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Improving Human Wellbeing and Ecosystem Health on BC's Coast: The Challenge Posed by Historic Resource Extraction

TOM L. GREEN
651 East 11th Avenue, Vancouver V5T 2E2, Canada (viableeconomics@yahoo.com)

Synopsis: Haida Gwaii and the Great Bear Rainforest (GBR) comprise the world's largest intact coastal temperate rainforest. British Columbia has encouraged industrial logging of this region. As a result, ecological values have been eroded and natural capital has been drawn down. The logging industry has provided few local economic benefits. Colonization and industrial resource extraction have contributed to high levels of social distress in First Nations communities. Since 2001, logging companies, environmental organizations, and the provincial and First Nations governments have collaborated in developing an Ecosystem Based Management (EBM) approach. EBM is intended to maintain ecosystem integrity and improve human wellbeing. In 2006, the province began implementing EBM by setting aside one third of the GBR's land base from logging and by proposing transitional EBM requirements. This paper draws on stumpage and forest cover data to analyze natural capital depletion. The analysis indicates that much of the GBR's natural capital, as represented by timber, has been depleted. Industrial logging was already on the decline before the decision was taken to implement an EBM approach. Expectations for improved socio-economic outcomes under EBM may not be realistic given the constraints implied by past logging. If EBM performance is measured using conventional economic indicators without accounting for past depletion, it risks being found to have failed the goal of improving human wellbeing. This would create pressure to relax EBM provisions to allow more logging, an outcome that would fail both ecosystems and human communities in the long term. If much reduced extraction levels are to support local human wellbeing, a greater share of economic benefits must be retained locally.

Key words: old growth forests, natural capital depletion, ecosystem based management

JEL classification: Q23, Q24, Q57, Q58

1. Introduction – the Great Bear Rainforest

1.1. Description, ecological importance and current status

The rugged North and Central coasts of British Columbia, a region frequently referred to as the Great Bear Rainforest (GBR), stretch 500 kms along a thin band of Canada's west coast – from Knight Inlet to the southern tip of the Alaskan Panhandle. The GBR equals Switzerland in size, covering almost seven million hectares of valleys, lakes, rivers, mountains, glaciers, islands and coastline. Haida Gwaii, an archipelago of 150 islands and hundreds of islets, with a land

area of approximately one million hectares, is 80 kms off the BC mainland coast. Moist, cool air from the Pacific Ocean drives the region's climate by moderating temperatures and generating heavy precipitation.

The GBR and Haida Gwaii together represent the heart of the Northeast Pacific archipelagos coast and form a region of global conservation significance, comprising 25% of the world's remaining coastal temperate rainforest. The region supports globally significant seabird colonies. The marbled murrelet (*Brachyrhamphus marmoratus*), ancient murrelet (*Synthliboramphus antiquus*), and Cassin's auklet (*Ptychoramphus aleuticus*) are of particular conservation interest. The region is also home to major populations of six Pacific salmon species, though logging and fishing pressure have diminished many runs. There are viable populations of mountain goat (*Oreamnos americanus*) and grizzly bear (*Ursus arctos*). The region contains 12 endemic species and 41 endemic subspecies (Rumsey et al. 2004, Prescott-Allen 2005).

The temperate environment and heavy precipitation in the GBR and Haida Gwaii facilitate growth and limit fire's influence as a natural disturbance agent. The result is that under natural conditions, most of the forest in the region reaches and stays in an old growth state, with trees sometimes exceeding 1000 years in age. Under these conditions tremendous accumulations of biomass are possible; in some high productivity areas, trees can grow to be 100 metres tall. Major tree species of commercial interest include western red cedar (*Thuja plicata*), yellow-cedar (*Chamaecyparis nootkatensis*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and pacific silver fir (*Abies amabilis*, colloquially known as balsam fir). However, due to complex terrain and productivity constraints, the proportion of the land base considered viable for commercial logging is limited to 7% of the North Coast, 12% of the Central Coast, and 24% of Haida Gwaii.

By the second half of the twentieth century, the natural capital that had accumulated as timber over centuries in the GBR and Haida Gwaii was being rapidly drawn down by logging. No accounting for this depletion, or for the ecological, cultural, and social consequences of such depletion, was made in the provincial accounts (Green 2000, 2002). Recovery from logging is a slow process in the GBR; for most stands, old growth conditions take 250 years to develop following stand disturbance. Old growth trees found on low elevation sites with good or medium productivity are often exceptionally large and valuable; consequently, the most ecologically valuable portions of many watersheds have been heavily impacted by logging. Nevertheless, large-scale industrial logging is a relatively recent phenomenon and many watersheds remain pristine.

This paper focuses on one small component of natural capital depletion: the industrial logging of old growth forests, largely to produce commodity lumber and pulp.[1] The analysis is based on historical data collected by the province so it could collect stumpage payments from logging companies. This research was motivated

by a desire to better understand how one narrow dimension of Haida Gwaii and the GBR's natural capital, namely trees as standing timber, has been depleted by industrial logging and what this implies for future economic opportunities under either status quo industrial logging or under EBM forestry.[2]

1.2. The people of the study region

Approximately 31 000 people call this region home, half of whom are of aboriginal descent. The largest city is Prince Rupert, with 14 000 inhabitants. A total of 11 First Nation communities, with populations of between 200 to 1200 inhabitants, account for another quarter of the population, while other non-aboriginal communities or dispersed habitations account for the remainder.

Prior to colonization, the diverse First Nations, interconnected through trade networks and war, lived in relative prosperity, supported by the harvesting of productive marine and terrestrial environments. With colonization, the region was drawn into the world economy to supply fish, fur, timber and mineral resources, while contact spread disease that decimated aboriginal populations.

With processing facilities located further south nearer to BC's industrial heartland, the majority of the economic benefits generated by resource extraction have leaked out of the region. Local First Nations communities were left with few economic prospects and serious social challenges. As of 2001, local residents, both aboriginal and non-aboriginal, held as few as 4% of logging and processing direct jobs supported by timber extracted from the Central Coast (Holman Terry & Ministry of Competition Science and Enterprise 2001), while in Haida Gwaii, local residents fared somewhat better, holding 24% of direct jobs.

Subsistence harvesting remains important to First Nation economies and supports cultural practices that are in a period of renewal. First Nations complain that monumental cedar required for totem poles, for dug-out canoes and for building traditional big houses is increasingly scarce. Salmon runs and forest resources important to subsistence production have been damaged by logging and resource extraction roads.

First Nations are no longer willing to see their territories despoiled by outside interests. First Nations insist that future resource exploitation take into account their values, and their subsistence and cultural activities. They are also seeking a fair share of tenure, revenues, royalties, jobs, and other economic opportunities. At the same time, with a rapidly growing population and a dearth of local economic opportunities, First Nations increasingly feel they face a trade-off between implementing more restrictive logging requirements that better protect their cultural and environmental values versus maximizing the benefits they could derive from increasing aboriginal participation in the logging industry.

1.3. Land use planning in the GBR

On April 4, 2001, environmental groups, logging companies, workers, communities, and indigenous Nations reached agreement to develop and implement an Ecosystem-Based Management (EBM) approach for application in British Columbia's North and Central Coasts. This agreement emerged as a result of three key developments – court decisions recognizing Aboriginal Title and Rights, escalating environmental protests, and growing international concern over the fate of British Columbia's coastal temperate rainforest.

As a result of the 2001 agreement, The Coast Information Team (CIT) was established to provide independent, peer-reviewed scientific advice regarding an EBM approach for the region.[3] EBM as defined by the CIT (2004, p. 3) is: '... an adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and human communities. The intent is to maintain those spatial and temporal characteristics of ecosystems such that component species and ecological processes can be sustained and human well-being supported and improved.'

As EBM is designed to maintain ecosystem integrity, EBM can be seen as a mechanism that seeks to maintain natural capital over time and to limit externalities to an acceptable level, while allowing for levels and types of economic activity that are consistent with ecosystem integrity requirements. EBM's focus on ecosystem integrity is in contrast to a more conventional approach to resource management focused on maximizing sustained yields of commercially valuable resources.

The CIT's scientific products included an EBM Planning Handbook which details the EBM approach to land use planning and focuses on management objectives and targets for the logging industry. EBM uses two key tools to achieve conservation objectives:

1) A system of protected areas and reserves that preclude industrial resource extraction; and
2) Management practices and targets in the surrounding matrix.

EBM practices reduce environmental risk[4] and constrain timber extraction in a number of ways:

- by setting targets for old growth retention and other environmental values,
- by allocating permissible environmental risk levels across the landscape in a manner that reflects the values found within landscapes, and
- by requiring specific management practices such as specifying cut-block retention levels and hydroriparian buffers.

The combined effect of protected areas and management practices within the remaining matrix is intended to sum to low environmental risk at the subregional level. There is a quid pro quo in EBM implied by this overarching low risk target. If more land is protected from development across the subregion, higher levels

of risk from management practices can be tolerated within the managed matrix. If less land is protected, management practices must meet lower levels of risk. Typically, logging companies incur greater costs for lower permissible risk levels in management practices. There is thus some economic advantage to industry in seeing the creation of an effective protected areas network, such that where logging is allowed, it can be done with fewer restrictions.

Prevailing industrial forestry was far from achieving low risk at the subregional scale. Environmental risk assessments completed for each of the three subregions indicate that industrial logging has resulted in high or very-high levels of risk to coarse filter biodiversity within high productivity ecosystems, and that if status quo resource management regimes are continued, many environmental values will end up at high environmental risk (Holt & Sutherland 2004, Holt 2006). As the CIT concluded, under status quo management: ' ... ecosystem diversity is poorly maintained and protected. Much has been damaged or reduced by logging and fishing, which have concentrated on the most productive and diverse ecosystems. The state of species and genetic diversity is even worse, with habitat protection of at-risk and focal species either lacking or (at best) inadequate. ... Fishery and timber populations—the sources of major provisioning and cultural services such as sustenance, employment, and income—are declining sharply' (Prescott-Allen 2005, p. 13).

The CIT's scientific products generally achieved a high level of credibility. They helped the diverse set of stakeholders involved in land use planning processes reach consensus on the Central and North Coast land use plans completed in 2003 and 2004. These land use plans recommended expanding the system of protected areas, and that the EBM handbook's ecological targets be fully implemented by March 31, 2009.[5]

The province, though generally reluctant to set aside land as protected areas, used the consensus land use plans as a basis for government-to-government negotiations with First Nations. The provincial government announced land use plans for the GBR on February 7, 2006 (see Figure 1). Adding to the 443 000 hectares of protected areas in existence prior to 2001, newly negotiated parks cover an additional 1.3 million hectares, while no logging zones protect an additional 297 000 hectares from industrial logging, for a total of over 2 million hectares protected from the chainsaw – or an area three times the size of Germany's Black Forest. This protection results in 33% of the 6.4 million hectare Central and North Coast being off limits to logging.[6] This proportion compares favorably to other global examples of large protected areas: the Great Barrier Reef at 33% protection and Costa Rica at 25% protection.

Although the level of protection newly set for the GBR is high as compared to other regions, the CIT's Ecosystem Spatial Analysis indicated the proportion of the GBR needing protected area status would likely have to exceed 60% if protection was the only tool available to achieve ecosystem integrity requirements (Rumsey et al. 2004). Protecting such a high proportion of the landscape was not politically feasible given the interests of logging companies, the business-friendly

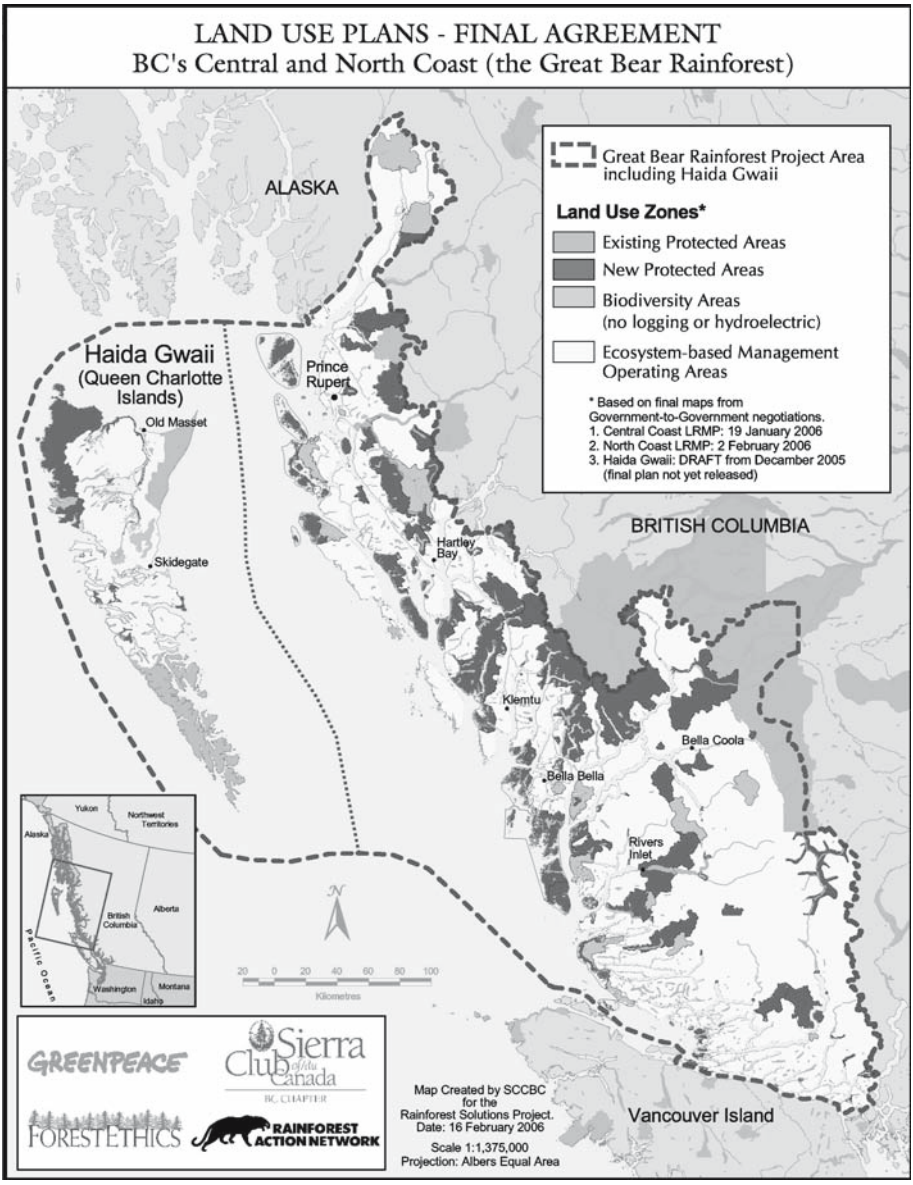

Figure 1. Location of Great Bear Rainforest/Haida Gwaii and Protected Areas Network.

orientation of the Liberal government, and the economic dependency of log processing communities located outside the GBR's boundaries. In addition, given the need for local economic opportunities, individual First Nations varied in their enthusiasm for creating protected areas within their traditional territories. Since the level of protection provided by land use plans was well below 60%, to achieve the CIT's recommended low environmental risk target at the subregional scale, management practices within the managed landscape must be more precautionary.

2. Methodology

In 2005, the Rainforest Solutions Project (RSP) obtained access to logging data gathered by the province so it could collect stumpage payments for timber logged on the BC Coast, covering 1979 to 1998. This data records all timber logged by year, forest district, licence, timber mark, species, grade, volume, and stumpage collected. Similar data for the period 1999 to 2005 was downloaded from the Ministry of Forests and Range Harvest Billing System website.[7] The two datasets were then merged. Although this harvest billing data is gathered by the province for revenue collection purposes, when combined with other recently obtained information on future logging plans, these datasets provide information to support independent analysis on the GBR's logging history and prospects for future logging that until recently had not been publicly available. This paper presents initial results from that analysis.

All timber logged in BC must be identified with a unique timber mark assigned by the province. The timber mark covers timber logged by a given licensee within a defined geographical area of a forest district. Forest district, logging tenure, and timber mark boundaries are not ecologically based and are frequently bisected by provincial land use planning boundaries. A given logging tenure (e.g. Forest Licence or Tree Farm Licence) can therefore cross over a variety of administrative boundaries that themselves do not align with the boundaries of Haida Gwaii or the Central and North Coast planning areas.[8]

The RSP does not have access to descriptions of the geographical boundaries applicable to each timber mark and, for some older timber marks this information may no longer exist. We gained access to a tenure database and a reforestation database containing patchy data linking timber marks to 1: 20 000 maps.[9] This allowed the geographic origin of trees logged by a little less than half of the timber marks to be determined with more specificity than the broad scale of forest district boundaries, thus assisting in determining if the logging was in the study area. Unfortunately, with these datasets, it is often difficult or impossible to determine at a finer scale than the forest district level where on the coast a given volume of timber was logged.

Adding to the analytical challenge, the coastal forest industry is in a state of flux, with government tenure take backs under the province's Forest Revitalisation Initiative and forest-company trades and acquisitions, resulting in tenures being reallocated between companies. For instance, one of the major players in the region begins the study period as MacMillan Bloedel, which was purchased by Weyerhaeuser in 1999, whose GBR holdings were recently acquired by Brascan in 2005 and allocated to a new subsidiary, Cascadia Forest Products, which was acquired by Western Forest Products in 2006.

As a result of the above complicating factors, and with over 4000 timber marks within, partly in, or potentially within the study area, considerable preparation of stumpage data was required before it could be analyzed. Despite best efforts, there remains a substantial volume of timber that cannot be coded as being logged either within or outside of the study area boundaries; for purposes of this analysis, only data definitively associated with the GBR and Haida Gwaii was used.

3. Analysis

3.1. Cedar depletion and over-harvesting

If logging fails to reflect the profile of species found in the forest and instead focuses only on one species with greater commercial value, economic opportunity can be rapidly exhausted and ecosystems where the species is concentrated can be put at high risk. Logging companies have an incentive to log the highest value stands first (i.e. the most valuable species on the most productive sites with the lowest logging costs), unless regulatory constraints effectively limit such behavior (Clark 1975). The data shows this behavior has been occurring.

'Hembal' (hemlock and balsam are commonly lumped together as 'hembal' due to similar end uses and log values) comprises approximately 56% to 62% of the commercial timber inventory for the Central and North Coast. For cedar (western red cedar and yellow cedar are also lumped together), the proportion averages 13% to 15% on the North Coast and 28% to 32% on the Central Coast. If the logging industry were 'logging the profile', it would be expected that similar proportions of hembal and cedar would be found in the logged volumes as in the inventory. However, while the industry once logged reasonably close to the profile, by the late 1990s it was engaged in high grading. Since 1998, within the GBR it has logged on average more than 40% cedar; since 2002, it has logged more than 50% cedar. The switch in relative contribution to the total volume logged is likely due to the loss of market value for green hemlock following the collapse of houses built with this material in the 1995 earthquake in Kobe, Japan.

The performance of the major logging companies that agreed in 2001 to adopt EBM is relevant to assessing whether voluntary commitments have translated into

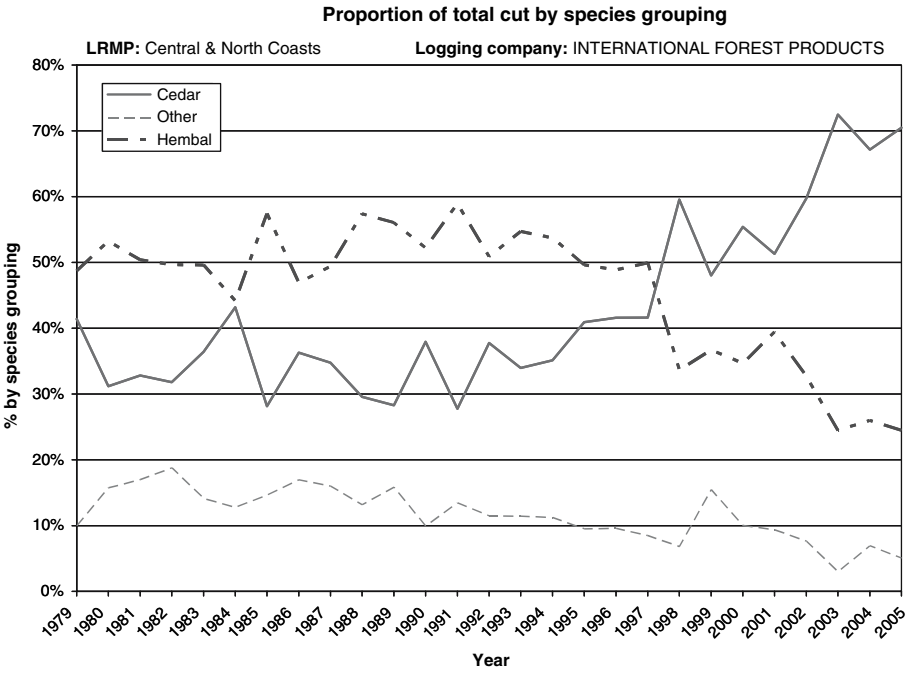

Figure 2. Proportion of volume logged by species grouping, International Forest Products.

on-the-ground improvements. The results suggest otherwise. In particular, International Forest Products Ltd. (Interfor), one of the major licensees on the Central and North Coast[10], has been aggressively logging cedar in recent years (see Figure 2), with the proportion of its harvest coming from cedar now surpassing 60%. Had Interfor logged more closely to the profile on the Central Coast after 2001, using the stumpage data it is estimated that company revenues from logging in the study area would have been reduced by approximately $90 million. The conversion return would have dropped by about $16/m^3, to a net loss of $40 million, and the company would not have been able to cover logging costs.[11]

3.2. Depletion of higher grades

The proportion of timber coming from the more valuable grades (B to G) rather than those that are less valuable (H to Z) has been declining over time as Figure 3 shows, indicating that much of the best timber has already been depleted.[12]

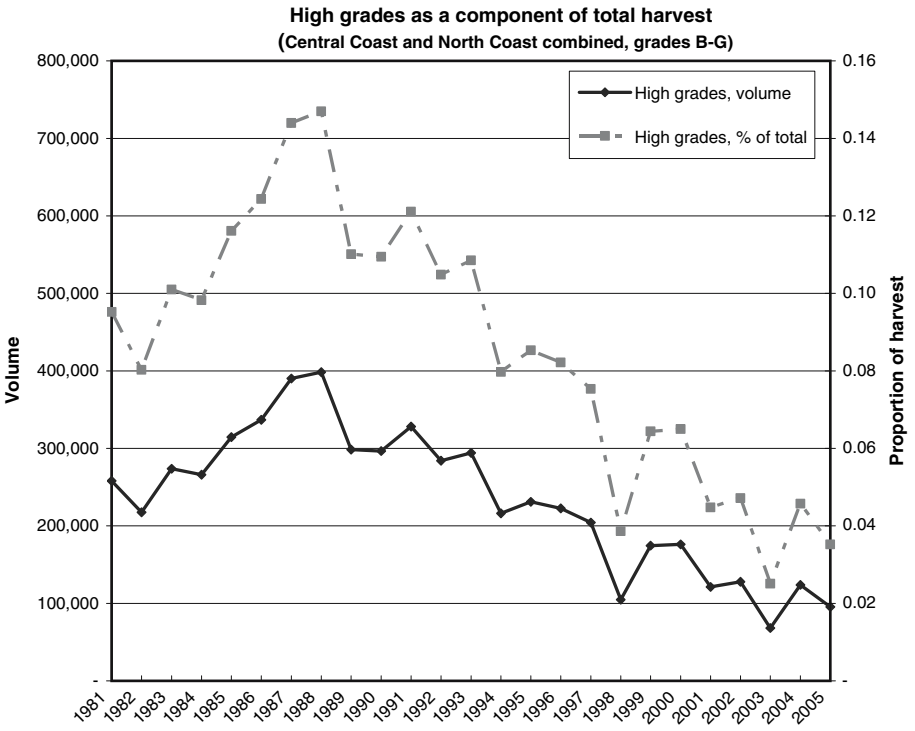

Figure 3. Proportion of volume logged in higher grades.

3.3. Comparison to depletions layer

The Nature Conservancy, the Rainforest Solutions Project, and Round River Canada have been working collaboratively to analyze the conservation value of the recently announced North and Central Coast land use plans. As part of this analysis, the organizations used forest cover data. Forest cover data provides information that indicates whether a stand is natural or has been logged, its productivity, and its leading species. While the historic stumpage data allows for the species profile and grades of past logging to be examined, forest cover data allows for a coarse examination of which ecosystem types have been logged and how much economic opportunity remains, and to estimate the level of risk to ecosystems entailed by tapping that opportunity. To understand the implications of this analysis, it is essential to recognize that a majority of the forested landbase is classified as having poor productivity, and how little of it is good and medium productivity cedar. A breakdown by productivity class for the Central Coast is provided in Figure 4 by leading species.

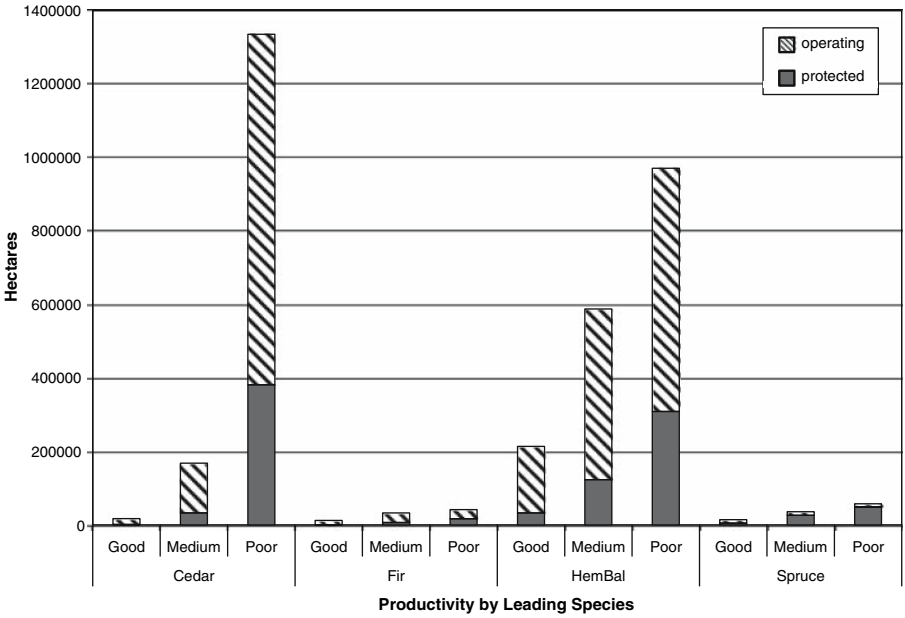

Figure 4. Proportion of Central Coast forested land base in different productivity classes by leading species.

Figure 5 shows a breakdown of the GBR's forested area in logged versus in natural state, by leading species and by productivity class.[13] For all but one tenure holder, most good cedar and hembal sites have already been logged, and current logging is taking place in medium productivity sites. The limited potential for future logging of old growth is made clear by the fact that good productivity sites in old and mature age classes are already scarce while the equivalent medium productivity sites are currently facing heavy logging pressure. Despite being mostly made up of old growth, poor productivity sites are rarely economic, though some of the more accessible stands with a high cedar component are now being logged. Figure 5 also shows that despite their aboriginal title, First Nations currently hold a fraction of the total tenure allocated by the Province, and none of that tenure involves cedar-leading sites with good productivity.

4. Discussion

EBM endeavours to reduce environmental risk and maintain natural capital stocks over time while allowing for human use of ecosystem goods and services (Costanza & Daly 1992, Swanson & Franklin 1992, Slocombe 1993, Christensen

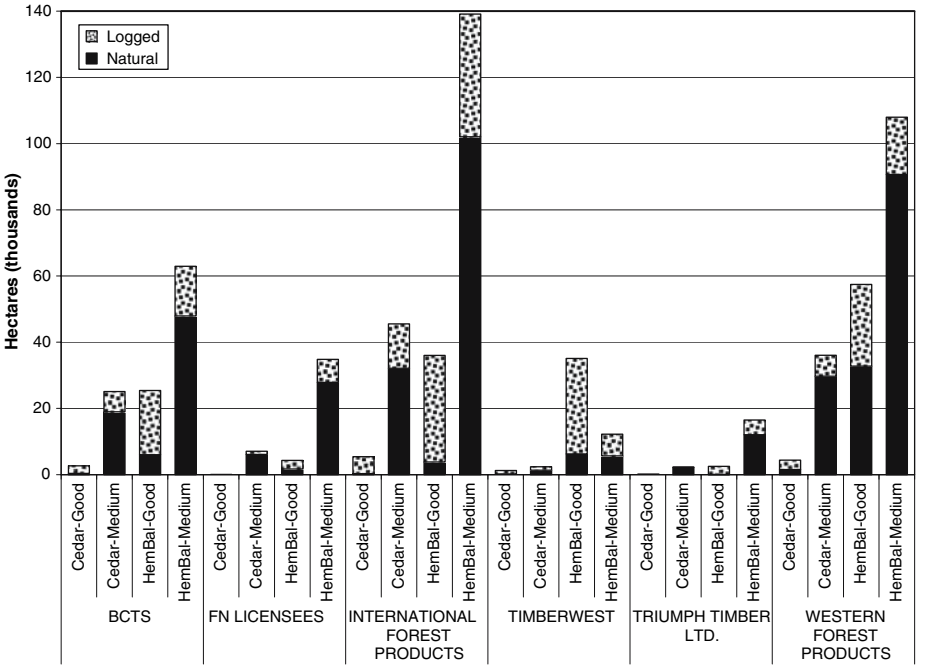

Figure 5. Good and medium site productivity for Cedar and Hembal leading stands, by licensee chart area, showing proportion logged vs. natural.

1996, Grumbine 1997). The proceeds from logging under EBM provisions should therefore not be the result of natural capital consumption, and can appropriately be classified as income. EBM also shifts management decisions towards a value-focused orientation which takes into account the full stream of economic benefits derived from forests in order to achieve better economic performance and socio-economic outcomes over time (Iverson & Alston 1993, Kant 2003, Kozak 2003, Maness & Farell 2004).

The analysis indicates that in the period from 1979 to 2005, the forest industry removed much of the accessible, highest value, lower-cost old growth timber from the GBR, focusing in recent years on cedar. This behavior has important implications for environmental risk, since the more valuable timber is generally found in the more productive ecosystems that are the most ecologically important. This finding also has important implications for First Nations and local communities who are seeking reallocation of timber harvesting rights. As the average grade of timber extracted declines, and as the less valuable species become predominant, it becomes more difficult to cover logging costs. By the time they benefit from the reallocation of logging rights, First Nations and local communities will largely be left with timber that has little commercial value.

Major logging companies have not been acting in a manner that accounts for the long-term interests of local First Nations and communities. They have systematically logged the best timber and have reacted to difficult market conditions by highgrading higher value cedar rather than logging the forest profile. This style of logging, focusing on the most productive and accessible sites and the most valuable species, forecloses many future economic opportunities in the region. Industry's behavior is not unexpected given lax environmental oversight, market pressures, investor interests, and the resource rights regime established by a government focused on resource extraction and commodity production (Ludwig et al. 1993, M'Gonigle 1997, Kant 2003).

The data also indicate that over the period 2001 to 2005, despite increased First Nation engagement, environmentalist pressure and marketplace scrutiny, the major logging companies continued to highgrade. Had companies been required to log the profile, many industrial logging operations would not have been viable. To avoid unacceptable risk to environmental values, voluntary commitments made by a subset of logging companies need to be replaced with legally mandated requirements that apply to all companies and that fully implement EBM.

In much of the GBR and Haida Gwaii, if logging had continued under business-as-usual practices and logging levels, the industry would have collapsed after two decades of old growth logging, at best. Although there would still be considerable volumes of old growth after two decades, most of this would be in small uneconomic pockets or in lower productivity sites.

Government justified its policy of old growth liquidation on the basis that second growth forests will be more productive and that once these stands are 60 to 140 years old they will have sufficient volume to be logged again. However, from a narrow timber perspective, the region's competitive advantage is in producing high quality old growth since rotation periods are too long to compete in low grade fibre markets with fast growing plantations at less northerly latitudes. A recent economic assessment of the commercial viability of logging second growth in Haida Gwaii (which generally has the region's lowest logging costs) found that at the planned rotation age, second growth stands would have a market value of between 55 to 70% of their old growth equivalents (Cortex Consultants and HiMark Forest Consultants 2004). This suggests that second growth logging in the region is likely to be an economically marginal undertaking. For much of Haida Gwaii and the GBR, logging is therefore a one-time affair supported by the liquidation of old growth timber stocks accumulated over centuries. Where a second rotation is not in fact economically viable, the stream of revenue generated from logging old growth is therefore more appropriately classified as capital consumption rather than income (El Serafy 1989, Green 2000, Victor 2001).

Recently, court cases and other events have given First Nations a stronger hand in resource management. The province has begun reallocating a small proportion of logging rights to local First Nations. Since most of the available good productivity sites and much of the medium productivity sites have already been logged,

achieving viability under EBM will be difficult. In effect, First Nations are being invited to the end of a banquet to pick at the leftovers. Because a high proportion of the most environmentally valuable stands have been logged already, future logging, including commercial logging by First Nations, will need to be limited in rate and extent to avoid compromising ecosystem integrity and the environmental and cultural values that support human well-being.

With resource extraction rates needing to drop substantially to meet EBM requirements and to avoid a collapse in long-term extraction levels, a much higher proportion of the revenue, jobs and other economic benefits generated from logging must be retained locally to improve human well-being (Walter 2002). The limited opportunities from logging also provide a strong rationale for developing economic alternatives to logging on the coast, and to managing forests for the broader set of economic opportunities they support (Kozak & Maness 2005). For this reason, ForestEthics, Greenpeace, and the Sierra Club of Canada, BC Chapter, have raised $60 million in conservation financing to help First Nations diversify the coastal economy. This amount is to be released once it is matched by $30 million each from the provincial and federal governments.

Often noted in the ecological economics literature is that, with respect to public policy, what is counted, counts (Waring 1988, Daly & Cobb 1989, Victor 2001). With respect to forest management, government has tended to count cubic metres of wood harvested, stumpage revenue, and jobs. Such indicators have tended to portray the route to economic success as those choices, policies, and enterprises that rapidly convert old growth forests into commodity products, with little attention to what economic opportunities will remain when the old growth is exhausted.

Through the land use planning process and subsequent negotiations between the province and First Nations, governments and other parties have grappled with selecting an appropriate set of socio-economic objectives, indicators, and targets. These would be used to guide implementation of land use plans and EBM in the region, and to monitor whether or not required improvements in human well-being are being achieved. If socio-economic targets are not met, government-to-government agreements provide that EBM requirements can be loosened so as to temporarily increase economic opportunity, though doing so will increase environmental risk. Socio-economic indicators and targets intended to monitor the implementation of EBM, such as wage levels, forest sector employment, and the volume of timber extracted as a proportion of the allowable cut, are oriented towards status quo resource extraction and the economic activity it supports, rather then reflecting the diverse ways in which ecosystems support economic activity and human well-being. Because socio-economic targets for many of the indicators have been set at national averages, they risk measuring improvements as failures. For instance, average wages in the GBR are very unlikely to reach the same level as they are in Montreal or Vancouver. There is no evidence that GBR wage levels must meet national averages for human well-being to be acceptable, yet the failure to achieve national averages could be used by some parties to

rationalize relaxing or abandoning EBM requirements. Furthermore, as the logging and wood processing industries continue to introduce labor-saving technologies, employment levels in these sectors will tend to decline over time irrespective of EBM constraints.

Sustaining current economic activity in the logging industry and increasing local economic activity in other sectors do not guarantee improved human well-being: economic activity can both contribute to and detract from human well-being (Power 1996, Helliwell 2003, Daly 2005). Market activity often displaces subsistence and informal economic activity, both of which are important in Haida Gwaii and the GBR. The apparent benefit from growing market activity can be, at least partially, cancelled by declines in non-monetized economic activity. Hence, addressing the currently unacceptable level of human well-being in the GBR is not merely a matter of increasing business opportunities and trusting that employment and income levels will improve, and from there, concluding human well-being has improved. The quality of economic activity that takes place in the region is of key importance, as is the economy's long-term sustainability. Jobs, business spin-offs, and royalties in an EBM framework are means to an end, rather than an end in their own right. Broader aspects of human well-being, and those not directly linked to monetized exchanges, need to be addressed by an indicator framework.

As of this writing, the process to translate transitional EBM objectives into legally binding requirements has been initiated and should be complete by early 2007. Licensees will then be obligated to ensure new planning is compliant with transitional EBM requirements, but already approved roads and cutblocks will be grandfathered. Because of grace periods to reach compliance and the lag time between planning and actual operations, logging of a given cutblock could be based on standards up to six years behind prevailing EBM requirements. While high level, subregional land use plans have been completed (i.e., identifying protected areas vs. areas where EBM practices apply), planning at the landscape and watershed scale is only beginning. This planning delay results in gaps in the multi-scale system of EBM since landscape and watershed level reserves have yet to be set aside, and allowable risk levels have yet to be allocated across the land base. Current annual allowable cut levels reflect industrial and not EBM practices, and are thus inflated. The implementation lag of more detailed EBM plans, the long time frame for legal requirements to change practices on the ground, and high allowable cut levels results in increased risk to old growth ecosystems during the transition period.

5. Conclusion

In February 2006, the province made a historic decision to implement new land use plans that substantially increase the amount of protected area in the GBR. The province also committed to full implementation of EBM requirements defined

through an independent science process by March 2009. These decisions were the outcome of sustained pressure for improved stewardship from First Nations, environmental organizations, and the forest products marketplace.

The government's February 2006 land use decision and EBM commitment improves prospects for the long term viability of a more modest, but sustainable, forest industry that benefits First Nations and local residents. However, uncertainty remains over what EBM requirements will be legally mandated, and implementation has been slow.

Fears expressed in the public arena that the economic impacts of EBM implementation are too great (because of impacts on the logging and wood processing industries) appear to be based on a failure to recognize that the logging industry in the GBR has already liquidated much of the most valuable old growth timber. Rather than generating wealth, the logging industry, with its commodity production orientation, has survived off the proceeds of liquidating an irreplaceable capital asset. Analysis of data from the province's Harvest Billing System over the period 1979 to the present demonstrates that the companies have taken out much of the best timber and that the grade of timber is declining over time. Combining this with analysis of forest cover data indicates future economic opportunity from industrial logging is limited. Current cut levels are too high and, if not brought into line with EBM requirements, the logging industry in the region, already in decline, faces further reductions as it runs into the reality of resource exhaustion which has already played out across most of North America (Clapp 1998). With or without implementing EBM, future economic opportunities in the GBR have already been eroded by logging. Improving human well-being in these circumstances is a daunting, but necessary undertaking.

EBM is intended to achieve human well-being and maintain ecosystem integrity. The province has tended to measure the logging industry's socio-economic performance on the basis of the more easily measured indicators, such as jobs, stumpage payments, and m^3 of timber logged. This, in effect, supports a policy of highest-value first old growth liquidation. New approaches to economic analysis of forest management are required that better address the contribution of healthy ecosystems to human well-being, and that account for the maintenance or depletion of natural capital.

Despite past logging in Haida Gwaii and the GBR, the region retains high conservation value and options are available to maintain ecosystem integrity while allowing for a diversity of activities that contribute to human well-being. The province has taken a first step by increasing the GBR's protected land base to 33%. For the remainder, despite the need for improved human well-being, it would be a mistake for the province to implement a weak version of EBM that sought to minimize timber supply reductions. Weak EBM provisions would fail to maintain natural capital and would increase risk to environmental and cultural values, as well as compromising future economic opportunities in sectors that depend upon environmental quality.

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Notes

1. While this paper examines the GBR from a 'forests as timber' perspective, in no way does the author advocate that this is the appropriate perspective from which to make management decisions for the region.
2. This paper does not address other aspects of natural capital depletion due to logging, such as increased risk to ecosystem integrity and environmental values, nor natural capital depletion due to other industrial activities, such as mining. It also does not address the economic implications involved when industrial logging affects sectors that depend on environmental quality, such as tourism and subsistence production.
3. The author served on the ten member management committee that oversaw the Coast Information Team process.
4. For further information definitions of risk and the use of risk assessment in BC, see Utzig & Rankin (2000).
5. A land use plan for Haida Gwaii is currently under negotiation between the Province and the Council of the Haida Nation as of writing. Like the Central and North Coasts, a land and resource management planning table was also convened for Haida Gwaii to provide land use recommendations to the governments, but it did not reach consensus.
6. It is anticipated that the Haida Gwaii land use plan will result in 40% or more of the land base being off limits to logging. It should also be noted that some protected areas, while prohibiting logging, would allow for mining.
7. Located at http://www4.for.gov.bc.ca/hbs/opq/ftas/invoiceSummary.jsp (current as of August 31, 2006).
8. In particular, the Central Coast land use planning boundary includes the northern tip of the Campbell River Forest District as well as the mainland portion of the North Island Central Coast Forest District, but not the portions of those same districts located on Vancouver Island. It includes all of the Mid Coast, and only the mainland portions of the Kingcome and Strathcona Timber Supply Areas. It includes portions of Tree Farm Licence 25, 39, 47 and all of 45.

9. Each map covers 12 minutes of longitude by 6 minutes of latitude. However, a given timber mark could reference up to a dozen 1:20 000 maps.
10. As of 2004, International Forest Products no longer has tenure on the North Coast.
11. For purposes of this estimate, it was assumed that no more then 34% and 4% of log volume could come from western red cedar and yellow cedar, but that log values per m^3 by species would otherwise be unchanged.
12. BC changed its log grading system in from a numeric system with 4 main grades to an alphabetical system with 15 grades in 1981, so comparisons with 1979 and 1980 data are more difficult and are omitted here.
13. To ensure the graph is readable, only stands with hembal and cedar leading species in the good and medium productivity classes are shown.

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