is discussed more fully in Section 3.

5 Increase the level of riparian protection by increasing streamside buffer widths, including headwater and intermittent streams, identifying and protecting unstable land areas. Water is critical to riparian areas—which are central to temperate rainforests—and protecting riparian zones underlies sustainable ecosystem management in Clayoquot Sound.

6 Broaden the silvicultural systems used in Clayoquot Sound, beyond clearcutting. Select appropriate silvicultural systems to maintain natural landscape patterns and stand structures, and to meet a variety of management objectives other than timber production.

7 Select harvesting methods to meet the requirements of silvicultural systems, minimize environmental impacts, and meet worker safety standards.

8 Practice adaptive management[9] so that forest practices improve as knowledge and experience are gained. Undertake formal adaptive management in carefully selected areas to assess the effectiveness of new forest practices.

9 Plan and manage forests to prevent ecosystem degradation. Restore ecosystems where damage occurs.

10 Provide education and training programs to upgrade the knowledge and skills of the current workforce and to increase the number of qualified workers on the ground. Sustainable ecosystem management is complex and requires a workforce informed of the principles involved.

11 Develop procedures for company or worker prequalification and disqualification. Even the best forestry practices can pose considerable risk to the environment if not carried out to their intended standards.

12 Consider worker safety when defining acceptable practices. Involve safety personnel when developing standards and new forest practices (e.g., Wildlife Tree Committee).

13 Use consistent terminology, definitions, and inventory requirements in defining standards and practices at different levels of the planning hierarchy.

14 Establish appropriate phase-in periods for standards requiring major changes to current practices. This will allow stakeholders time to adjust and will help to ensure compliance.

[9]Adaptive management rigorously combines management, research, and monitoring so that credible information is gained and management activities can be modified by experience.

Recommendations on four specific issues which flow from these general recommendations are presented in Section 5:

- inclusion of First Nations;
- forest planning;
- undeveloped watersheds; and
- Special Management Area boundaries

3.0 Changes Needed for Sustainable Ecosystem Management

The Panel's general findings on current forest practice standards in Clayoquot Sound make clear the need for a new approach to management. Deficiencies in current standards relate primarily to the context in which decisions are made, rather than to the implementation of forest practices. For example, current standards governing road construction lead to well-constructed roads; they do not, however, guide the larger question: "Given the slope position, gradient, parent material, and climate, should the road be constructed here at all?"

Historical approaches to forest management have focused largely on products rather than on the biological systems from which these products derive. In Clayoquot Sound, as elsewhere in British Columbia, sustaining timber production has historically taken precedence over maintaining forest ecosystems.

The Panel believes that forests should be managed as ecosystems, rather than as potential products.

The Panel believes that forests should be managed as ecosystems, rather than as potential products, and that forest practices should not put at risk the long-term health of forest ecosystems. "Sustainable ecosystem management" is characterized by resource management practices that are scientifically based, ecologically sound, and socially responsible. In Clayoquot Sound, sustainable ecosystem management also incorporates the traditional ecological knowledge and values of the Nuu-Chah-Nulth.

The goal of sustainable ecosystem management is to maintain the integrity of ecosystems. Achieving this goal requires maintaining ecosystem components and ecological processes that enable the land, water, and air to sustain life, be productive, and adapt to change.

The objectives of sustainable ecosystem management include: maintaining soil formation, stability, and productivity; maintaining water quality, flow, and channel integrity; and maintaining biodiversity. Failure to maintain these processes and states may lead to failure to sustain a flow of products from the forest and failure to protect cultural, scenic, recreation, and tourism values.

Human needs are one of many considerations in designing management activities. The needs of current generations should not supersede the needs of future ones. The protection of ecosystem components and maintenance of ecosystem processes and productivity must take precedence over all other management objectives.

In the long term, managing forests as ecosystems is the best way to secure a supply of timber and other products from the forest, and to sustain British Columbia's multitude of other forest values.

3.1 Long-term, Inclusive Planning

The shift from managing forests for products to managing forests as ecosystems is significant and far-reaching. To achieve sustainable ecosystem management objectives, a change in current planning processes is needed. Planning must be long term and inclusive. It must begin at the provincial level and progress to the local level. At each level, sustaining ecosystem productivity and biodiversity must take precedence over specific product outputs.

Provisions must exist for determining levels of resource extraction within the limits prescribed by ecosystems.

Social, environmental, and economic dimensions of resource management must be incorporated into the planning process. Provisions must exist for determining levels of resource extraction within the limits prescribed by ecosystems. In Clayoquot Sound, planning should consider the territorial boundaries, resource ownership, and stewardship, represented by the Nuu-Chah-Nulth term "HaHuulhi."[10] HaHuulhi is the traditional system of land and resource management centering around ownership and stewardship of specific sites and their resources by hereditary chiefs. All the lands, waterways, shorelines and offshore sites, except for relatively remote areas far inland, fall under this system of ownership, control, and resource use.

Government, industry, and local communities must be involved effectively in resource management decision-making. The benefits and costs of resource use and environmental management must be equitably distributed. Because Clayoquot Sound is their homeland, the Nuu-Chah-Nulth must be directly involved throughout the planning process and in day-to-day management. Only such involvement will ensure that First Nations retain cultural and spiritual benefits, and receive economic benefits from resources of their traditional territories.

3.2 Monitoring and Adaptive Management

Sustainable ecosystem management is a new endeavour and requires new approaches. We must learn quickly how well these approaches work. The best way to improve our management approaches and procedures as we gain experience and knowledge is to practice adaptive management.

Management approaches and procedures must improve as experience and knowledge are gained.

Adaptive management involves three key steps or procedures. First, the management practice itself is treated as a rigorously designed, replicated experiment. Second, the outcomes of the practice are monitored and compared to anticipated or predicted outcomes. Third, a feedback procedure is developed so that practices are changed when outcomes do not match anticipated results. Each step or procedure is necessary to ensure that knowledge is gained and practices improve.

[10]HaHuulhi governed intertribal resources and also designated the food hunting and resource use of the tribal members within the chief's territories.

Adaptive management has been applied effectively to fisheries management but not yet to forest management. It is costly to do well, but still more costly to implement new practices without careful monitoring or mechanisms to modify the practices.

3.3 Education and Training

The transition to sustainable ecosystem management will require many levels and types of education and training. There are currently too few professional and technical personnel available to plan, conduct, and monitor activities associated with forest management in Clayoquot Sound.

Education is required to increase the knowledge base of all stakeholders. Training is required to convert that knowledge into usable skills that can be applied to forest practices. Education programs must address the needs of everyone from planners and supervisors to machine operators. These programs must clearly explain ecological processes and silviculture practices, and support the explanations with field studies. They must also explain and demonstrate rules and guidelines along with the opportunities for, constraints on, and consequences of implementing them. Finally, they must make clear the link between sustainable ecosystem management and the processes of resource extraction that occur on the land.

To keep the education process current, there must formal feedback from field personnel, managers, and industry to government, scientists, and educators. The absence of feedback systems in the present educational process must be recognized as a serious flaw, rather than a minor issue.

Education must upgrade the knowledge of the current workforce and increase the number of qualified workers on the ground.

Education must both upgrade the knowledge of the current workforce and increase the number of qualified workers on the ground. Programs are required to develop and modify policy over time, to monitor the effects of forest practices, to conduct research, and to practice adaptive management. These programs will require staffing by appropriate personnel. Disciplines such as archaeology and anthropology, not well integrated in forest management in the past, must be represented in these programs.

Forest planners, managers, and workers will need new skills to adapt to an interdisciplinary, team-oriented management approach. Training must include subjects such as group problem-solving, consensus-building, and conflict resolution. A team approach will also require shifts in attitudes about resources and disciplines and how they interrelate. Training should encourage professions to share information, ideas, and decision-making among disciplines.

3.4 Support for Change

To successfully implement sustainable ecosystem management will require support for change from labour, industry, public interest groups, and government. As a society we must redefine institutions, worker training, products, markets, and attitudes—along with planning and administrative functions. A phase-in period will be required, during which open communication and a commitment to common goals among all stakeholders will be critical.

4.0 Specific Findings and Recommendations on Current Standards

This section provides more detail on the findings emerging from the Panel's review of current forest practice standards in Clayoquot Sound. The discussion follows four main themes: maintaining watershed integrity—which includes soil, surface erosion, slope stability, water flow, water quality, and channel integrity; maintaining biodiversity; recognizing First Nations' values; and maintaining scenic resources, recreation and tourism values.[11] Each theme presents:

- a rationale that describes the major concepts in the theme and identifies what must be protected, maintained, or adopted to ensure sustainability;
- goals and objectives for the theme following from the Panel's Guiding Principles;
- findings about the ability of current standards to meet these goals and objectives; and
- recommendations for changes necessary to meet these goals and objectives.

These findings and recommendations will guide the development of standards for sustainable forest practices in Clayoquot Sound, which will form the basis of our final report.

4.1 Maintaining Watershed Integrity

Watersheds are the natural functional units of the landscape.

Watersheds are the natural functional units of a landscape, within which the many components of an ecosystem are connected through transfers of energy, water, and matter. Watershed integrity represents the sustained normal regime of those transfers, which depends upon the stability of bedrock, soils, and landforms. Watershed integrity is the necessary physical basis for the security of the forest and stream ecosystem.

The landscape of coastal British Columbia is ever-changing. However, natural change is slow, taking place over thousands of years. Major storms and large events such as landslides occur as part of long-term change. Such events may be catastrophic for some living parts of ecosystems, but the biota is adapted to survive or recover from occasional high-impact events.

In systems where humans have intervened heavily, the rate and degree of environmental change, and the frequency of high-impact events may significantly reduce soil, slope, and stream channel stability. The biota of systems affected may not adapt rapidly enough and, consequently, will be at substantially greater risk of loss.

[11] A subsequent report will present the Panel's findings and recommendations on current forest practice standards related to transportation systems, silvicultural systems, and harvesting methods.

In the past, many concerns about forestry-related effects on ecosystems centered around impacts on fisheries. These impacts were often the cause of serious land management conflict. From the late 1950s, attention focused on the effects of increased sediment and water temperature on fish and fish habitat. Sediment effects on fish directed attention to questions of soil erosion and slope stability. Over time, research has shown that channel integrity, large woody debris in channels, and the riparian area also affect fish and fish habitat.

Effective ecosystem management conserves fisheries, wildlife, and biodiversity.

The Panel assumes that if ecosystem management is carried out successfully, special values associated with fisheries, wildlife, and biodiversity will be conserved. Management procedures that maintain watershed integrity will provide ecological protection for terrestrial and aquatic life, and for fisheries values.

The following four subsections consider components of watersheds that must be maintained to attain watershed integrity.

4.1.1 Soils, Slope Stability, and Erosion

The landforms, surficial materials, and soils[12] of Clayoquot Sound are a legacy of the last glaciation and over 12 000 years of post-glacial weathering and erosion. The valleys that penetrate Vancouver Island mountains are glacial troughs, with steep, rocky mid to upper slopes and gentler lower slopes commonly covered by thick glacial till. Near the mouths of larger valleys and on the Estevan coastal plain, glacial outwash and marine sediments occur. On the floors of the larger valleys, floodplains, fluvial fans, modern deltas, and estuaries have formed in recent millennia. On the steep slopes above, weathering and gravity have modified and redistributed the glacial and bedrock materials through landslides.

Rationale

Surface materials are an important component of a watershed because they support plants, regulate the flow of water and the supply of sediment to streams, and provide the substrate for roads. Surface materials can be viewed from two distinct but related perspectives: physical (surficial materials) and ecological (soil).

Accelerated soil erosion degrades forest sites and aquatic habitat.

From a physical perspective, maintaining soil and slope stability, and preventing surface erosion are key concerns. Loss of soil through erosion can be compensated for only very slowly, by weathering of surficial materials or bedrock and by accumulating organic matter. When soil and surficial materials are eroded in new ways or at accelerated rates compared to natural "background levels," terrestrial ecosystems are degraded, and the sediments produced can

[12]The term "surficial materials" refers to unweathered geological materials such as glacial till and alluvium, whereas "soil" refers to the uppermost 1-2 m of these materials that has been modified by physical and biological processes.

cause undesirable changes in associated aquatic ecosystems. From an engineering perspective, processes such as landsliding and how surficial materials respond to manipulation such as road construction, are of particular interest.

Ecological and silvicultural interests in soil relate to its ability to support plants. Soil provides the necessary physical, chemical (nutritional), and biological conditions for plant growth. Soil also regulates the entry, storage, and flow of water and solar energy. Differences across the landscape in soil properties, and resulting capabilities, largely determine the pattern and productivity of ecosystems. Changes in soils because of their use can enhance (usually short term) or damage (usually longer term) soil capability.

On steep slopes in Clayoquot Sound, debris slides and flows are a significant process of soil erosion.

On Vancouver Island's steep slopes, weathering and gravity result in various types of landslides. Rockfalls and rockslides result from the collapse of rock faces and bluffs—sites often too steep to support closed forest and therefore not usually affected by logging.

Debris slides and flows result from a combination of steep slopes, discontinuities between the permeable soil and relatively impermeable surficial materials or bedrock, and heavy rainfall. During prolonged heavy rainfall, at times augmented by snowmelt, water moving down through the soil accumulates above less permeable material. This accumulation leads to higher pore water pressure, reduced soil strength and, on vulnerable sites, the eventual sliding of soil. Earthquakes and wind stresses transmitted to the ground via trees and windfall may also trigger debris slides and flows.

Clearcutting on steep slopes increases the frequency of debris slides and flows by disturbing soil during yarding, triggering windfall along cutblock edges, and reducing soil strength when the root web decays following cutting. Inadequately built or maintained roads can create unstable cutslopes and fillslopes, and alter slope hydrology triggering slides some distance downslope (see Section 4.1.2).

Accelerated surface erosion by water (including raindrop, sheet, rill, and gully erosion) occurs in Clayoquot Sound forests when the continuity of the protective forest floor is broken, and erodible mineral soil materials are exposed. This exposure occurs mainly along roads and landings, and on areas affected by slides and windfall. Surface erosion can result from poorly planned or poorly applied logging methods.

Roads are a major source of sediment in Clayoquot Sound forests.

Roads are usually the main source of sediment, particularly in the absence of slides and streambank erosion. Concentrated water flows along ditches are a potential continuing source of sediment, although this erosion can be reduced substantially by designing and constructing roads tailored to the local materials and by applying erosion control measures.

The physical, nutritional, and biological character of soil must be maintained to preserve its productive capability. Management of organic matter is central to all three characteristics. Organic matter on the forest floor and in the mineral soil improves the physical properties of the soil (e.g., density, porosity, permeability), affecting its infiltration capacity, water retention, and water flow. This improves the soil's resistance to surface erosion by water, and provides a more favourable physical environment for plant roots.

Because forest soils in Clayoquot Sound are relatively strongly weathered for their age, and consequently have low pH and base saturation, most "available" nutrient elements reside in soil organic matter. The mineral soil component is more important in providing a physical medium and support for plants than in storing nutrients. Ecosystem function and productivity are maintained by efficient cycling of a limited stock of nutrients. Organic matter on the forest floor and within the soil is the main source of energy and nutrients for a highly complex community of soil animals and microorganisms. These organisms are critical to the decomposition of organic matter and nutrient cycling, and other specialized functions such as nitrogen-fixation and mycorrhizal symbiosis.

Even shallow organic soils over bedrock have surprisingly good capability to support forests. When shallow soils are present, forests can successfully colonize denuded areas in 50 to 150 years, prior to redevelopment of a deep mineral soil.

Soil organic matter must be maintained to maintain forest productivity.

Soil organic matter must be maintained to maintain forest productivity. Maintaining soil capability must allow for change in soil properties over time (e.g., during forest succession). The key questions are how much change is acceptable, and over what time period. This time period varies between vegetation subzones and from site to site. After a major disturbance, forest soil will not be fully redeveloped until a late-successional forest appears—approximately 200 to 300 years in Clayoquot Sound. However, essential soil properties can recover in these organically-dominated soils in about two decades after the forest canopy closes.

Goal

- To maintain the integrity of the soil component of terrestrial ecosystems.

Objectives

- To retain the soil and surficial materials in place; that is, to manage the land and ecosystems so that modes and rates of landsliding and erosion are not significantly changed, and remain within the range of natural variability.
- To maintain the physical, chemical (nutritional), and biological characteristics of the soil and maintain the soil's capability to sustain a wide range of ecosystem states.

Both objectives are inherent to soil conservation. Achieving the first objective is a prerequisite to water conservation, and to achieving the second objective.

Findings

Although considerable progress has been made recently in understanding and avoiding soil instability, current standards do not adequately meet these two objectives.

- "Operable forest" is that portion of the "production forest"[13] that, under current market conditions, can be harvested at a profit. The process used to determine the operable forest for commercial timber production has been poorly defined and unevenly applied. This process does not adequately consider the fundamental ecology of the land.

- In the steeper terrain of much of Clayoquot Sound, slope instability will delimit many areas where forest cover must be maintained to prevent accelerated erosion. "Protection forests" are forests maintained on steep, unstable slopes to prevent accelerated erosion. Defining protection forests requires a consistent approach to evaluating and mapping slope stability.

- Requirements for mapping terrain and assessing slope stability are not specified in sufficient detail to ensure that appropriate information is supplied to the successive planning steps.

- There is no requirement for a landslide inventory to establish the "natural" rate against which the frequency and magnitude of landslides and erosion in disturbed areas can be compared.

- Logging and other forest management activities require physical access. An extensive road network has contributed to accelerated mass movement of soil and surficial materials. Several factors contribute to slope failures: location of roads on marginally stable slopes, fills and sidecast on excessively steep slopes, deficient road drainage structures, inadequate road and road drainage maintenance, and lack of road deactivation. Available techniques to avoid such problems have not been consistently applied.

- Road construction methods and practices on steep hillslopes have not adequately recognized the importance of shallow subsurface drainage in maintaining slope stability. Converting dispersed subsurface flows to concentrated surface flows has led to accelerated surface erosion and landslides. It has also short-circuited the natural routing of water from the soil to stream channels, thereby modifying stream flow regimes.

[13]The forest used for production of various commodities.

- Emphasis on the protection of fish-bearing (Class A and B) streams (*British Columbia Coastal Fisheries/Forestry Guidelines*) allows a lower standard of care to be applied to slopes above Class C streams.[14]

- Current standards do not require the consistent re-vegetation of exposed mineral soils associated with roads. As a result, considerable material is eroded by rainfall and surface runoff.

- Re-vegetation of landslide scars, which are vulnerable to ongoing surface erosion, has been inconsistent.

- Thin soils on steep, rocky slopes and on areas of hummocky or ridged bedrock are sensitive to disturbance. These soils include both shallow organic soils ("Folisols") that consist of an organic forest floor lying directly on bedrock, and very shallow mineral soils (<25 cm) over bedrock. These thin soils can be damaged by scraping off during yarding, consumption by fire during slashburning (largely historical), and sloughing off due to desiccation, particularly on drier, south to west aspects, and on limestone. Soils underlain by limestone are particularly vulnerable because limestones are weathered by solution, which produces deep fissures and very little residue to form a mineral soil.

- The natural water table of poorly-drained forest soils and open or sparsely wooded wetlands has not always been maintained. Although many of these ecosystems do not "produce" much wood, they are ecologically productive for a range of plant and animal species and are an important component of biodiversity.

Recommendations About Soils, Slope Stability and Erosion

1 Develop standards that maintain natural conditions of slope instability, erosion, and sediment input to all streams.

2 Identify and map areas of land, soils, and ecosystems capable of sustained production, as well as areas with sensitivities that prevent the sustainable harvesting of ecosystem products. Then, define "production forest" and "protection forest" in terms of terrain, soil, ecosystem, and site characteristics, and the "operable forest" in terms of economics and technology. The area considered production forest will not change with time unless new insight is gained from research. The operable portion of the production forest will shift in time, as economic factors change and technology develops.

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[14]The *British Columbia Coastal Fisheries/Forestry Guidelines* defines three stream classes: Stream Class A includes streams or portions of streams that are frequented by anadromous salmonids and/or resident sport fish or regionally significant fish species; or streams identified for fishery enhancement in an approved fishery management plan; stream gradient is usually less than 12%. Stream Class B includes streams or portions of streams populated by resident fish not currently designated as sport fish or regionally significant fish; stream gradient is usually 8–20%. Stream Class C includes streams or portions of streams not frequented by fish; stream gradient is usually greater than 20%.

3 Define methods and levels for mapping terrain and assessing slope stability. Apply these methods and levels consistently in developing Total Resource Plans, Development Plans, and operational plans.

4 Carry out a landslide inventory in conjunction with initial terrain and slope stability mapping.

5 Improve the location, design, construction, maintenance, and deactivation of roads and road drainage structures (e.g., ditches, stream and cross-drain culverts) to meet the demands of the wet, coastal climate.

6 Improve road design and construction techniques to better maintain natural hillslope hydrology and drainage.

7 Re-establish vegetative cover on cutslopes, fillslopes, and landslide scars consistently and promptly following disturbance (except on bedrock or clean shot-rock). Monitor the effectiveness of re-vegetation efforts and undertake follow-up work as needed.

8 For major watersheds develop comprehensive sediment and erosion control plans and programs that:

- identify and rate the severity of both natural and human-induced sources of sediment and erosion;
- integrate erosion control plans with road maintenance and construction plans; and
- outline contingency action plans for specific erosion events, and prescribe mitigation and rehabilitation measures.

9 Reserve as protection forests, areas where slopes, soils, and surficial materials have a high hazard of sliding when disturbed by logging.

10 Apply partial cutting methods to retain root strength on sites with moderate slope stability hazard, and in localized areas of high hazard where retaining small patches of standing trees poses a high risk of windfall.

11 Conserve the accumulated soil organic material of thin soils. Develop appropriate silviculture and logging plans to protect thin soils on steep, rocky slopes and on areas of hummocky or ridged bedrock.

12 Protect poorly-drained forest sites and wetlands by designing and constructing roads and road drainage, and managing adjacent upland forests in ways that ensure water tables are not altered.

4.1.2 Water Flow

Rationale

Forest harvesting changes the runoff regime.

The volume and seasonal pattern of water flows in watersheds affect the timing of many events and ecological processes (e.g., fish migration and algal production in streams). Water mobilizes nutrients for uptake by plants and animals, and transfers mineral and organic particulate material. Water on hillsides may initiate erosion, including landslides and debris flows.

Maintaining the normal volume and timing of water flows depends on maintaining the natural drainage system. Forest harvesting changes the balance of evaporation and runoff so that, for some years after logging, runoff is greater than it would have been if the forest had not been removed. Alteration of natural drainage systems may also substantially increase peak runoffs. These changes can benefit fish production during summer periods of low flow but they can also cause major damage in stream channels and aquatic ecosystems.

Changes in the natural range of flows increase soil erosion and threaten stream channel integrity.

In the steep, small watersheds typical of Clayoquot Sound most precipitation seeps into the permeable forest soils and moves downslope in subsurface drainage channels. Interruption of these pathways by cut-and-fill roadbuilding on slopes brings the water prematurely to the surface, and often redistributes surface drainage. Slope stability problems, gully erosion, increases in debris flows, and increases in sediment delivery to stream channels often follow this change in drainage pattern.

The runoff regime, including the incidence and magnitude of high flows, depends on the pattern of cutblocks in the landscape, the degree of surface disturbance throughout the watershed, the density and layout of roads, and the rate of cut. Vegetation and soil filter and transform water inputs into runoff; the manipulation of vegetation and soil influences the operation of the filter. The integrity of the drainage system is affected by road layout, construction, and maintenance practices, and by log-yarding methods. Measures that maintain the natural drainage regime contribute significantly to the maintenance of water quality and to slope and soil stability.

Goals

- To preserve the fundamental timing of ecological processes associated with water flows.
- To minimize soil erosion.

Objectives

- To maintain water flows within the range of natural variability on both a seasonal and event basis.
- To maintain the natural drainage system on hillslopes.

Findings

Principles related to runoff regimes are incorporated into forestry planning documents and manuals (notably, the *Coastal Watershed Assessment Procedure*). Drainage is a major subject in the *Forest Road and Logging Trail Engineering Practices*. In particular, guidelines about deactivating roads deal with establishing conditions to stabilize the drainage system. Aspects of drainage that affect stream channel integrity are incorporated into the *British Columbia Coastal Fisheries/Forestry Guidelines*. However, these documents do not take full account of the natural drainage pattern. Our findings are listed below.

- No formal requirement exists for information about the drainage network to be developed in sufficient detail to ensure that road construction and cutblock layout will minimize disturbance of the drainage network and runoff.
- Although provisions for road drainage are well detailed and recognize the problem posed by drainage diversions (*Forest Road and Logging Trail Engineering Practices*), no provisions assure that drainage design conforms with the natural drainage pattern.
- Hydrological analyses that would constrain land use practices to maintain runoff within the range of natural variability are not required.
- Recommended road construction practices include procedures that disturb the natural drainage pattern by forcing water to the surface at hillslope cuts.
- With the exception of some measures related to road design and construction practices, regulations and guidelines about water management and control are not mandatory, and are practically unenforceable.

Recommendations About Water Flow

1 Map permanent and ephemeral stream channels, evident seepage zones, and other significant hydrological features during pre-harvest terrain analysis. Apply this information to plan road and site development with minimal disturbance of the natural drainage network.

2 Establish regulations for the design and maintenance of road drainage that require natural drainage routes be maintained.

3 Design cutblock layout and harvest sequence at the watershed level to minimize disturbance of the natural runoff regime and to maintain flows within the range of natural variability.

4 Apply rate-of-cut criteria within watersheds greater than 200 ha in area.

4.1.3 Water Quality

Rationale

Protecting water quality within a stream ecosystem requires maintaining safe thermal regimes, controlling suspended sediment concentration, retaining natural levels of nutrients, and avoiding release of toxic materials. Unfavourable temperature, sediment, and nutrient levels each affect parts of an aquatic system. These effects vary with the intensity of disturbance.

The rates and timing of many natural processes are controlled by water temperature.

Increase in water temperature affects macroinvertebrate production and many elements in the biology of fish. The latter include fish growth, fish egg incubation rates and consequent timing of fry emergence, timing of fish movements, interspecific competition, stress, disease, and mortality.

Alteration of rates of processes such as egg incubation may affect the timing of critical events (e.g., fry movement to sea) and attainment of important growth stages (e.g., smolt transformation and timing of migration). These changes can increase or decrease the success of a particular population of fish depending on the species or life stage affected.

Increases in the concentration of suspended sediment can reduce algal production in streams, displace or eliminate species of macroinvertebrates, and affect fish in a range of ways. At low concentrations suspended sediment may alter fish social behaviour, territorial stability, and feeding effectiveness. As concentration increases, fish may suffer from gill impairment, physiological stress, changes in blood chemistry; at high sediment concentrations, fish may die. The impacts suspended sediment have on fish depend on both the concentration and duration of exposure. Fish are adapted to withstand episodic exposure to suspended sediment, but it is an undesirable and stressful environmental element where it occurs.

The fluctuations of nutrient release after logging and during post-logging silviculture treatments influence productivity in the aquatic ecosystem.

Falling, yarding, and slashburning after logging make ions and nutrients in the soil more readily available for transport by water. The rate of nutrient loss from a logged area changes over time. After logging, the flux of nutrients through a stream system increases in the short term, but decreases over the long term relative to pre-logging conditions. Short-term increases in nutrient levels have potentially positive effects on the production of stream algae and, hence, stream insects. The short-term benefits may be less than optimal because much of the nutrient influx after logging may be lost through export during autumn and winter freshets. These nutrient-export rates are particularly high if slashburning has occurred. Following these short-term upsurges, stream nutrient levels decrease during second-growth generation and may fall below levels that occurred in the old-growth forest stage.

A distribution in the landscape of early-, mid-, and late-successional forest stages must be maintained to balance nutrient release, retention and cycling. A balanced distribution also favourably influences the thermal, sediment, and water flow regimes of the stream system.

Introduction of toxic chemicals into the ecosystem can cause sub-lethal effects difficult to detect.

Toxic chemicals, released through spills or seepage into aquatic ecosystems, may have different effects on the components of the system depending on the nature of the chemical and its concentration. Release of herbicides may eradicate macrophytes. Such plant loss will in turn reduce stream insect production. Other toxic chemicals, such as brake fluid, diesel fuel, gasoline, oil, and pesticides in the aquatic system may produce a range of effects on macroinvertebrates and fish. Exposure to sub-lethal concentrations of toxins over a prolonged period, or higher concentrations over a short period, may alter the behaviour and survival of fish or invertebrates. Exposure to lethal concentrations of toxic chemicals obviously results in the loss of invertebrates and fish.

Goals

- To manage land use practices so that critical elements of water quality remain within natural ranges and follow natural patterns within the ecosystem.
- To ensure that overall ecosystem productivity is maintained over the long term (hundreds of years).
- To maintain the productivity of fish populations and other biota.

Objectives

- To maintain the stream thermal regime within the natural range for the system, including maintaining the timing of seasonal thermal changes, the range of daily fluctuations, and the levels of maximum temperatures.
- To minimize both concentration and duration of suspended sediment in aquatic ecosystems.
- To minimize the export of nutrients from the ecosystem in the period between logging and forest re-establishment.
- To prevent the entry of toxic chemicals into the hydrological system.

Findings

These water quality objectives are explicitly or implicitly recognized in current standards and guidelines for forest practice. Many of the measures that reduce suspended sediment levels will be the same as those that reduce impacts from other slope- and soil-related problems such as slides and debris flows.

The *British Columbia Coastal Fisheries/Forestry Guidelines* attempts to deal with such management concerns. These guidelines, which have evolved over a 10-year period of constructive interaction between forest and fishery managers from

the provincial and federal governments and forest industry, incorporate much useful experience.

Our findings about current standards on water quality follow.

- Aquatic ecosystems are not fully recognized as independently valued resources sharing the forest land base with timber; their management is subordinated to the management of the forest for timber.
- Water quality is not treated as an integral topic, except in relation to community watersheds.
- Current guidelines, even when they encode definitive experience, are typically written in language which makes them effectively unenforceable (e.g., "should," "may," "consider").
- The *British Columbia Coastal Fisheries/Forestry Guidelines* provides some protection for habitat (and hence for fish), but the effectiveness of these guidelines has been lost due to unenforceable language and poor compliance.
- Current *British Columbia Coastal Fisheries/Forestry Guidelines* do not mention thermal regimes in stream systems.[15] Guidelines that call for establishment of leave strips provide some control of temperature regimes in streams; however, no standards exist for acceptable levels of temperature divergence from natural values.
- The management of Class C streams[16] does not adequately consider potential downstream effects on water quality, particularly sediment introduction and woody debris deposition.
- Currently recommended forest management practices do not adequately recognize long-term effects on nutrient mobility.
- Although some documents cite "cumulative effects" as a cause for concern, the term is not adequately defined and effective protocols do not exist for measuring such effects.[17]
- No provisions exist to adjust timber harvesting operations to offset the impacts of severe natural events in aquatic ecosystems.

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[15]Information from Carnation Creek studies suggests that logging on upslope areas may affect stream temperatures, particularly in winter, with serious effects on chum salmon survival.

[16]See footnote 13.

[17]"Cumulative effects" refers to the combined effect of several different physical and/or biological factors. For example, cumulative effects on fish may reflect combined effects of increased sediment deposition, temperature alteration, and loss of channel integrity. As such, population responses may be difficult to attribute to a particular impact and adaptive management may be impossible at this level.

Recommendations About Water Quality

1 Designate floodplains, gully complexes, and alluvial fans as riparian management zones to recognize physical and ecological connections.

2 Revise the current *British Columbia Coastal Fisheries/Forestry Guidelines* to make enforceable those sections related to sediment loading and nutrient flushing.

3 Recognize the value of and develop plans that maintain aquatic ecosystems with and without fisheries resources.

4 Develop appropriate operational definitions for processes where additive and cumulative effects occur.[18]

5 Conduct research to improve understanding of the effects of slope clearcutting on groundwater and stream thermal regimes.

6 Impose constraints on the rate-of-cut and consequent area in early- and mid-successional forest at any given time.

7 Prevent the discharge of oil, diesel fuel, gasoline, pesticide, or other toxic material onto the ground or into any part of the aquatic system. Maintain a system for cleaning up toxic materials accidentally spilled.

4.1.4 Channel Integrity

Rationale

West coast British Columbia streams have high hydrological energy. Their natural flow regimes are sufficiently dynamic to cause rapid changes in channel conditions if the soil and vegetation of hillslopes or riparian areas are disturbed. These changes may be more rapid or severe if land-use practices cause more extreme flows.

Slope stability must be maintained to prevent increased sediment in streams, and to maintain channel integrity.

Channel integrity is an indicator of slope stability within a watershed. The character of the downstream channel is largely determined by the volume of sediment delivered to stream channels from hillslopes. The volume, stability, and distribution of large woody debris, the rate of channel bank erosion, and the frequency of lateral relocation of the channel are measures of channel stability. Further indicators of rates of change of channel stability include scour-rates, sediment-deposition rates, degree of channel aggradation and consequent dewatering during low flows, and the increase in channel width-to-depth ratio.

[18] An example of an additive effect is where the input of sediment to a stream comes from several different sources. Cumulative effects occur when several elements interact, for example, to reduce the productivity of fish populations.

Flushing of gravel from the upper parts of a stream system, and excessive rates of deposition in the lower parts are symptoms of destabilization of channel integrity. Loss of channel stability is indicated in the short term by changes in gravel "quality," and over the long term, by changes in gravel budgets (i.e., the amount of gravel stored in headward gullies, and the rate of gravel movement through the stream and gravel deposition in the lower reaches or estuary).

Rapid changes in channel environments may disrupt elements in the system that are critical to fish production. This may reduce production of food organisms, alter rates of fish growth, and disrupt patterns of habitat use and distribution. Such changes may also reduce fish numbers or dramatically increase fish population fluctuation, either of which increase the risk of population collapse.

Stream channel integrity must be maintained over the entire length of the drainage system to sustain the structure of the aquatic ecosystem and populations of aquatic organisms.

Large woody debris is critical to channel integrity and stream productivity in small coastal streams. Accumulations of woody debris store sediments and particulate organic matter. The latter plays a key role in biotic production in small streams. Large woody debris structures create riffles and a spectrum of different types of pools. These microhabitats are essential for insect and fish production. The debris is essential cover for fish, particularly during winter.

Lateral movement of the channel results in transport and deposition of additional sediment. In many coastal streams, this sediment destroys secondary channels (which are particularly important for rearing of young fish), fills in downstream pools, and reduces the quality of chum salmon spawning areas near the stream mouth.

Channel aggradation and increase in the width-to-depth ratio result in potentially undesirable conditions for fish production. Dewatering of the channel occurs during periods of low discharge because the water flows below the gravel surface. Increased water temperature occurs with the increased surface area per unit volume of water. The increase in scour and deposition that accompanies channel aggradation may destroy fish eggs or young fish which are hiding in the streambed, and may temporarily reduce the density of resident and drifting stream insects. All of these changes typically are accompanied by increased concentrations of fine sediment, which clog spawning gravels and directly
stress fish.

Goal

- To manage watershed systems to prevent alterations in hydrological regimes, increases in sediment input, and loss of riparian vegetation, which result in loss of channel integrity and dependent biological productivity.

Objectives

- To maintain full-length stream channel integrity.
- To maintain the character of the riparian area and the integrity of the channel in the floodplain of the stream.
- To minimize the deposition of fine sediment and sand in the channel system, and maintain the quantity and quality of spawning gravel used by fish.
- To maintain the structural diversity of the channel by maintaining the volume, stability, and distribution of large woody debris.
- To manage the floodplain and the riparian area to assure a continuing supply of large woody debris to the channel.
- To manage the slopes and gully systems to maintain at natural frequency the episodic input of large volumes of broken woody debris.

Findings

Forestry practices in coastal British Columbia frequently result in hillslope failures, debris slides, and sediment loading that directly disturb the stream channel. Prescriptions for road layout, construction, and maintenance, and for designating riparian zones must be more effective to prevent these problems. Such prescriptions are well developed in the *British Columbia Coastal Fisheries/Forestry Guidelines* for channel zones in Class A and B streams.[19] Slope stability is addressed in *Forest Road and Logging Trail Engineering Practices* guidelines. However, these documents do not sufficiently recognize how important the headwater stream channels and gullies are in mobilizing and transferring sediments into productive reaches.

Our findings about channel integrity follow.

- Current standards are not adequate to ensure that Class C channels do not become sources and conduits for extraordinary volumes of mobile sediments to move into stream reaches where fish food production or fish production occurs.
- The procedures outlined in the document *Gully Management: Field Considerations for Stream Reach C Assessments* (1993) are an excellent step toward better management of steep slope gully systems.
- Channel integrity is often put at risk because of poor compliance with the *British Columbia Coastal Fisheries/Forestry Guidelines* where compliance would have provided protection.
- Streamside leave strips are usually too restricted in extent to successfully protect channel integrity.

[19] See footnote 13.

Recommendations About Channel Integrity

1 Designate and manage riparian management zones to ensure that an adequate future supply of large woody debris is available along the immediate reach of the stream channel, even if a reach of the channel moves elsewhere on the floodplain.

2 Maintain a leave strip to protect stream channel integrity in all stream reaches with flowing water or with intermittent flows which may transport sediment or debris. Do not remove trees from this leave strip even if it seems likely that they will blow down.

3 Complete and implement procedures for assessing risk of debris and sediment transport from gully systems.

4 Implement measures to avoid creating hydrological conditions in which extremely high water flows destabilize banks and dislodge large woody debris.

5 Implement measures to avoid increasing sediment inputs from upslope areas into any reach of the stream channel or other part of the aquatic system. Deal with all potential sources of sediment including those associated with yarding, building bridges and landings, and building, maintaining, and deactivating roads.

6 Revise the *British Columbia Coastal Fisheries/Forestry Guidelines* to ensure that sections affecting the maintenance of channel integrity are written in enforceable language.

4.2 Maintaining Biodiversity

Rationale

Ecosystems provide essential ecological services.

Biodiversity means the full variety of living organisms. It includes all animals, plants, and microscopic organisms living in terrestrial, freshwater, and marine ecosystems. Biodiversity also includes the genetic variation within and among populations of each of these species. There are thousands of living species in Clayoquot Sound, many of them not yet discovered and described by scientists. Little is known about the ecological requirements of those described beyond the kinds of habitats in which they are found. The challenge of conserving biodiversity is to protect, over the long term, all these species and genetic variants from serious declines or extinctions caused by human activities.

Primary reasons for conserving biodiversity are:

- Conserving biodiversity is a prerequisite to sustaining ecosystem integrity, which depends on interactions among a broad range of the ecosystem's component species, both known and unknown.

- Ecosystems provide essential "ecological services" in addition to specific products such as timber. Examples of such services are purification of air and water, building and conservation of soil, regulation of water flow, and buffering of climatic variation.

- Many species which were considered "useless" in the past now have important uses, and many currently without known uses will become useful in the future.

- Once a species is extinct, it can never be restored; its disappearance may deprive our descendants of options we cannot foresee. We have a responsibility to future generations to maintain the options allowed by ecosystems with their full complement of native species and genetic variants.

- Canada is a signatory of the *UNCED Convention on Biodiversity*. This commits us to managing our resources in a way that does not lead to the long-term decline of biological diversity.

Maintaining biodiversity requires a system of protected areas as well as sustainable ecosystem management outside protected areas.

Maintaining biodiversity requires a system of protected areas as well as sustainable ecosystem management outside protected areas. When large areas of forest are fragmented by logging there is a loss of habitat for any species that requires extensive areas of forest interior. Large protected areas are needed for such species. Habitat for other species can be provided by smaller patches of forest in a more managed landscape mosaic. Managing forest ecosystems for biological diversity is not solely an issue of protected areas. Biological diversity depends on appropriate management of forests outside protected areas to ensure that they maintain favourable habitat attributes and do not become ecological barriers to movement.

Genetic and species diversity reflect habitat diversity.

Loss of habitat is the chief cause of species' declines and extinctions in the modern world. The protection of natural habitats is the surest approach to conserving biodiversity. Maintaining the full variety of habitats is a first step to maintaining the full variety of species and genotypes. The size and configuration in which habitats are provided is critical. The need to provide sufficient habitat for viable populations of native species is a fundamental premise of our recommendations.

Forest structure, species composition, and ecological function vary substantially over environmental gradients (e.g., rainfall) within a watershed. Variation among watersheds results from differences in the distribution of ecosystem types, ecological history, and chance biogeographic factors. Species distribution and genetic variation follow these changes in environmental factors and in forest structure, composition, and function.

Maintaining forests representing the range of environmental variation would protect the range of habitats for the creatures living there. In places such as Clayoquot Sound, where little is known about the majority of species, protecting and managing habitats becomes a surrogate for protecting and managing

species. This habitat-oriented approach must be supplemented by species-specific conservation plans where necessary (e.g., for endangered or threatened species). However, much research is needed before we can design effective plans for all but a few species.

Sustainable ecosystem management is based on natural landscape patterns and stand structures.

Through most of its history, a large part of Clayoquot Sound's forested area has been covered by older forests; young forests have normally occupied a comparatively small area. Except for landslides, natural disturbances most often kill trees in small patches; frequently they are of low intensity and leave the forest understory relatively undamaged. Wind is a common natural disturbance agent, whereas fires are infrequent. When occasional larger natural disturbances occurred in the past, they were often discontinuous and resulted in the establishment of younger forests that were structurally diverse.

Natural forest landscapes in Clayoquot Sound are dominated by old-growth forests which are diverse in composition, structure, and ecosystem function.

Where no logging has occurred, forests in Clayoquot Sound today are almost entirely old growth. Old-growth forests in Clayoquot Sound characteristically have abundant large logs and snags, uneven canopies with gaps where trees have died, well-developed understory layers, and a broad mix of tree ages. Substantial research in various types of old-growth forests has demonstrated that this structural diversity is important to many aspects of ecosystem function and in the provision of habitat for many species of plants, animals and microorganisms.

We believe more species will be maintained in their natural abundances by logging practices that create forests resembling natural stand and landscape patterns than by those which establish forests that are very different. Although almost axiomatic, this belief is currently untested. The data to test this belief must be gathered, but in the absence of data to the contrary, it presents the most logical approach to sustainable ecosystem management.

Streams and riparian areas are significant for both terrestrial and aquatic biodiversity.

Fish and the fisheries they support play a central role in the culture and economy of Clayoquot Sound. Fish depend on the biodiversity and ecological function of stream systems and riparian areas. The complex food chains supporting fish such as salmon depend on a host of physical and biological factors which are sensitive to forest management practices (see Sections 4.1.2, 4.1.3, and 4.1.4).

Stream systems and the surrounding forests are strongly linked. The root systems of streamside trees stabilize streambanks; woody debris creates a diversity of stream habitats; and leaf litter, when decomposed in streams, forms the basis for aquatic food chains. Riparian areas, in addition to being the primary habitat of large numbers of terrestrial and aquatic species, are commonly used as movement corridors or feeding sites for terrestrial species. These connections between water and land define riparian areas. A riparian area may or may not support distinctive vegetation. In either case, it is the site of important interactions.

In steep-sided rainforest watersheds, streams are numerous and their key role in ecological integrity goes beyond physical hydrological processes. We believe that maintaining the integrity of the water drainage network and its associated vegetation should be a keystone of any biodiversity conservation strategy in such areas.

Goals

- To maintain all naturally-occurring species and genetic variants such that they are able to persist over the long term and adapt to changes in their environment within the normal range of variation.
- To maintain the functional integrity of ecosystems, recognizing the connections between terrestrial, freshwater, and marine ecosystems.

Objectives

- To conserve water quality, hydrological processes and soils (see Section 4.1).
- To maintain ecosystem function by protecting the integrity of riparian areas from the terminus to the headwaters of watersheds.
- To protect habitats of known importance to particular species.
- To maintain old-growth and forest-interior habitats.
- To use forest management techniques that produce stand structures, species composition, and landscape patterns similar to those generated by the natural disturbances of forests in Clayoquot Sound.

Achieving these objectives requires integrated, ecosystem-based planning at three levels: the region, the watershed or groups of watersheds, and the stand.

Findings

Many of the documents in Tables 1-4 (Appendix III) include standards or procedures that affect the maintenance of biodiversity. Some of these documents address biodiversity directly (e.g., *British Columbia Coastal Fisheries/Forestry Guidelines, Guidelines to Maintain Biological Diversity in Coastal Forests, Guidelines for Maintaining Biodiversity During Juvenile Spacing, Interim Wildlife/Forestry Guidelines for Biological Diversity at the Stand Level During Juvenile Spacing Entries, Guidelines to Maintain Biodiversity in TFLs 44 and 46*). Other documents address aspects of forest planning that affect biodiversity indirectly. Our findings from a review of these documents follow.

- When applied well, the *British Columbia Coastal Fisheries/Forestry Guidelines* achieves its objective of maintaining salmonid habitat. The guidelines, however, do not (and were not intended to) maintain the full biodiversity of freshwater systems.

- The *British Columbia Coastal Fisheries/Forestry Guidelines* also does not mention thermal regimes in stream systems. Available data suggest that logging in headwater areas beyond the range of fish can affect stream temperatures in both winter and summer, hence survival of salmon and other aquatic organisms.

- Stream classification focuses on presence of fish. These classifications are inadequate to meet the needs of all species that require stream and riparian habitats. Stream classification considers gradient but not streambank stability, sediment loads, or transport capability.

- Protection of riparian areas is not afforded to all streams, and protection of steep stream gullies and gully-headwall complexes often is insufficient. Where riparian zones are designated, rules governing the protection and management of riparian zones do not provide for adequate streamside protection.

- The draft *Guidelines to Maintain Biological Diversity in Coastal Forests* defines a procedure for designating Forest Ecosystem Networks (FENs) based primarily on areas with existing administrative constraints on harvesting (e.g., parks, Environmentally Sensitive Areas, visually sensitive areas, and inoperable areas). While such areas may have value in a plan for maintaining biodiversity, their inclusion in FENs currently requires no assessment of their potential contribution to biodiversity. This approach places apparent emphasis on minimizing the removal of land from timber harvesting rather than on maintaining biodiversity.

- The *Guidelines to Maintain Biological Diversity in Coastal Forests* assumes that maintaining 12% of the land and 20% of the forest as old growth will adequately maintain biodiversity. These targets are set *a priori*, without a strong biological rationale.

- Current procedures to prepare sites for planting trees do not recognize the importance of down wood as habitat for small mammals, amphibians, invertebrates, and fungi.

- Recommendations for numbers of wildlife trees per hectare are inconsistent among documents. Further, these estimates consider mainly nesting requirements for woodpeckers. Recommendations to retain wildlife trees do not recognize clearly that patches of trees are often more useful than trees left individually.

- Guidelines to maintain biodiversity often conflict with other guidelines (e.g., utilization standards require removal of all logs with commercial value from the treatment unit). Although silviculture standards (e.g., species planted,

stocking levels) are somewhat flexible, they may not be sufficiently flexible to maintain the desired biodiversity.

- Most documents are based on the premise that clearcutting is the silvicultural system of choice. They do not provide standards relevant to other silvicultural and harvesting systems (e.g., appropriate approaches to retaining large trees, dying trees, and down wood will vary with silvicultural system). Alternative standards will often be required when other silvicultural systems are employed (e.g., "green-up" criteria established for clearcuts may be relaxed under a selection system).

- Definitions of the size of a "landscape unit" (large areas used in planning) vary considerably among documents.

- Current guidelines to maintain biodiversity recommend that a variety of patterns and age classes of tree species be arranged on the landscape but do not provide sufficient rationale for doing so.

- The spatial consequences of various harvesting patterns have not been adequately considered.

- Spatially explicit planning (whether 5-year or 20-year) uses time periods too short to integrate the long-term needs of biodiversity.

- Some forest planning documents (e.g., *Clayoquot Sound Forest Practices Standards*) recommend cutting patterns that will produce a regular checkerboard of cut and uncut areas on the landscape. This pattern fragments the remaining forest. Moreover, the next pass of harvesting may result in large areas of early seral stages, which can be detrimental to many wildlife species.

- Planning documents currently require only the use of "readily available information" to plan for biodiversity. In most cases, readily available information is inadequate to develop a management plan that reflects biodiversity requirements; better inventories are required.

- Many of the recommendations found in larger scale planning documents are not reflected in the more specific documents dealing with smaller areas. In particular the recommendations for inventory of a wide variety of resources found in the *Coast Planning Guidelines* are not reiterated in the more widely used *Five Year Development Plan Guidelines*.

- The *Coast Planning Guidelines* do not specifically consider the roles that riparian and late successional forests play in ecosystem productivity, hydrological processes, landscape connectivity, and biodiversity.

- Planning documents do not explicitly recognize the importance of closing some roads or minimizing road density to maintain wildlife species that are sensitive to human activities.

- Pre-harvest Silviculture Prescriptions (PHSPs) do not require the stand-level management practices recommended in the *Guidelines to Maintain Biological Diversity in Coastal Forests.*

- No procedures or objectives have been specified for selecting trees or patches of trees to be retained when carrying out alternatives to clearcutting. This makes undertaking such treatments more difficult and less likely to achieve objectives broader than just timber management.

- The *Pre-harvest Silviculture Prescription Procedures and Guidelines for the Vancouver Forest Region* document recommends leaving trees of good form to avoid highgrading, but does not recognize the utility of large trees with poor form (e.g., big branches, deep canopies) to wildlife species.

- Some guidelines addressing concerns for scenic resources recommend removing snags or trees with poor form, minimizing stump heights, and removing slash. These suggestions conflict with concerns for biodiversity.

Recommendations About Maintaining Biodiversity

1 Develop a regional system of protected areas that protects representative examples of all major ecosystems.

2 Undertake complementary activities to maintain biological diversity in managed watersheds.

3 Require an inventory of ecological resources as a prerequisite to development planning.

4 In managed watersheds, maintain the connection between habitats by ensuring that treatment units are not ecological barriers. This can be accomplished by choosing appropriate silvicultural systems, green-up periods, and silviculture treatments, or by developing Forest Ecosystem Networks (FENs).

5 Build FENs from the following critical components:

- riparian management zones adjacent to water bodies, including some upland habitat;

- habitats important to threatened and endangered species;

- patches of old forest large enough to provide forest-interior habitat for species requiring those conditions;[20] and

- representation of rare ecosystems which are not included in any of the previous components.

[20]Marbled Murrelet may be an example.

Areas of inoperable and unmerchantable forest can be included, but not at the expense of any of the previous components.

6 Develop a stream classification system based on broad criteria of biological diversity and hydrological and geomorphic processes, rather than primarily on fish.

7 Protect riparian areas. Retain most trees (including merchantable trees) and understory vegetation in riparian areas to maximize the value of riparian areas for terrestrial and aquatic biodiversity.

8 Recognize the importance of coarse woody debris as habitat in guidelines and standards for stand management (e.g., utilization standards, site preparation guidelines).

9 In all watersheds, minimize the number, total length, and width of cleared right-of-way of roads, and deactivate some roads after use to accommodate species sensitive to human activity.

10 Develop a planning procedure for retaining trees for wildlife individually and in patches at the stand level. In the procedure, recognize that appropriate levels and patterns of retention will vary among sites. Require PHSPs to include a prescription for structural retention in each treatment unit.

11 Base guidelines for stand structure, age-class distributions, and landscape patterns on the historical states of forests in each area. In Clayoquot Sound, focus stand-level prescriptions to maintain biodiversity on maintaining old-growth characteristics in managed stands. These characteristics include large old trees, large down wood, dying and dead trees, and complex vertical and horizontal structure.

12 Require planning documents to consider a range of silvicultural systems for the watershed. Include structural retention in standards for silvicultural systems. Incorporate stand-level management practices in PHSPs (e.g., as recommended in the *Guidelines to Maintain Biological Diversity in Coastal Forests*).

13 Avoid silvicultural systems that produce a regular checkerboard of cut and uncut areas across the landscape (e.g., clearcutting).

14 Develop guidelines for resolving conflicts between existing guidelines (e.g., between guidelines for biodiversity and utilization standards). Ensure that stocking standards and other silviculture standards are flexible enough to maintain biodiversity.

15 Develop procedures for resolving potential conflicts between guidelines for scenic resources and for biodiversity (e.g., removing what might be considered unsightly snags that are valuable woodpecker habitat). Provide public education on why specific practices are undertaken for biodiversity.

4.3 Recognizing First Nations' Values and Perspectives

Rationale

Agenda 21 of UNCED '92 recognizes the relevance of traditional values and resource management practices. Specifically, it recognizes:

International principles recognize the importance of First Nations' values and traditional knowledge.

- the need to protect the lands of indigenous people and their communities from activities that are environmentally unsound or that the indigenous people consider to be socially and culturally inappropriate; and
- the importance of First Nations' values, traditional knowledge, and resource management practices in promoting environmentally sound and sustainable development.

Similarly, UNCED's *Guiding Principles on Forests*, included as a principle:

- National forest policies should recognize and duly support the identity, culture, and rights of indigenous people, their communities and other communities, and other forest dwellers. Appropriate conditions should be promoted for these groups to have an economic stake in forest use, perform economic activities, and achieve and maintain cultural identity and social organization as well as adequate levels of livelihood and well being through *inter alia*, those land tenure arrangements which serve as incentives for the sustainable management of forests.

Forest policies and standards should protect sites and areas of cultural and spiritual importance to First Nations.

Nuu-Chah-Nulth people have always relied on land, foreshore, and offshore resources for sustenance. The Nuu-Chah-Nulth people form a majority of the population of the Clayoquot Sound area, yet they have benefited least from economic activity in the area. Further, their cultural sites have been threatened or damaged by activities of the dominant non-indigenous culture. Many of these sites are essential for Nuu-Chah-Nulth cultural and spiritual well-being. For these and other important reasons First Nations must be one of the primary participants in determining the extent of logging activities in Clayoquot Sound.

Goals

- To recognize and support the long-standing aspirations and needs of the Nuu-Chah-Nulth people which are based on traditional occupation and use of the land and waters.
- To recognize, support, and incorporate Nuu-Chah-Nulth traditional ecological knowledge and values into land use planning and decision-making.
- To recognize and support the intent of the *Interim Measures Agreement* to engage Nuu-Chah-Nulth participation in Clayoquot Sound land and resource use, including aquatic and marine systems.

Objectives

- To recognize and respect the fundamental spiritual heritage of the Nuu-Chah-Nulth.
- To accommodate First Nations' traditional ownership of land and resources in Clayoquot Sound in land use decision-making and activities.
- To involve the Nuu-Chah-Nulth in planning and managing resource use activities in Clayoquot Sound.
- To consult and negotiate with Nuu-Chah-Nulth about economic benefits before developing further economic activity in Clayoquot Sound.
- To ensure that forest practices do not negatively impact Nuu-Chah-Nulth foreshore and offshore resource use.
- To ensure that cultural sites defined by the Nuu-Chah-Nulth are inventoried, mapped, effectively protected, and restored where damaged.

Findings

Other than providing minimal protection for archaeological sites, current standards do not recognize Nuu-Chah-Nulth interests and needs. This is a major deficiency in current forest practice standards in Clayoquot Sound and a key issue to be resolved. Recommendations for including First Nations' values are discussed in Section 5.1.

4.4 Maintaining Scenic Resources, Recreation, and Tourism

The way the landscape looks is vitally important to numerous groups including tourists, recreationists, residents, and First Nations. Not only is the purely aesthetic aspect important, but also appearances indicate the general state and vitality of resources and the attitudes of resource managers.

4.4.1 Scenic Resources

Rationale

The scenic resources of Clayoquot Sound are outstanding. Dramatic exposed topography along the west coast provides panoramic views from Pacific Rim National Park; scenic alpine, river, and lake landscapes are visible from the highway; and many kilometres of coastal waterways include steep fjords, islands, estuaries, and distinctive shoreline features. Large open areas provide significant views up valleys and over ridges, often to alpine peaks in the background.

There have been major impacts on the scenery in portions of Clayoquot Sound due to extensive logging. Vast mountainsides have been clearcut to such a degree that it will take many years for scenic values to be re-established. Other areas remain in an unaltered state.

Forest appearance, and its implications, are important to many people.

Scenic resources are particularly valuable to tourists and recreationists, who represent major and growing industries in British Columbia. In recent studies[21] in which tourists and recreationists were asked to identify the resources most important to their activity, all groups but one indicated that scenery is highest in importance. The only exception was the sport-fishing group that ranked presence of fish first and scenery second.

Scenic resources are also important to resident groups including First Nations, who speak often about the wounds that previous forestry activities have inflicted on the land. Because people have a strong interrelationship with the landscape and care about it deeply, it is essential that the public be given the opportunity to understand and comment on scenic resource analysis and planning.

Analysis of scenery involves more than assessing the degree of logging which is acceptable—which is how it has often been viewed in the past. To manage for scenery, the inherent characteristics of the landscape must be analyzed to consider how all land and water uses affect the scenery as it is experienced by different types of viewers.

Scenic resources must be planned and managed at a broad scale.

To fully understand scenic resources, it is necessary to look at broad patterns in the landscape in terms of inherent characteristics, type and degree of use or alteration, and existing and potential public use. People experience scenery over a large area, generally in relation to a "trip." If the landscape is analyzed and planned only at a detailed scale, these broad patterns will not be acknowledged. The detailed level of analysis is also important for more specific forest planning applications.

Scenic resources have traditionally been considered at the inventory and analysis stages of forest planning. This approach has been inadequate for protecting scenic resource values. Without plans for scenic resource management, the protection of scenic values cannot be ensured. Because every alteration affects the scenery, visual landscape principles should be used in the layout of all forest plans. That approach will help ensure that scenic resources are protected.

Goals

- To manage scenic resources to maximize the enjoyment of those present by ensuring that opportunities for tourism and recreation reflect the inherent quality of resources in an area.

[21]Ministry of Tourism, Recreation and Culture. 1991. Survey of coastal tourism operators.

- To ensure that First Nations and other residents are satisfied that the essential elements of the scenery around them are maintained.

Objectives

- To provide for a range of visual landscape experiences ranging from completely unaltered or undeveloped settings to areas with various uses. To plan the experiences in relation to existing and potential recreation and tourism routes.
- To conduct sustainable forest practices and related educational/interpretive programs, because this will affect how people perceive forest practices and the landscape.
- To apply landscape design principles in all areas so that the visual impacts of commercial forestry are minimized through proper location, size, and shape of alterations.
- To maintain examples of different types of natural landscapes in a relatively unaltered state so that people can experience their landscape heritage (e.g., fjord, lake, archipelago).
- To use procedures for landscape analysis and planning which are as thorough and objective as possible, and which involve recreation, tourist, and resident groups.
- To consider all existing and potential uses of the landscape in inventory, analysis, and planning for scenic resources.

Findings

Requirements, guidelines, and procedures for visual landscape management are changing rapidly. Because numerous documents have been released within the past year and methods continue to evolve, evaluating existing standards is difficult. Many of the recently-developed standards have not yet been used or implemented in the field.

When evaluating current standards for visual landscape management, we considered two kinds of source documents: standards specific to visual landscape management, and general forest practice standards. Our findings about scenic resources follow.

- The current visual landscape management system is completely oriented to timber production and does little to account for other existing or potential integrated management uses. Forest landscape inventory is specifically related to existing and potential logging. Landscape analysis, which sets visual quality objectives (VQOs), is based on determining the maximum amount of logging that can occur, rather than an evaluation of scenery.

- Visual landscape management is sometimes treated as a subset of recreation planning although scenery is important to many people besides recreationists.

- Visual landscape management techniques focus almost exclusively on identification and analysis of "landscape units" which are very small (e.g., unaltered steep face of a slope). Analyzing the broader landscape, however, is critical to decision-making.

- Currently, the closest that visual landscape planning comes to actual planning is the application of VQOs on a landscape unit basis. The results of this process more closely resemble landscape "prescriptions" than they do a landscape "plan." Recommendations for landscape management need to go beyond the level of site-specific prescriptions and VQOs in their content and geographical range.

- Landscape experts recommend VQOs for specific areas. These recommended scenic values are considered along with other forest values and approved VQOs are established by the Ministry of Forests District Manager. There is inconsistency in the degree to which approved VQOs reflect recommended VQOs, and no process exists for balancing the various concerns (e.g., scenery, timber).

- Forest planning and management as currently practised do not integrate visual landscape values into decision-making to an acceptable degree. Many forest plans do not adhere to landscape design principles.

- Because forest plans, including landscape inventory, are usually presented to the public as technical documents which are difficult for the lay person to understand, meaningful public involvement is minimal.

- There are problems with the current system of landscape inventory. For example, visual absorption capability (VAC)[22] is intended to incorporate site productivity information which is generally not known to the person doing the landscape inventory. Landscape sensitivity rating (LSR) is intended to account for so many factors (some of which can only be assumed, such as user expectations), that LSR becomes a relatively subjective rating, and therefore inconsistent. Determining areas from which landscape inventory is conducted is also inconsistent. For example, inventories in the past were conducted only from highways and primary water corridors, whereas some visual landscape inventories are now conducted from logging roads and trails.

- The current visual landscape management system applies only to "visually sensitive areas," but these are not defined. Are they areas with high and medium sensitivity (as identified in a landscape inventory), entire identified scenic corridors, or any areas that are visible from a public use area?

[22]The ability of the landscape to absorb detectable alteration.

- The recent development of the draft *Visual Landscape Management Guidelines for Visually Sensitive Areas Within Provincial Forests* is a positive step. Unfortunately, it is not clear where these guidelines apply; they are at times in conflict with other guidelines, and many of the site-specific guidelines for landscape management are difficult to interpret and enforce. For example, biodiversity guidelines recommend leaving slash in place, and visual landscape guidelines recommend removing slash. Virtually no research efforts have integrated the concerns of various disciplines.

- Procedures for monitoring the effects of logging using visual landscape management methods are inconsistent. Monitoring is extremely important to the ongoing process of accountability and to the improvement of standards and techniques.

- Few examples of the visual effects of alternative silvicultural systems are available.

- Current standards for landscape inventory and analysis were originally developed by the U.S. Forest Service and have evolved and been modified through use. Little scientific or perception research has checked or justified the methods, which have not been updated substantively since computer technology became available.

- There is no consistent requirement for long-term planning (minimum 20 years) of forests that incorporates visual landscape management principles.

- Many forest practices documents are vague in their references to visual landscape management. For example, *Clayoquot Sound Forest Practices Standards* states that a Total Resource Plan will contain "a forest landscape management plan." However, that term is never defined and is not used in the visual landscape management documents. *Development Plan Guidelines* for the Vancouver Forest Region states that the Development Plan should include a landscape inventory, but provides no direction about what to do with that inventory. The *Coast Planning Guidelines* states that integrated resource management planning should incorporate aesthetic resources, net down the land base addressing concerns such as landscape issues, and use landscape management requirements to determine harvest pattern. Specific methods for these processes are not provided.

- To address some of the previous shortcomings, the document *Procedures for Factoring Recreation Resources into Timber Supply Analysis* was prepared in December 1993. This document represents a first step towards incorporating visual landscape considerations into forest planning, but it also has drawbacks. The procedures are a highly quantified approach to determining the amount of area which can be "denuded" within each landscape unit. While the procedures present defined information which can readily be passed on to the person doing the forest planning, some concerns are:

- because this information could be generated easily by a timber supply analyst there may be less perceived need to involve a landscape expert in planning, even though there would not be enough information for a timber supply analyst to adequately plan for scenic resources; and

- these procedures have been developed within a timber-oriented approach to forest management, which the Panel views as too restrictive.

Recommendations About Scenic Resources

1 Inventory, analyze, and manage scenic resources in all areas, not only "visually sensitive areas." Recognize that the level of management may vary depending on the scenic values in respective areas.[23]

2 Develop long-term plans (minimum of 20 years) that outline management objectives for scenic resources over large areas.

3 Develop methods for more objective landscape inventories, and complete landscape inventories using these methods.

4 Consider other uses than timber management in the inventory, analysis, and planning of scenic resources.

5 Analyze scenic resources with consideration for existing and potential tourism and recreation opportunities.

6 Include the perceptions of First Nations and other residents in Clayoquot Sound in all analyses of scenic resources.

7 Provide opportunities for meaningful input from public, tourism industry, recreation, and First Nations groups on scenic resources inventory, planning, and management.

8 Use landscape design principles to develop forest plans, integrating ecological and cultural values.

9 For key areas identified during landscape analysis, illustrate the visual effects of planned forestry development[24] and make these plans available for public input.

10 Monitor the effects of all forestry activities on scenic resources. Document findings immediately and use them to evaluate and modify existing plans as necessary.

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[23]For example, management for scenic values would have higher priority in Special Management Scenic Corridor Areas than in the General Integrated Management Areas outlined in the *Clayoquot Sound Land Use Decision*.

[24]For example, using three-dimensional techniques such as computer perspectives.

4.4.2 Recreation and Tourism

Rationale

Clayoquot Sound has outstanding resources for recreation and tourism.

Recreational activities are rapidly growing in importance in B.C. and particularly in Clayoquot Sound. Numerous studies have documented the significance of recreational pursuits to the public[25] and economic statistics show that recreation and tourism are already major contributors to the wealth of the province.[26] The fact that recreational values must be addressed in all forest planning and management activities is rarely questioned.

Clayoquot Sound has outstanding resources for recreation and tourism. Pacific Rim National Park and the surrounding area provide significant opportunities for many activities including viewing of natural systems such as old-growth forests. Some of the primary activities beyond the road-serviced area include wildlife viewing tours, kayaking, air tours, sport fishing and excursions (e.g., to Hot Springs Cove). Many of these opportunities and others, such as remote lodges and yachting, have the potential to expand.

Tourism has not been adequately addressed in forest planning and management.

Tourism is one of the largest industries in the province. While some tourism interests are recognized in current forest management standards through the protection of scenic and recreation resources, current standards do not ensure that the specific needs of the tourism industry are identified and addressed.

Some of the objectives and requirements for tourism and recreation are the same, and others differ. Recreation and tourism are presently within the jurisdictions of different provincial ministries. Recreation and tourism should be integrated in forest planning, whether within one combined program or through separate, linked programs. This report includes tourism when discussing recreation with the intent that procedures for the two be integrated.

To properly understand recreation resources, broad patterns of use and detailed sites must be examined. Recreation or tourism experiences often extend over large areas. To be effective, analysis and planning must consider the entire experience including the voyage to a destination and the destination itself in its surroundings.

Recreation resources have traditionally been considered at the inventory and analysis stages of forest planning. This approach has inadequately protected recreation values. If no plans for recreation resource management exist, the protection of recreation values cannot be ensured.

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[25]Outdoor Recreation Council of British Columbia. 1988. The future of outdoor recreation in British Columbia; *and* Parks and Recreation Federation of Ontario. 1992. The benefits of parks and recreation.

[26]Tourism contributed $2.662 billion to provincial gross domestic product in 1991. (B.C. Ministry of Tourism and Ministry Responsible for Culture. 1992. Tourism's value to British Columbia.). Industry, Science and Technology Canada, Ministry of Tourism, Ministry of Regional and Economic Development. 1991. Marine tourism in British Columbia: opportunity analysis.

Public involvement is needed at various planning levels.

Because recreation and tourism are public activities, the public perspective is extremely important at all levels of recreation and tourism planning. The public can assist in inventory, must be able to express views about analysis, and will have valuable comments on recreation plans.

Goals

- To manage resources to protect features which are important to tourism and recreation.
- To provide recreation and tourism opportunities that reflect the inherent quality of the resources in Clayoquot Sound and the recreational desires of residents and visitors to the area.

Objectives

- To provide for a range of recreation and tourism opportunities from wilderness-based expeditions to high-end excursions that are sensitive to and based on the area's natural resources.
- To protect valuable resources for recreation and tourism.
- To use procedures for recreation and tourism analysis and planning which are as thorough and objective as possible.
- To integrate into recreation planning the use patterns and needs of tourist and resident groups including First Nations.
- To involve recreation, tourist, resident, and First Nations groups in planning and managing recreation resources.

Findings

Long-standing procedures for recreation inventory have functioned relatively well with minor refinements occurring as required. However, recreation planning and clear requirements for incorporating recreation needs into forest plans have been lacking. Guidelines to address these shortcomings are under development.[27]

[27]For example: B.C. Ministry of Forests. 1993. Procedures for factoring recreation resources into timber supply analysis; *and* B.C. Ministry of Forests. 1994. An interim guide for completing a recreation analysis report in the Vancouver Forest Region.

The primary document related to forest recreation is the B.C. Ministry of Forests' *Recreation Manual*. This document presents a method for recreation inventory which also includes some analysis of the significance of recreation resources. Until recently, other documents dealt with specific topics such as cave management or protected areas.[28] The following are the primary findings about these recreation documents.

- Recreation inventory methods that focus primarily on identifying and analyzing recreation resources at a relatively detailed scale are not sufficient for understanding and portraying overall patterns of recreation use.

- Recreation planning does not currently address tourism planning needs nor has planning for tourism been adequately addressed in other forest management programs. (The Scenic Corridor Planning Process occurring in Clayoquot Sound is a notable exception.) Tourism is an important activity in forest areas and is relevant at the inventory, analysis, and planning stages.

- Recreation analysis indicates the significance of recreation resources and assigns each recreation resource to a management class. But no formal planning process deals with recreation resources except in designated wilderness areas.

- Recreation experts conduct the recreation inventory and analysis, usually with input from user groups. The inventory and analysis mapping is presented in a highly technical way. The opportunity for meaningful public or tourism operator involvement is limited once documents have been drafted. The completion of the analysis by experts and the lack of public review can pose problems in consistency because the analysis of recreation significance is fairly subjective.

- Forest planning and management as currently practised do not incorporate recreation values into decision-making to an acceptable degree. This deficiency derives from the lack of recreation plans or the measures required to protect recreation resources. Recreation experts appear to be involved in forest planning on an *ad hoc* basis.

- No consistent procedure exists for monitoring the effects of forestry activities on recreation resources. Monitoring is extremely important to ongoing accountability and improvement of standards and techniques.

- Many forest practice documents are vague in their references to incorporating recreation concerns or make recommendations that would be difficult to fulfill with available information. For example, the *Clayoquot Sound Forest Practices Standards* states that "a Total Resource Plan will contain location of protected areas and deferred areas and linkages needed to

[28]B.C. Ministry of Forests Recreation Branch. 1993. Wilderness management handbook.
B.C. Ministry of Forests Recreation Branch. 1990. Cave management handbook.

maintain . . . recreational values." Because recreation plans do not exist, the information needed to meet that requirement is only available through direct contact with a recreation officer, which may or may not occur. *Development Plan Guidelines Vancouver Forest Region* states that the Development Plan should include a recreation inventory, but provides no direction about what to do with that inventory.

- The proposed *Forest Practices Code* recommends the use of Recreation Opportunity Spectrum (ROS) objectives, but at the present time ROS categories are established as objectives only for designated wilderness areas.

- At the analysis level, the document *An Interim Guide for Completing a Recreation Analysis Report in the Vancouver Forest Region* addresses many of the concerns and existing drawbacks noted previously. The recommended procedure needs to be tested, refined, and monitored.

- To address some of the shortcomings noted previously, the document *Procedures for Factoring Recreation Resources into Timber Supply Analysis* was prepared in December 1993. This document represents a first step towards incorporating recreation considerations into forest planning. It provides for recreation values to be incorporated within the Environmentally Sensitive Area (ESA) system.[29] Some observations are:

    - The appropriateness of the ESA system for this purpose must be evaluated over time. A concern is that ESAs are used to protect specific values (e.g., wildlife) but they do not guarantee that the areas identified will be used for recreation.

    - The recreation inventory, and especially the recreation capability information may not be well adapted to the ESA system because they were not developed for this use.

    - Because this information could be generated easily by a timber supply analyst there may be less perceived need to involve a landscape expert in planning, even though there would not be enough information for a timber supply analyst to adequately plan for recreation resources.

    - These procedures have been developed within a timber-oriented approach to forest management, which the Panel views as too restrictive.

[29]Environmentally sensitive areas include potentially fragile, unstable soils that may deteriorate unacceptably after forest harvesting, and areas of high value to non-timber resources such as fisheries, wildlife, water, and recreation.

Recommendations About Recreation and Tourism

1 Develop long-term plans (minimum 20 years) covering large areas that outline management objectives and specific plans for protecting recreation and tourism resources.

2 Provide opportunities for meaningful involvement by public, tourism industry, recreation, and First Nations groups on recreation resource inventory, planning, and management.

3 Integrate the requirement to maintain recreation and tourism resources into forest plans at all levels.

4 Monitor the effects of all forest activities on recreation and tourism values. Document findings immediately and use that information to evaluate and modify existing plans.

5.0 Key Issues Arising From the Review

The Panel recognizes that not all issues arising from its review of current forest practice standards in Clayoquot Sound are equally important. This section discusses some key issues and presents findings and recommendations concerning them.

5.1 Inclusion of First Nations in Clayoquot Sound

In its review of current standards, the Panel found that First Nations' values and perspectives were not included at a level consistent with internationally recognized goals, such as those of *Agenda 21* and *Guiding Principles on Forests*.[30]

5.1.1 Existing Situation

Few of the standards and guidelines applicable to Clayoquot Sound contain references to, or recognize, First Nations' interests in forest practices in the area. Some steps are being taken to address this deficiency.

An *Interim Measures Agreement* about joint management of parts of Clayoquot Sound was negotiated between the Nuu-Chah-Nulth Tribal Council and the Government of British Columbia, and ratified by both parties on March 19, 1994. This agreement creates a Central Region Board whose objectives will include assessing forest practices in Clayoquot Sound relative to world class standards and including perspectives of First Nations.

The Scientific Panel specifically included First Nations' perspectives in its first report of January 31, 1994 by stating that: "The cultural, spiritual, social, and economic well-being of indigenous peoples is a necessary part of forest management in Clayoquot Sound." More specifically, the report stated: "Indigenous peoples live within the landscape from which they and the rest of society extract resources. Because of their longer, often closer connections to nature, the cultural and spiritual relationships of First Nations peoples with their environment are different from those of other cultures. Such cultural and spiritual needs must be accommodated in standards governing land use and resource management."

[30]These documents emerged at UNCED '92, or the "Earth Summit" at Rio de Janeiro.

5.1.2 Findings About Inclusion of First Nations

As noted in Section 4.3, First Nations' values, perspectives, and interests are not reflected in current forest practice standards for Clayoquot Sound. Deficiencies are listed below.

- Nuu-Chah-Nulth people and Nuu-Chah-Nulth interests are currently not included in planning and decision-making processes at any stage of forest planning in Clayoquot Sound. The Interim Measures Agreement will begin to remedy this omission by creating the Central Region Board in 1994.

- Traditional ecological knowledge and lived experience of the Nuu-Chah-Nulth are neither recognized nor incorporated into forestry planning and forest practices. (These include understanding of loss of ecosystems and biodiversity.) Information, such as that contained in the writings and oral presentations to the Panel by Nuu-Chah-Nulth elders (e.g., *Herring in Clayoquot Sound, Forestry and Fishing in Clayoquot Sound*), demonstrate the importance of recognizing traditional ecological knowledge of the Nuu-Chah-Nulth in forest planning and forest practices.

- Traditional Nuu-Chah-Nulth concepts and philosophies about land tenure and resource management are neither recognized nor respected. The Nuu-Chah-Nulth people have long had a complex and sophisticated system of land and resource management, centering around ownership and stewardship of specific sites and their resources by hereditary chiefs. All the lands, waterways, shorelines, and offshore sites, except for relatively remote areas far inland, fall under this system of ownership, control, and resource use, called HaHuulhi ("private ownership").

- The identification, description, protection, and restoration of culturally important sites and resources in the Clayoquot area are not adequate. Documents reviewed by the Panel indicate that archaeological sites, including middens, burial sites, habitation sites, culturally modified trees and wood, and rock art, are the only type of cultural heritage sites currently recognized for protection. Some culturally important sites that fulfill spiritual, cultural, ceremonial, and educational needs, as well as needs for sustenance and economic benefit, are currently excluded.

- There is no requirement to employ or include First Nations and other residents in managing, research, and monitoring programs. This deficiency denies non-indigenous managers access to Nuu-Chah-Nulth traditional knowledge and lived experience.

5.1.3 Recommendations About Inclusion of First Nations

The Panel makes the following recommendations to incorporate First Nations' interests and perspectives into standards and practices for Clayoquot Sound.

1 Include First Nations representatives at the onset of planning processes for Clayoquot Sound.

2 Respect traditional values, spirituality, and HaHuulhi, and provide for the traditional resource use and subsistence needs of the Nuu-Chah-Nulth in forest planning and management.

3 Incorporate First Nations' forest management practices, which are founded in traditional values and ecological knowledge, and which arise as a result of treaty negotiations, in forest inventory, planning, and management.

4 Conduct comprehensive consultation with the Nuu-Chah-Nulth about land use practices as specified in the *Interim Measures Agreement*.

5 Define cultural sites more comprehensively according to First Nations' understanding (e.g., including a variety of sacred sites, berry-picking sites, medicine-gathering sites). Use Nuu-Chah-Nulth guidance to undertake research, inventory, and identification of culturally relevant places and resources.

6 Recognize the importance and potential of concepts of tribal parks and sacred site reserves in land use planning.

7 Restore traditional sites that have been altered or degraded by logging practices (e.g., the former Carter Lake in Herbert Arm) in consultation with the Nuu-Chah-Nulth.

8 Provide for training, education, and meaningful employment of Nuu-Chah-Nulth people in both research and forestry activities to ensure that they benefit from commercial use of resources in Clayoquot Sound.

9 Give precedence to traditional Nuu-Chah-Nulth needs for sustenance (the definition of which should be agreed upon by governments and First Nations) over sport fishery, commercial, or other interests outside Clayoquot Sound. Provide for the well-being of wild fisheries before the needs of fish farming.

10 Develop standards that recognize, respect, implement, and enforce the maintenance of cultural and biological diversity recognized in UNCED's *Agenda 21* and *Guiding Principles on Forests*, in forest management practices.

11 Recognize and take steps to minimize the impact of forest practices on marine ecosystems.

5.2 Forest Planning

Implementing effective ecosystem management will require fundamental changes in forest management planning and administration. These changes will affect planning approaches and procedures, planning time frames, and the boundaries of planning units. A fundamental change will be required in the way governments, First Nations, and the public participate in planning, interact with each other, and share responsibility for decisions.

5.2.1 Existing Approaches and Procedures for Planning

The traditional approach to planning forest harvesting has been constrained maximization, in which other values constrain use of the timber resource. Existing standards, such as the *Development Plan Guidelines* for the Vancouver Forest Region, require a plan to harvest all operable timber in the planning area subject to the principles of integrated resource management. Integrated resource management is difficult because inventory about environmental and cultural values (for instance) are lacking.

The planning procedure usually involves a referral process in which the Ministry of Forests and the forest company involved are lead agencies that collect the information and do most of the basic planning to harvest the timber resource. Prior to Ministry of Forests approval to begin logging or road construction, logging plans are referred to other agencies and interested parties who respond *after* most of the planning is done. This referral process is an integral part of the constrained maximization approach in which timber interests have historically taken precedence over other forest values. First Nations have been largely absent from the process.

Historically, long-term planning has focused on determining timber supply available within a large administrative unit. These long-term plans have been based on the volume of timber and have not, in general, considered specific, smaller units of land. Operational planning has usually been over five-year planning periods where specific, smaller units of land or cutblocks are identified in Five Year Development Plans. Thus, most operational planning for a specific area of land has been short-term and based on administrative or practical rather than ecological units. Five Year Development Plans have focused foremost on logging, silviculture, and protection activities at the stand level while attempting to minimize impacts on other resource values.

In Clayoquot Sound there have been several local planning initiatives to replace this referral process, involving various parties interested in a more inclusive, participatory approach to planning. Initiatives such as the Tofino Creek Watershed Plan have covered longer planning horizons than is common, and have used ecological rather than administrative units. Several specific projects to collect inventory on resources and values other than timber have also been initiated. Since the *Clayoquot Sound Land Use Decision*, three provincial ministries have shared decision-making responsibility. This is the beginning of a better

approach to planning. Some of the needed change may come through implementation of the *Interim Measures Agreement*.

5.2.2 Findings About Forest Planning

- Current planning procedures are inadequate for sustainable ecosystem management (see Section 2.2).
- The existing referral process (sending harvesting plans to other agencies such as the Ministry of Environment, Lands, and Parks for approval) provides inadequate levels and stages of involvement for professionals representing other disciplines.

5.2.3 Recommended Approach to Forest Planning

1 Adopt an ecosystem approach to forest planning that integrates the full spectrum of resource values, including timber. Undertake the following activities as part of the ecosystem planning process:

   - identify ecosystem components that must be maintained to sustain the productive capacity of the whole ecosystem;
   - plan how to produce and harvest timber while protecting ecosystem integrity;
   - plan all phases of forest management including inventory, access, logging, post-logging regeneration, stand treatments, road maintenance and deactivation, and watershed and wildlife habitat restoration; and
   - collect baseline biophysical and cultural information about the full range of forest conditions and resources before beginning development activities.

2 Conduct planning at ecologically relevant time and spatial scales—in the order of 100 years and over single watersheds, groups of watersheds, or other logical biophysical units. Develop a long-range resource or ecosystem plan before undertaking detailed plans at smaller scales for shorter planning periods.

3 Make the necessary changes to current planning processes to support ecosystem management, including providing for shared decision-making, shared authority, and an open public planning process. Respectfully incorporate Nuu-Chah-Nulth wisdom and perspectives, and involve Nuu-Chah-Nulth as partners in planning.

4 Use interdisciplinary teams and involve more specialists (e.g., hydrologists, biologists, geomorphologists, anthropologists) in planning and implementing ecosystem management activities than is done currently.

5.3 Undeveloped Watersheds

In an undeveloped watershed less than 2% of the watershed has been modified by industrial or land use practices.[31]

5.3.1 Existing Situation

The *Clayoquot Sound Land Use Decision* (1993) delineated three main categories of land use: Protected Areas, General Integrated Management Areas, and Special Management Areas. The establishment of new Protected Areas recognized the importance of specific tracts of older forest including large, undeveloped watersheds, such as the Megin, Talbot, and Watta.

Some of the opportunities for future logging in the General Integrated Management Area and Special Management Areas are in undeveloped watersheds: the Clayoquot River, Ursus River, Sidney River, Ice River, and Cecilia Creek. In at least the first three of these watersheds, older forests (age class 8 and 9, 141 years and older) represent between 98 and 100% of the forest area.[32]

Areas that are currently undeveloped, but will be logged in the future, provide opportunities to manage according to principles and practices the Panel proposes. These principles and practices require fundamental changes in the way forests are managed—ways that, as a society, we have little experience in implementing. A substantial amount of learning, better information, different logging practices, and different planning procedures are required to ensure sustainable ecosystem management will be implemented effectively. During the transition to a new approach to forest management, options for future management in the undeveloped watersheds must be maintained. They represent our best opportunity to demonstrate our commitment to stewardship and to development of exemplary forest practices.

5.3.2 Findings Relevant to Undeveloped Watersheds

- Total Resource Plans provide one approach to integrating different resources during the planning process. However, documents pertinent to Clayoquot Sound are inconsistent in their recommendations for the development of Total Resource Plans in undeveloped watersheds.

  The Government of British Columbia's Response to the Commission on Resources and the Environment (1993) states: "Where development is contemplated in a previously undeveloped watershed and in those watersheds which are substantially undeveloped, **Total Resource Plans will be developed with**

[31]Wilkinson, J.F. 1990. Undeveloped watersheds on Vancouver Island larger than 1000 hectares. B.C. Ministry of Forests Integrated Resources Branch. Unpubl. Rept.

[32]B.C. Ministry of Forests Inventory Branch.

boundaries based on watersheds or other ecological or biophysical features." [boldface in original text].

The *Interim Measures Agreement* (1994) states that harvesting in the Clayoquot River Valley should occur under a Total Resource Plan. Such plans have not yet been developed for the Clayoquot River or other locations in Clayoquot Sound. The initial entry into the Clayoquot River Watershed, however, is exempted from this requirement in the *Clayoquot Sound Forest Practices Standards*.

- The *Interim Measures Agreement* has two further clauses that relate directly to the Panel's findings and recommendations regarding undeveloped watersheds. The Central Region Board has a clear and significant role to play in developing strategy for these areas and it appears critical that no options be foreclosed until the Board has played its intended role, namely:

  - Section 7(l): "Within 30 days of receipt of any plan, application, permit, decision, recommendation or report from any ministry, agency or panel pursuant to clause 7(f)(ii) or 7(g) or 7(h), the Board shall accept, propose modifications to, or recommend rejection of the plan, application, permit, decision, recommendation or report."

  - Section 13(n): "for greater certainty, the Parties shall consider applying the concept of tribal parks for all or part of . . . the Clayoquot River Valley."

- To ensure that companies and individuals can meet specific standards, the Provincial Government has an excellent prequalification procedure for contractors in the Ministry of Transportation and Highways. This procedure includes a set of explicit criteria by which companies or individuals can be approved to work in sensitive areas. There also are criteria by which a company or individual can be denied access to work in such areas after failing to meet specified standards. The Ministry of Forests could use this procedure as a model for prequalification of logging and other forest management contractors.

- Watersheds such as the Bulson River or Tofino Creek, which have a history of logging, present opportunities to acquire experience in sustainable ecosystem management.

- The major undeveloped watersheds in the General Integrated Management and Special Management Areas present an important opportunity to benefit from implementing knowledge and experience acquired elsewhere.

- A significant opportunity for demonstrating commitment to developing standards of forest practice that are among the best in the world is to establish exemplary practices in the as-yet-undeveloped watersheds.

5.3.3 Recommended Approach to Undeveloped Watersheds

1 Road construction and logging in the Clayoquot River, Sidney River, Ursus River, Ice River, and Cecilia Creek watersheds should be delayed until the following steps have been taken:[33]

- The necessary inventories of environmental and cultural resources and values, along with the approach to long-term planning (e.g., Total Resource Plans) have been prepared and subsequently approved by the Central Region Board (see also Section 5.5.2).

- Exemplary forest practices and silvicultural systems have been demonstrated elsewhere before they are applied in undeveloped watersheds.

- The Ministry of Forests has developed a prequalification procedure for work in environmentally sensitive areas, and all relevant companies and individuals are prequalified.

2 An implementation plan should be established and publicized for those steps potentially requiring significant time to implement. Phasing in the steps outlined in recommendation 1 should be completed as quickly as possible.

5.4 Special Management Area Boundaries

The *Clayoquot Sound Land Use Decision* describes and delineates on a map the following land use categories: previously Protected and new Protected Areas; General Integrated Management Areas; and three types of Special Management Areas: Recreation, Wildlife, and Scenic Corridors.

5.4.1 Current Approach to Special Management Areas

The *Clayoquot Sound Land Use Decision* describes these land use categories as follows:

- New Protected Areas: "are immediately reserved from any new resource development or allocation," and they include some intact watersheds, coastal fjords, outer coastal areas, and specific lake, river, and plateau areas.

- General Integrated Management Areas: "will continue to support various types of economic activity, including timber use and management, fisheries, wildlife, tourism, recreation and mineral exploration and development."

- Special Management Areas allow timber harvesting as required to meet recreation, wildlife, and scenic landscape objectives as follows:

[33]The Panel is aware that planning initiatives such as Local Resource Use Plans are considering these areas.

- "recreation values . . . will be maintained through a resource use plan, to be completed before any timber harvesting,"
- "important wildlife values . . . will be maintained through a resource use plan, to be completed before any timber harvesting," and
- "landscape management plans to ensure that the key scenic landscape values important to tourism and recreation are not compromised."

In its review the Panel considered the boundaries of the Special Management Areas, focusing primarily on the Scenic Corridor Areas. The international interest in Clayoquot Sound is partly due to the scenic values in the area, and enough information is available on the Scenic Corridor Areas to enable substantive comment.

5.4.2 Findings About Special Management Area Boundaries

- The "scenic corridors" defined in the *Clayoquot Sound Land Use Decision* do not correctly document the areas visible from scenic corridor routes. The inaccuracy becomes apparent when traveling those corridors. The proposed boundaries encompass little more than the foreground view. Yet the nature of the landscape makes visible large areas of land in the midground and background from the scenic corridor routes.
- Recent work conducted by the ministries of Small Business, Tourism and Culture; and Environment, Lands and Parks[34] supports the finding regarding inaccuracies of Special Management Area boundaries. Specifically:
  - A much larger area is visible than the area designated as scenic corridors in the *Clayoquot Sound Land Use Decision*. While lack of tree height information in the computer model used in the study was a source of inaccuracies, the analysis reveals that the visible area extends far beyond the area designated.
  - The Pretty Girl area set aside for Special Management–Recreation is 173% larger than initially estimated.
  - The Ursus River area for Special Management–Wildlife is 201% larger than initially estimated.
- As a result of the two errors in estimated size of the Special Management Areas for Pretty Girl Lake and Ursus River, the General Integrated Management Area is roughly 10% smaller than initially estimated in the *Clayoquot Sound Land Use Decision*.

[34]Whyte, B.D., Minty, D., and R.F. Gowan. 1994. Visible areas analysis and classified satellite image analysis in support of scenic corridor management for Clayoquot Sound. Unpubl. paper.

- The inaccuracies in the Special Management Area boundaries confirm the problems in designating land use category areas before conducting adequate inventories.

5.4.3 Recommended Approach to Special Management Area Boundaries

1 Boundaries of Scenic Corridor Areas should be revised using more detailed information on resources to more accurately reflect the intent of the *Clayoquot Sound Land Use Decision*.

2 The Recreation and Wildlife Special Management Areas should also be subject to modification following adequate inventories and comprehensive consultation.

Appendix I

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound

Guiding Principles

Following from its general principles,[35] the Panel established 18 guiding principles that provide the framework for reviewing existing standards and developing new standards for forest management in Clayoquot Sound.

Forest management standards must prescribe practices that:

1 *Meet or exceed international and emerging world standards.*

2 *Are based on the capabilities, limitations, and sensitivities of ecosystems.*

3 *Recognize cumulative effects and response thresholds within ecosystems.*

4 *Maintain healthy ecosystems that sustain well-distributed populations of native species.*

5 *Avoid activities that would damage natural ecosystems, and where unforeseen damage has occurred due to human activity, rehabilitate such landscapes and habitats.*

6 *Recognize the watershed as the basic unit for planning and management. More than one watershed may be required to plan for values such as biodiversity, scenery, and cultural features.*

7 *Take an ecosystem approach to planning, in which the primary planning objective is to sustain the productivity and natural diversity of the Clayoquot region, and the flow of specific forest products are determined in a manner consistent with this objective.*

8 *Recognize that the rate (percent of area affected per unit time) and geographical distribution of timber harvesting are more important determinants than total volume when wood harvest is planned and removed.*

9 *Provide for sustainable activities such as logging, fishing, tourism, and cultural pursuits.*

10 *Accommodate the needs of First Nations for cultural, social, and economic well-being.*

[35]Nine general principles concerning forest management in Clayoquot Sound were discussed in the Panel's first report, January 31 1994.

11 *Protect cultural and spiritual values and other special sites.*[36]

12 *Represent the best application of scientific, traditional, and local knowledge and experience in the Clayoquot region.*

13 *Are adaptive and respond to new knowledge and experience as well as to unforeseen natural and human-induced environmental changes.*

14 *Involve local people and affected parties in planning and management processes.*

15 *Provide a constructive and safe working environment.*

16 *Are clear, understandable, and enforceable. Where local decisions may replace prescribed standards, they must result in equal or better integrated resource management.*

17 *Are supported by ongoing education and training programs to ensure that standards are applied correctly and effectively.*

18 *Are continually monitored, evaluated, and improved.*

This simple list of principles does not adequately express their underlying foundations. To support these guiding principles, Panel members have assembled knowledge and developed targets for specific components of natural systems; these are not summarized here.

The relevance of these principles in light of stewardship responsibilities has also been considered. For instance, aboriginal self-government and jurisdiction over land and resources, currently being addressed by government, may substantially influence forest practices in Clayoquot Sound. The guiding principles articulated above, however, derive from the vision of future forest stewardship shared by all Panel members. The Panel believes that these principles will remain relevant as guidelines for developing exemplary forest management standards regardless of the outcome of deliberations about resource jurisdiction.

[36]For example: areas of cultural or spiritual significance; habitats for threatened, rare, or endangered species; exceptional natural features (e.g., caves and hotsprings); community watersheds; or important recreational and scenic areas.

Appendix II

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound

Panel Members

Co-Chair	**Dr. Fred Bunnell**, Professor of Forest Wildlife Ecology and Management, Director of the Centre for Applied Conservation Biology, University of British Columbia.
Co-Chair	**Dr. Richard Atleo**, Hereditary Chief UMEEK, Researcher, Consultant, Indigenous Human Resources, New Westminster

Other members of the Scientific Panel, by area of expertise:

Biodiversity	**Dr. Ken Lertzman**, Assistant Professor, Forest Ecology, Simon Fraser University
	Dr. Chris Pielou, Ecologist, Denman Island
	Laurie Kremsater, Consultant, Forest Management and Wildlife Biology, Vancouver
Ethnobotany	**Dr. Nancy Turner,** Professor, Environmental Studies, University of Victoria
First Nations	**Ernest Lawrence Paul**, Hesquiaht Elder, expert in Hesquiaht history, culture, traditional resource use and language, Hesquiaht
	Roy Haiyupis, Ahousaht Elder, expert in Ahousaht history, culture, language and traditional use of resources, Lytton
	Stanley Sam, Ahousaht/Tla-o-qui-aht First Nations Elder, expert in First Nations history, language, culture and traditional resource use, Ahousaht
Fisheries	**Dr. Gordon Hartman**, Consultant, Fisheries Biology, Nanaimo

Forest Harvest Planning	**Keith Moore**, Registered Professional Forester, Consultant, Environmental Forestry, Queen Charlotte City
Hydrology	**Dr. Mike Church**, Professor, Fluvial Morphology, Department of Geography, University of British Columbia
Roads and Engineering	**Dr. Peter Schiess**, Professor and Head of Forest Engineering, University of Washington, College of Forest Resources, Seattle
Scenic Resources, Recreation, and Tourism	**Catherine Berris,** Consultant, Landscape Architecture and Land Use Planning, Vancouver
Silvicultural Systems	**Dr. Jerry Franklin**, Professor, University of Washington, College of Forest Resources, Seattle
Slope Stability	**Dr. June Ryder**, Consultant, Terrain Analysis, Vancouver
Soils	**Dr. Terry Lewis**, Consultant, Soils and Land Use, Courtenay
Wildlife	**Dr. Alton Harestad**, Associate Professor, Wildlife, Simon Fraser University
Worker Safety	**Jim Allman**, Regional Manager, Workers' Compensation Board, Victoria
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Appendix III

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound

Standards Documents Reviewed

Tables 1 through 4 list the current standards documents reviewed by the Scientific Panel. The "Relevant Documents" columns include all provincial, coastal, and regional standards, standards of practice, and standard operating procedures, memos and directives that the Panel considers apply or might apply in Clayoquot Sound. The "Status" columns denote standards as draft, emerging, interim, or established (estab.), in increasing order of force, and also indicate their scope as regional, coastal, or provincial.

Table 1. Management unit planning (broad, long-term planning)

Plan/Permit	Purpose	Relevant Documents	Format	Status
Mgmt Plans (TFL, FL, Woodlot Licence)	Planning document for entire tenures (e.g., TFL). Sets AAC.	Forest Licence Management and Working Plan (MWP) Outline.	Circular Letter - VR-88-520	Estab. standard (regional)
		TFL Management and Working Plan - Recreation Content. 1988.	Document	Revisions pending
		Forest Inventory Environmental Protection Area Guidelines. Also applies to TSA Plan.	Inventory manual chapter	Estab. standard (provincial)
		Archaeological Impact Assessment Guidelines. 1991. Also applies to TSA Plan.	Booklet	Estab. standard (provincial)
TSA Plan (Land and Resource Mgmt Plan)	Planning document for entire TSA. Sets AAC.	As for MWPs.		
		Procedures for Factoring Recreation Resources Into Timber Supply Analysis. December 1993	Document	Estab. (provincial)
Local Resource Use Plan	Long-term planning to determine land use priorities and allocation in a given area. Usually a public process in area of some controversy and high values.	Local Resource Use Plans. MOF. 1991.	Guide, procedures	Estab. (provincial)
Wilderness Area Mgmt Plans			Discussion paper	
Integrated Watershed Mgmt Plan	MOF and Water Mgmt Branch, integrated plan for community watersheds.	Guidelines for Watershed Management of Crown Lands Used as Community Water. 1980.	Booklet	(provincial)
		Community Watershed Guidelines Project - Guiding Principles and Summary of Public Input.	Booklet	Draft, progress report (provincial)
Total Resource Plan	Long-term planning to guide timber harvesting over a given area, (e.g., watershed). An integrated use plan after basic land use decisions are made.	Total Resource Planning. MOF. 1993.	Discussion paper	Proposed process (provincial)

Table 2. Development planning (Five Year Development Plans and long-term development plans)

Purpose	Relevant Documents	Format	Status
Plan for logging and road construct. for 5-year period (up to 20-year period for long-term plans proposed in Code.	Development Plan Guidelines. Vancouver Forest Region. December 10, 1993.	Circular Letter	Estab. standard procedures (regional)
Based on AAC and management objectives and constraints in MWP.	Coast Planning Guidelines, Vancouver Forest Region. October 8, 1993.	Circular Letter	Estab. standards (regional)
Annually updated.	Watershed Workbook - Forest Hydrology Sensitivity Analysis for Coastal B.C. Watersheds - 2nd Edition. 1993.	Document	Draft (coastal)
	Watershed Workbook - Forest Hydrology Sensitivity Analysis for Coastal Watersheds. 1987.	Booklet and floppy, procedures	Interim, approved (coastal)
	Guidelines for Watershed Management of Crown Lands Used as Community Water. 1980.	Booklet	(provincial)
	Community Watershed Guidelines Project - Guiding Principles and Summary of Public Input. 1993.	Booklet	Draft, progress report (provincial)
	British Columbia Coastal Fisheries/Forestry Guidelines. Revised 3rd Edition. July 1993.	Booklet	Estab. standards (coastal)
	Guidelines to Maintain Biological Diversity in TFLs 44 and 46. December 1991.	Document	Approved for TFLs 44 and 46
	Guidelines to Maintain Biological Diversity in Coastal Forests. October 27, 1993.	Document	Emerging standards (coastal)
	Interim Forest Management Recommendations to Protect Marbled Murrelet Nesting Habitat in Coastal British Columbia. February 8, 1991.	Letter	Interim, not approved
	Conservation of Marbled Murrelet Habitat. November 12, 1993.	Memo	Draft
	Guidelines for Terrain Stability Assessments. November 18, 1992.	Circular Letter	Estab. procedures (regional)
	Landslide Hazard Mapping Guidelines; Guidelines for B.C. January 12, 1994.	Document	Draft
	Interim Forest Landscape Management Guidelines for the Vancouver Forest Region.	Booklet	Interim, approved (regional)
	Visual Landscape Management Guidelines for Visually Sensitive Areas within Provincial Forests. December 1993.	Document	Draft, confidential (provincial)
	Procedures for Factoring Recreation Resources Into Timber Supply Analysis. December 1993	Document	Estab. standards
	Wilderness Management Handbook. October 1993	Document	First draft
	Interim Guide for Completing a Recreation Analysis Report in the Vancouver Forest Region.	Circular Letter	Interim (regional)

Table 3. Operational planning

Plan/Permit	Purpose	Relevant Documents	Format	Status
Pre-harvest Silviculture Prescription (PHSP)	Legal contract between Licensee and Province that prescribes the appropriate silvicultural system, harvesting practices, and regeneration measures up to "free-to-grow" for a specific cutblock.	Silviculture Regulation, B.C. Reg. 147/88.	Reg. under *Forest Act*	Statute (provincial)
		Pre-harvest Silviculture Prescription Procedures and Guidelines for the Vancouver Forest Region. March 17, 1994.	File 18790-01	Estab. standards (regional)
		Site Diagnosis, Tree Species Selection and Slashburning Guidelines for the Vancouver Forest Region. 1984.	Booklet	Estab. standards re: species (not slash-burning) (regional)
		Site Degradation Guidelines for the Vancouver Forest Region. 1991. Interim Site Degradation Guidelines for Road Fill Slopes.	Circular Letters	Estab. standard and interim (regional)
		Minimum Cutting Ages for TSAs.	Circular Letter - VR-85-470	Estab. standards (regional)
		Residual Falling Policy.	Circular Letter - VR-78-345	Estab. standards (regional)
		Guidelines for Slash Disposal Orders.	Circular Letter - VR-86-505	Estab. standards (regional)
		Guidelines for Free Growing Stocking Standards for the Vancouver Region.	Circular Letter - VR-90-545	Estab. standards (regional)
		Hemlock Dwarf Mistletoe Mgmt.	Circular Letter - VR-85-485	Estab. standards (regional)
		Sitka Spruce Weevil Mgmt.	Circular Letter - VR-85-471	Estab. standards (regional)
		B.C. Coastal Fisheries/Forestry Guidelines. Revised 3rd ed. July 1993.	Booklet	Estab. standards (coastal)

Table 3. continued

Plan/Permit	Purpose	Relevant Documents	Format	Status
Road Permit	Legal document that approves a road location and sets road construction standards.	Forest Road and Logging Trail Engineering Practices (Interim). July 15, 1993.	Booklet	Interim, approved standards
		Engineering Specifications for the Planning, Location, Design, Construction and Deactivation of Logging Roads and Drainage Structures in the Vancouver Forest Region. 1989.	Document	Estab. approved standards (regional)
		B.C. Coastal Fisheries/Forestry Guidelines. Revised 3rd ed. July 1993.	Booklet	Estab. approved standards (coastal)
Cutting Permit	Legal document that approves a cutblock and gives authority to cut. Embodies PHSP contents.	Utilization Standards - Coast. 1989.	MOF Policy	Estab. standards (coastal)
		Provincial Harvesting Guidelines for the Management and Maintenance of Wildlife Trees.	Booklet	Draft, not approved (provincial)
		Methods for the Conservation and Management of Wildlife Trees in British Columbia. March 1994.		Draft, Wildlife Tree Committee
		Cave Management Handbook. 1990.	Handbook	Estab. standards (coastal)
		Gully Management: Field Considerations for Stream Reach C Assessments. 1993	Document	Draft
		Interim Mobile Backspar Trails Construction and Rehabilitation Strategies. 1991.	Booklet	Interim (regional)
Foreshore Use Permit	Authority for log sorting, booming, and storage.	Guidelines for Log Dumping. MOELP.		(coastal)
Special Use Permits	Authorizes various uses including logging camps.			

Table 4. Second-growth management

Plan/Permit	Relevant Documents	Format	Status
Second-growth management	Free Growing Surveys.	Circular Letter - VR-90-546	Estab. standards (regional)
	Guidelines for Free Growing Stocking Standards for the Van. Region.	Circular Letter - VR-90-545	Estab. standards (regional)
	Coastal Seed Transfer Guidelines. 1990.	Booklet	Estab. standards (coastal)
	Stand Tending Guidelines.	Circular Letter - VR-91-558	Estab. standards (regional)
	Aerial Spraying of Herbicides.	Circular Letter - VR-84-453	Estab. standards (regional)
	Methods to Maintain Wildlife Habitat Characteristics in Managed Stands. August 21, 1992.	Letter	Approved
	Guidelines for Maintaining Biodiversity During Juvenile Spacing. 1993.	Booklet	Interim, not approved
	Interim Wildlife/Forestry Guidelines for Biological Diversity at the Stand Level During Juvenile Spacing Entries. February 1992.		Interim

Appendix IV

Scientific Panel for Sustainable Forest Practices in Clayoquot Sound

Glossary

Adaptive management: Adaptive management rigorously combines management, research, monitoring, and means of changing practices so that credible information is gained and management activities are modified by experience.

Additive effects: Effects on biota of stress imposed by one mechanism, contributed from more than one source (e.g. sediment-related stress on fish imposed by sediment derived from streambank sources and from land surface sources) (see also cumulative effects).

Age-class: Any interval into which the age range of trees, forests, stands, or forest types is divided for classification. Forest inventories commonly group trees into 20-year age classes.

Aggradation: Accumulation of sediment in a stream channel on an alluvial fan or on a floodplain. Also applied to sediment accumulation on slopes.

Allowable annual cut (AAC): The average volume of wood that may be harvested annually under sustained yield management. It equals roughly the amount of new growth produced by the forest each year, including a proportion of the mature volume minus deductions for losses due to fire, insects, and disease.

Basic silviculture: The harvesting methods and silviculture operations, including seed collecting, site preparation, artificial and natural regeneration, brushing, spacing and stand tending, and other operations, prescribed for the purpose of establishing a free-growing crop of trees of a commercially valuable species.

Biodiversity (biological diversity): The diversity of plants, animals, and other living organisms in all their forms and levels of organization, including genes, species, ecosystems, and the evolutionary and functional processes that link them.

Biogeoclimatic Ecosystem Classification System: A hierarchical classification scheme having three levels of integration—regional, local, and chronological; and combining three classifications—climatic, vegetation, and site.

Blowdown (windthrow): Uprooting by the wind. Also refers to trees so uprooted.

Cable logging: A yarding system employing winches, blocks, and cables.

Canopy: The forest cover of branches and foliage formed by tree crowns.

Channel integrity: Refers to a stable mean condition of a stream.

Clearcut with reserves: A variation of the clearcut silvicultural system that leaves some standing green trees and/or wildlife trees in a dispersed or aggregated form to meet integrated resource management objectives, such as habitat

protection and visual quality, but not to provide seed or shelter for regeneration purposes.

Clearcutting silvicultural system: A system in which the crop is cleared from an area at one time and an even-aged, replacement stand is established. It does not include clearcutting with reserves. Clearcutting is designed so that most of the opening has full light exposure and is not dominated by the canopy of adjacent trees (this produces an open area climate). The minimum size of a clearcut opening is generally considered to be 1 ha.

Coarse woody debris: Sound and rotting logs and stumps that provide cover for plants, animals, and their predators.

Community watersheds: Those watersheds designated by the B.C. Ministry of Environment, Lands and Parks for domestic water production.

Crown closure: The condition when the crowns of trees touch and effectively block sunlight from reaching the forest floor.

Culvert: A pipe, pipe arch, or log structure covered with soil and lying below the road surface, used to carry water from one side of the road to the other.

Cumulative effects: Effects on biota of stress imposed by more than one mechanism (start e.g. stress in fish imposed by both elevated suspended sediments concentrations in the water and by high water temperature).

Cut-and-fill: System of bench construction on hillslopes to produce road rights-of-way and landings whereby convex slopes are excavated and concave slopes (gullies) are filled ; also, excavation of the upslope side of the right-of-way, and fill on the down slope side. (so called half-bench construction).

Cutblock: A specific area, with defined boundaries, authorized for harvest.

Cutslopes: An excavated slope; commonly, the excavation on the upslope side of a road crossing a slope, to establish a bench for the right-of-way.

Debris flows: Mixture of soil, rock, wood debris and water which flows rapidly down steep gullies; commonly initiate on slopes greater than 30°, but may run out onto footsteps of low gradient.

Designated skid road/skid trail: A pre-planned network of skid roads or skid trails, designed to reduce soil disturbance and planned for use in subsequent forestry operations in the same area. Multiple passes by tracked or rubber-tired skidders or other equipment are anticipated.

Dewatering: Condition in stream channel when all the water flow occurs within the permeable streambed sediments, so no surface water is left; common in small streams with considerable accumulations of gravel.

District Manager: The Manager of a Forest Service District Office, with responsibilities as outlined in the *Forest Act*, *Ministry of Forests Act*, and *Range Act*.

Drainage basin: Area of the earth surface from which surface drainage all flows to a single outlet stream (a watershed in North America).

Drainage structures: Includes metal and wooden culverts, open-faced culverts, bridges, and ditches.

Drainage system: A culvert, cross-ditch, swale, or outslope/inslope to move water from one side of the road to the other.

Ecosystem: A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size—a log, pond, field, forest, or the earth's biosphere—but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation, for example, forest ecosystem, old-growth ecosystem, or range ecosystem.

Edge effect: Habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the more-or-less well-defined boundary between ecosystems, as, for example, between open areas and adjacent forest.

End hauling: Removal of excess materials from one section of road to another or to a designated waste area, instead of sidecasting.

Endangered species: See Threatened/endangered species.

Entrainment: Mobilization, by flowing water, of sediment or organic debris from the bed or banks of a stream channel.

Environmentally Sensitive Areas (ESAs): Areas requiring special management attention to protect important scenic values, fish and wildlife resources, historical and cultural values, and other natural systems or processes. ESAs for forestry include potentially fragile, unstable soils that may deteriorate unacceptably after forest harvesting, and areas of high value to non-timber resources such as fisheries, wildlife, water, and recreation.

Fill: The height of material required to raise the desired road profile above the natural ground line.

Fillslopes: Slope constructed of dumped material, commonly on the downslope side of a road crossing a slope, to establish a bench for the right-of-way.

First order stream: Stream originating in a seepage zone or spring, with no entering tributaries; the most headward channels in the drainage network.

First pass: The initial entry of a multiple entry plan to harvest timber.

Fish-bearing waters: Lakes, streams, and ponds that have resident fish populations.

Fisheries-sensitive zones: Aquatic environments important for the life history of fish, including areas that may not be defined as streams. May include side and flood channels, swamps, seasonally flooded depressions, lake spawning areas, or estuaries.

Floodplain: Surface of the body of sediment, adjacent to a stream channel, which was deposited by the stream during high flows.

Fluvial fan: (alluvial fan) The body of sediment deposited by a (relatively steep) stream where it flows into a surface of lower gradient.

Fluvial processes: All processes and events by which the configuration of a stream channel is changed; especially processes by which sediment is transferred along the stream channel by the force of flowing water.

Folisol: Soils consisting of decomposed vegetable litter (i.e., from foliage)

Forest cover: Forest stands or cover types consisting of a plant community made up of trees and other woody vegetation, growing more or less closely together.

Forest Development Plan: An operational plan guided by the principles of integrated resource management (the consideration of timber and non-timber values), which details the logistics of timber development over a period of usually five years. Methods, schedules, and responsibilities for accessing, harvesting, renewing, and protecting the resource are set out to enable site-specific operations to proceed.

Forest practice: Any activity that is carried out on forest land to facilitate uses of forest resources, including but not limited to timber harvesting, road construction, silviculture, grazing, recreation, pest control, and wildfire suppression.

Forest Practices Code: A package of legislation, regulations, and standards that govern forest practices in British Columbia.

Forest resources: Resources or values associated with forest land, including but not limited to water, wildlife, fisheries, recreation, timber, range, and heritage.

Free-growing crop: A crop of healthy trees with growth unimpeded by competition from plants, shrubs, or other trees.

Freshet: High stream flow, usually confined to the stream channel and caused by a regularly recurring hydrological phenomenon (e.g. the snowmelt freshet) (regional term).

Fry: The young stage of fishes (i.e., less than one year old), particularly after the yolk sac has been absorbed.

Genetic diversity: Variation among and within species that is attributable to differences in hereditary material.

Green tree retention: The reservation of live trees of a specific species and size from harvesting, to achieve a site-specific objective.

Green-up: The process of reestablishing vegetation following logging to achieve specific management objectives. Green-up criteria are usually based on commercial tree species ecologically suited to a site, wildlife requirements, and hydrological considerations.

Ground-based systems: Logging systems that employ ground-based equipment such as feller-bunchers, hoe chuckers, skidders, and forwarders.

Groundwater: Water below the level of the water table in the ground; water occupying the sub-surface saturated zone.

HaHuulhi: HaHuulhi is the traditional system of land and resource management centering around ownership and stewardship of specific sites and their resources by hereditary chiefs. All the lands, waterways, shorelines, and offshore sites, except for relatively remote areas far inland, fall under this system of ownership, control, and resource use.

Harvest pattern: The spatial distribution of cutblocks and reserve areas across the forested landscape.

Harvest rate: The rate at which timber is harvested, commonly expressed as an allowable annual cut (AAC).

Harvesting (logging): Forest harvesting activities including felling, yarding (skidding), hauling, and road building; the cutting and removal of trees from a forested area.

Harvesting method: The mix of felling, bucking, and yarding (skidding) systems used in logging a stand of timber.

Heritage areas: Sites of historical, architectural, archaeological, paleontological, or scenic significance to the province.

Heritage trail: A trail having cultural significance by reason of established aboriginal use or use by early immigrants.

Highgrading: The removal of only the best trees from a stand, often resulting in a residual stand of poor quality trees.

Hydrology: The science that describes and analyzes the occurrence of water in nature, and its circulation near the surface of the earth.

Inoperable lands: Lands that are unsuited for timber production now and in the foreseeable future by virtue of their: elevation; topography; inaccessible location; low value of timber; small size of timber stands; steep or unstable soils that cannot be harvested without serious and irreversible damage to the soil or water resources; or designation as parks, wilderness areas, or other uses incompatible with timber production.

Insloping: Shaping the road surface to direct water onto the cut side of the road.

Integrated resource management: The identification and consideration of all resource values, including social, economic, and environmental needs, in land use and development decision-making. It focuses on resource use and land use and management, and is based on a good knowledge of ecological systems, the capability of the land, and the mixture of possible benefits.

Interim Measures Agreement: 1994. Interim Measures Agreement (IMA) Between the Province of British Columbia and the Hawiih of Clayoquot Sound

Landing: The area to which logs are yarded or skidded to be loaded out.

Landscape level: A watershed, or series of interacting watersheds or other natural biophysical (ecological) units, within the larger Land and Resource Management Planning areas. This term is used for conservation planning and is not associated with visual landscape management and viewscape management.

Landscape sensitivity: A component of the landscape inventory that estimates the sensitivity of the landscape based on: the visual prominence or importance of features; conditions that affect visual perception; and social factors that contribute to viewer perceptions.

Landscape unit: Ecologically determined planning units that are defined within management units (Tree Farm Licences, Timber Supply Areas) and that are made up of a series of smaller stand level units.

Large Organic Debris (LOD): Entire trees or large pieces of trees that provide channel stability or create fish habitat diversity in a stream channel.

Large woody debris: Large tree part; conventionally a wood piece greater than 10 cm in diameter and 1 metre in length.

Local Resource Use Plan (LRUP): A plan for a portion of a Timber Supply Area or Tree Farm Licence that provides management guidelines for resource use integration in the area.

Mass wasting: Movement of soil and surficial materials by gravity.

Non-timber resource values: Values within the forest other than timber which include but are not limited to biological diversity, fisheries, wildlife, minerals, water quality and quantity, recreation and tourism, cultural and heritage values, and wilderness and aesthetic values.

Old growth: Old growth is a forest that contains live and dead trees of various sizes, species, composition, and age class structure. Old-growth forests, as part of a slowly changing but dynamic ecosystem, include climax forests but not sub-climax or mid-seral forests. The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another.

Operable forest: That portion of the production forest that, under current market conditions, can be harvested at a profit.

Operational plans: Within the context of area-specific management guidelines, operational plans detail the logistics for development. Methods, schedules, and responsibilities for accessing, harvesting, renewing, and protecting the resource are set out to enable site-specific operations to proceed.

Outsloping: Shaping the road surface to direct water away from the cut side of the road.

Partial cutting: A general term for tree removal other than clearcutting, in which selected trees are harvested.

Pore water pressure: Pressure exerted by water in soil pores; in unsaturated soil the value is negative (i.e. it is a suction or tension)

Pre-harvest Silviculture Prescription (PHSP): A documented process for collecting site-specific field data, establishing site-specific management objectives and standards for basic silviculture, and prescribing a series of treatments necessary to achieve these objectives and standards.

Production forest: The forest used for production of various commodities, e.g., timber.

Productive forest land: Forest land that is capable of producing a merchantable stand within a defined period of time.

Protected areas: Areas such as provincial parks, federal parks, wilderness areas, ecological reserves, and recreation areas that have protected designations according to federal and provincial statutes. Protected areas are land and freshwater or marine areas set aside to protect the province's diverse natural and cultural heritage.

Protection forest: Forest maintained on steep, unstable slopes to prevent accelerated erosion.

Reach: A length of stream channel exhibiting, on average, uniform hydraulic properties and morphology.

Recreation feature: Biological, physical, cultural, or visual features that have an ability to attract and sustain recreational use.

Recreation Opportunity Spectrum (ROS): A mix of outdoor settings based on remoteness, area size, and evidence of humans, which allows for a variety of recreation activities and experiences. The descriptions used to classify the settings are on a continuum and are described as: rural, roaded resource, semi-primitive motorized, semi-primitive non-motorized, and primitive.

Recreation resource: Any biological, physical, cultural, historical, scenic, or wilderness feature that has recreational significance or value, or any recreational facility.

Referral: The process by which applications for permits, licences, leases, etc., made to one government agency by an individual or industry, are given to another agency for review and comment.

Resource values: Products or commodities associated with forest lands and largely dependent on ecological processes. These include, but are not limited to, water quality and quantity, forage, fish, wildlife, timber, recreation, energy, minerals, and cultural and heritage resources.

Riparian area: The land adjacent to the normal high water line in a stream, river, lake, or pond and extending to the portion of land that is influenced by the presence of the adjacent ponded or channeled water. Riparian areas typically exemplify a rich and diverse vegetative mosaic reflecting the influence of available surface water.

Riparian management zone: The area within and adjacent to riparian and other wetlands required to meet the structural and functional attributes of riparian ecosystems.

Road deactivation: Measures taken to stabilize roads and logging trails during periods of inactivity, including the control of drainage, the removal of sidecast where necessary, and the re-establishment of vegetation for permanent deactivation.

Rotation: The planned number of years between the formation or regeneration of a tree crop or stand and its final cutting at a specified stage of maturity.

Salmonid: A fish of the fish family *Salmonides*; e.g. salmon, trout and chars.

Secondary channel: Subordinate channel in a stream reach with more than one channel; minor channel in a floodplain.

Sedimentation: The process of deposition by gravity of matter carried in water; usually the result of the reduction of water velocity below the point at which it can transport the material.

Seepage zone: An area on a hillslope or at the slope base where water frequently or continuously springs to the surface.

Selection silvicultural system: A silvicultural system that removes mature timber either as single scattered individuals or in small groups at relatively short

intervals, repeated indefinitely, where the continual establishment of regeneration is encouraged and an uneven-aged stand is maintained.

Sensitive/vulnerable species: Species identified as "blue listed" by the B.C. Ministry of Environment, Lands and Parks, these are indigenous species that are not threatened but are particularly at risk.

Shelterwood silvicultural system: A silvicultural system that removes the old stand in a series of cuttings to promote the establishment of an essentially even-aged new stand under the overhead or side shelter of the old one.

Sidecasting: Moving excavated material onto the downslope side during construction.

Silvicultural system: A process that applies silviculture practices, including the tending, harvesting, and replacing of a stand, to produce a crop of timber and other forest products. The system is named by the cutting method with which regeneration is established. The four classical systems are seed tree, shelterwood, selection, and clearcut.

Silviculture: The art of producing and tending a forest, and the application of the knowledge of silvics in the treatment of a forest; the theory and practice of controlling forest establishment, composition, and growth.

Skid road: A bladed or backhoe-constructed pathway where stumps are removed within the running surface as necessary. Skid roads are suitable only for tracked or rubber-tired skidders bringing trees or logs from the felling site to a landing.

Skid trail: A random pathway traveled by ground skidding equipment while moving trees or logs to a landing. A skid trail differs from a skid road in that stumps are cut very low and the ground surface is mainly untouched by the blades of earth moving machines.

Skidding: The process of sliding and dragging logs from the stump to a landing.

Slide: A mass movement process in which slope failure occurs along one or more slip surfaces and in which the unit generally disintegrates into a jumbled mass en route to its depositional site. A debris flow or torrent flow may occur if enough water is present in the mass.

Slope failure: See Slide.

Slope processes: All processes and events by which the configuration of the slope is changed; especially processes by which rock, surficial materials and soil are transferred downslope under the dominating influence of gravity.

Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

Soil: The naturally occurring, unconsolidated mineral or organic material at the surface of the earth that is capable of supporting plant growth. It extends from the surface to 15 cm below the depth at which properties produced by soil-forming processes can be detected. The soil-forming processes are an interaction between climate, living organisms, and relief acting on soil and soil parent material. Unconsolidated material includes material cemented or compacted by soil-forming processes. Soil may have water covering its surface to a depth of 60 cm or less in the driest part of the year.

Stand: A community of trees sufficiently uniform in species composition, age, arrangement, and condition to be distinguishable as a group from the forest or other growth on the adjoining area, and thus forming a silviculture or management entity.

Stand level: The level of forest management at which a relatively homogeneous land unit can be managed under a single prescription, or set of treatments, to meet well-defined objectives.

Stream class: The *British Columbia Coastal Fisheries/Forestry Guidelines* defines three stream classes: Stream Class A includes streams or portions of streams that are frequented by anadromous salmonids and/or resident sport fish or regionally significant fish species; or streams identified for fishery enhancement in an approved fishery management plan; stream gradient is usually less than 12%. Stream Class B includes streams or portions of streams populated by resident fish not currently designated as sport fish or regionally significant fish; stream gradient is usually 8–20%. Stream Class C includes streams or portions of streams not frequented by fish; stream gradient is usually greater than 20%.

Subsurface drainage: Water flow through permeable soil or rock beneath the surface of the land.

Suspended sediment: Mineral and organic matter in the water column, the weight of which is borne by flotation or by upwardly directed (turbulent) water currents.

Sustainability: The concept of producing a biological resource under management practices that ensure replacement of the part harvested, by re-growth or reproduction, before another harvest occurs.

Terrain hazard assessment: An assessment or characterization of unstable or potentially unstable slopes on forested lands. A determination of the relative potential of landslide initiation and the type of landslide that may occur on different types of terrain, based on the data obtained from the review of available maps, photos, site data, and field observations.

Threatened/endangered species: Species identified as "red listed" by the B.C. Ministry of Environment, Lands and Parks, these are indigenous species that are either threatened or endangered.

Understory: Any plants growing under the canopy formed by others, particularly herbaceous and shrub vegetation under a tree canopy.

Visual green-up: The mix of herbaceous growth and deciduous and coniferous trees which acts to blend the cutblock into the surrounding forested landscape, making the cutblock less visually obvious.

Visual landscape management: The identification, assessment, design, and manipulation of the visual features or values of a landscape, and the consideration of these values in the integrated management of provincial forest lands.

Visual Quality Objective (VQO): An approved resource management objective that reflects a desired level of visual quality based on the physical and sociological characteristics of the area; refers to the degree of acceptable human alteration to the characteristic landscape.

Visual quality: The character, condition, and quality of a scenic landscape or other visual resource and how it is perceived, preferred, or otherwise valued by the public.

Watershed: Drainage basin (North American usage).

Watershed integrity: refers to a stable overall physical condition of the watershed (bedrock, landforms, soils, drainage ways) within which transfers of energy, matter and, especially of water occur. It is prerequisite for the security of forest and stream ecosystems.

Wildlife: Raptors, threatened species, endangered species, game, and other species of vertebrates prescribed as wildlife by regulation.

Wildlife trees: Dead, decaying, deteriorating, or other designated trees that provide present or future critical habitat for the maintenance or enhancement of wildlife.

Yarding (yarding systems): In logging, the hauling of felled timber to the landing or temporary storage site from where trucks (usually) transport them to the mill site. Yarding methods include cable yarding, ground skidding, and aerial methods such as helicopter and balloon yarding.