METHODS

Confusing liquidation with income in BC’s forests: economic analysis and the BC forest industry

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Abstract

Forest exploitation in British Columbia is currently unsustainable. Economic analysis is frequently used to justify the high rate of cut by documenting the revenue, job and wage benefits of current industrial forestry. However, Hicks’ definition of income implies that it is poor accounting practice to count the consumption of natural capital as income. Yet in BC, economic analysis fails to make adjustments for the consumption of forest capital. Such analysis provides society with misleading signals of future economic prospects. By reference to landscape ecology, conservation biology, forest ecology, and ecosystem-based management, this paper sets out requirements for a forest management regime that maintains forest capital intact and for determining a rate of cut that would likely maintain ecosystem structure and function. This ecologically sustainable rate of cut can be seen as an ‘extraction ceiling’. Extraction beyond this ceiling is considered to involve natural capital consumption. This extraction ceiling is used to divide the proceeds from timber extraction into ‘interest’ and ‘depletion’ streams. The interest stream is consistent with maintaining capital intact, and can be considered true income. The depletion stream involves capital consumption. Basing economic analysis of the forest industry on an extraction ceiling encourages debate about defining sustainable extraction levels and about how to make the transition to sustainable forestry. It also shows that the timber industry overstates its contribution to government revenues and to the province’s economic well-being. Critics of industrial forestry in BC have yet to take full advantage of how proper accounting for natural capital depletion can show the advantages to moving towards an ecoforestry approach. By insisting that economists make adjustments where natural capital depletion is projected to occur, advocates of ecoforestry can ensure a more level playing field for the comparison of industrial forestry and ecoforestry. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Income; Natural capital; Accounting; Extraction ceiling; Ecoforestry

1. Introduction

The forests of British Columbia, Canada’s westernmost province, range from globally rare
coastal temperate rainforests to northern and alpine spruce forests, and cover an area of 59 million hectares, of which slightly less than half is considered commercially important and available for timber cutting (BC Ministry of Forests, 1996). In 1994/1995, 190 000 hectares of public forest were cut, with over 90% of the total volume coming from clearcutting old-growth stands. Most of the forests are publicly owned, with long-term tenures granted to large, vertically integrated forestry corporations. Two-thirds of the annual cut is controlled by the top 17 corporations. The forest industry makes up a declining but still important proportion of provincial GDP; in 1997 there were 78 000 direct employees (4.2% of the provincial labor force) and the industry generated $16 billion (Cdn) in sales (Marchak et al., 1999).

The BC forest industry portrays itself as the engine powering the provincial economy: it provides jobs and it fills provincial coffers so that society can afford to have good hospitals, to pay teachers, and to offer social assistance (Price Waterhouse, 1998; Council of Forest Industries, 1999). Yet there are mounting concerns that industrial forestry is causing unacceptable environmental impacts, including soil degradation, destruction of fish habitat, impairment of water quality, and loss of biodiversity (Hammond, 1991; M’Gonigle, 1997; Sierra Legal Defense Fund, 1997a,b; Marchak et al., 1999).

BC environmental organizations and disaffected foresters propose an alternative commonly known as ecoforestry (Hammond et al., 1996; Greenpeace, 1997; Silva Forest Foundation, 1999; Travers, 1999). Under ecoforestry management, clearcuts would be replaced by partial cuts; planning would be ecosystem-based, with much of the forest set off-limits from logging; and cutting would be less frequent to allow the forest to develop old-growth characteristics. As a result, the volume of timber removed annually would fall by 65–90%, a reduction somewhat offset by the fact that timber derived under an ecoforestry management regime would be of higher quality as harvest age would be greater (Scientific Panel, 1995; Hammond et al., 1996; BC Wild, 1998, p. 33). Proponents of the status quo such as the Council of Forest Industries and the Ministry of Forests argue that the large drop in timber outputs entailed by ecoforestry would cause wages and tax revenues to plummet and British Columbians to lose their high standard of living (Wilson, 1998; Council of Forest Industries, 1999).

All participants in the forestry debate fail to address a fundamental accounting error. In British Columbia the consumption of the forest’s natural capital is treated as income. The province is involved in an unacknowledged form of deficit financing. Current comparisons between industrial forestry and ecoforestry are thus unfair. Until critics of industrial forestry tackle this accounting sleight of hand, they place themselves at a disadvantage in challenging the status quo. Ecoforestry is designed to maintain natural capital (Travers, 1999); industrial forestry was designed to liquidate natural capital, replacing BC’s old-growth forest inheritance1 with tree plantations that fail to provide the same range of ecosystem services (Hammond, 1991; Marchak et al., 1999). The situation in BC has parallels around the globe. As the co-chairs of the World Commission on Forests and Sustainable Development wrote in the foreword to their report, ‘Rather than living on the ‘interest’ of the ‘natural capital’, we are borrowing from poorer communities and from future generations’ (World Commission on Forests and Sustainable Development, 1999, p. 4).

This article proposes a pragmatic approach to correcting for renewable natural capital consumption in economic analysis of BC’s forest industry. It does not address the consumption of non-renewable natural capital.

This article makes three main points:

- economic analysis ought to make adjustments for natural capital consumption;
- BC is failing to maintain forest capital intact, yet government and industry are treating the proceeds from unsustainable industrial forestry as if it were income; and
- advocates of forestry reform should push for proper accounting for natural capital depletion such that the implications of both status quo

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1 It would be more accurate to acknowledge that this ‘inheritance’ came from dispossessing the original inhabitants of the land.
policies and of making the transition to a sustainable alternative are more accurately portrayed.

2. Income and natural capital

The definition of income commonly accepted by economists, proposed by economist Sir John Hicks, presupposes that income is derived by maintaining capital intact.\(^2\)

Implicit in the definition of income is the concept of sustainability (Daly, 1992). As El Serafy notes, for the economist, maintaining capital intact is a technical artifact; 'it does not spring from any desire to preserve the capital stock as an end in itself, but simply to get a grip on the estimation of income which has to be sustainable if it is to be identified as income at all' (El Serafy, 1996, p. 78). No 'paradigm shift' is required to begin accounting for natural capital depletion (Potvin, 1990).

Until recently, economists have applied this definition of income to manufactured capital only, and have done their best to take into account the depreciation of buildings and machinery. Natural capital, such as forests and marine ecosystems, have been ignored, and countries could mistakenly believe, based on economic indicators such as GDP, that their income was increasing even as the resources from which much of the income was derived was exhausted (United Nations, 1993; El Serafy, 1997). Now that humanity presses against ecological limits, this omission provides a very misleading picture of ecological and economic health (van Dieren, 1995). In this paper, I take the 'strong sustainability' approach (Daly, 1992, pp. 250–251). The emphasis is on accounting for natural and manufactured capital stocks separately, rather than aggregating the two stocks.

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2 Hicks wrote: ‘The purpose of income calculations in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves. Following out this idea, it would seem that we ought to define a man’s income as the maximum value which he can consume during a week, and still expect to be as well off at the end of the week as he was at the beginning’ (Hicks, 1946, p. 172).

3. The natural capital of forests

Once the need for economic analysis to account for natural capital depletion is accepted, the next dilemma involves defining what is implied, in a forestry context, by maintaining natural capital intact. There have long been rules of thumb for the sustainable management of renewable resources. For instance, it is commonly accepted that harvesting rates should not exceed regeneration rates. New insights from landscape ecology, conservation biology, and forest ecology have shown such rules to be inadequate. Most such rules do not address habitat fragmentation, landscape connectivity, the maintenance of biodiversity, linkages between ecosystem components, the need for ecological legacies (e.g. trees allowed to grow old, die, fall down, and rot — thereby providing habitat and enriching the soil), etc. Resource management regimes should be designed that have a good a priori likelihood of protecting ecological productivity, integrity, and diversity because they respect fundamental ecological principles (Holmberg et al., 1996).

3.1. Rules for maintaining the natural capital of the forest intact

Relevant rules for maintaining the forest's natural capital can be deduced by consulting the landscape ecology, conservation biology and forest ecology literature. From my reading of this literature, maintaining the natural capital of the forest in the BC context requires the following:

1. resource extraction must be constrained in a way that maintains connections across the landscape and ensures the protection of representative and sensitive habitats (Franklin, 1993; Grumbine, 1994; Mangel et al., 1996);
2. managed forests must not significantly 'contrast' with their natural counterparts. Instead, they must contain the same structures and legacies and function in similar ways (Franklin, 1992; Pimmental et al., 1992; Swanson and Franklin, 1992; Christensen et al., 1996);
3. rotation ages must be set significantly longer than the culmination in mean annual incre-
ment to allow old-growth characteristics to develop (Franklin, 1984, 1992; Hopwood, 1991);
4. soil productivity must be maintained (Utzig and Walmsley, 1988; Maser, 1993);
5. species, genetic, and habitat diversity must be maintained (Christensen et al., 1996; Sanjayan and Soule`, 1997); and
6. timber extraction rates must be cautiously set to ensure the above constraints can be respected and to provide a safety factor in the face of uncertainty and natural variability (Mangel et al., 1996).

In response to widespread criticisms of BC’s forest practices, particularly on the west coast of Vancouver Island, the BC government established a well-respected scientific panel to study and report on the requirements for sustainable forestry in BC’s renowned Clayoquot Sound. Support for each of the above requirements can be found in the report of the Scientific Panel (1995).

One way to design a management regime that satisfies the above conditions and thereby maintains the forest’s capital intact is to prepare and implement an ecosystem-based landscape plan and then to manage stands within the landscape in accordance with eco-certification standards.

Ecosystem-based landscape plans aim to protect biodiversity and ecosystem functioning at the landscape level. This is done by identifying a protected landscape network, which includes sensitive ecosystems and riparian and cross-valley corridors. These corridors maintain linkages between various habitats. Once the analysis identifies and protects environmentally sensitive areas, as well as areas that must be protected from logging in order to maintain landscape level functioning, a much smaller land base remains available for logging in timber extraction zones (Hammond, 1991; Scientific Panel, 1995; Hammond et al., 1996).

For ecosystem-based plans to be effective, constraints are required at both the landscape level and the stand level. The peer-reviewed eco-certification standards of the BC-based Silva Forest Foundation set aside a portion of the large trees to grow old, to die, and to remain as snags; limit the amount of timber that can be extracted from a stand during a given year; require delays of over a decade between entries to extract timber from a given stand; and require that rotation ages are sufficiently long for old-growth conditions to develop (Silva Forest Foundation, 1999).

Once an ecosystem-based plan has been prepared, and stand level constraints have been applied, the next step is to calculate an ecologically sustainable rate of timber cutting that respects all landscape and stand level constraints. Typically, such an ecologically sustainable cut would require government-sanctioned extraction rates to drop by 65–90% (Scientific Panel, 1995; Hammond et al., 1996; BC Wild, 1998).

The ecologically sustainable cutting rate is deemed to be an ‘extraction ceiling’.3 If extraction stays within the limits specified by the plan and the sustainable cut, natural capital can be said to be maintained intact. If the plan is not followed or the sustainable cut is exceeded, natural capital depletion is held to be occurring. The forest’s integrity is thereby considered threatened, even if scientists and managers cannot predict the ultimate ecological effects of exceeding ecosystem limits. The potential for future sustainable extraction will therefore be diminished, and the extraction ceiling will need to be adjusted downwards. Eventually, if aggressive extraction continues, what remains of the forest may have to be declared off limits to timber extraction for decades while restoration takes place.

The extraction ceiling has some parallels to the safe minimum standard (SMS) proposed by Bishop (1978) and the sustainability standard proposed by Hueting (1991). The SMS approach is a conditional requirement for the protection of irreversible losses in natural capital where the costs of protection are not intolerable. The sustainability standard is a level of environmental quality defined by society which may or may not involve consumption of natural capital, depending on how stringently the standard is set. In contrast, in setting the extraction rate ceiling the intent is not to define an acceptable minimum, where a certain loss of environmental function is accepted.

3 In Green (1998) the term used for extraction ceiling was natural capital baseline, but this proved confusing.
Rather, it is to identify the requirements for fully maintaining ecosystem function and structure and then to determine what extraction can take place while meeting these requirements. In other words, the intent is to define the conditions under which natural capital is not consumed.

3.2. Current forestry practices: evidence of depletion

It is hard to dispute that natural capital is being depleted in BC, even if one refers to the optimistic analysis of the BC Ministry of Forests. The Ministry of Forests typically defines two extraction levels for a given region: the allowable annual cut that operators cannot currently exceed (henceforth the current cut), and the long-term harvest level (henceforth the long-run cut).

The current cut is based on liquidating high-volume old-growth stands of timber; it is a one-time shot at quickly cutting the accumulated inventory of older, larger trees (140–400 or more years old). The justification for this liquidation policy is that old-growth stands are decadent and not increasing in volume, and therefore society would benefit by replacing these forests with tree plantations managed on short rotations that will grow larger volumes of fiber per year (Dellert, 1998). The long-run cut is based on cutting the annual growth produced by tree plantations. Because these plantations are managed on short rotations (typically of 70–140 years), they will have less volume per area than did the old-growth stands they replaced. Therefore, once old-growth is depleted there is a significant ‘falldown’ from the current cut to the long-run cut, known as the ‘falldown effect’ (BC Ministry of Forests, 1997, p. 81).

In many parts of BC, falldown has already begun and mills are closing; in others it is projected for one or more decades hence (BC Wild, 1998; Marchak et al., 1999). The Ministry thus manages the forests to maximize the volume of fiber produced, as opposed to managing to maximize timber value or for maintaining ecosystem integrity and flows of other environmental services. One consequence is that BC will be shifting away from a being high-quality saw log producer towards lower-value sawlogs and pulp (Dellert, 1998; Marchak et al., 1999).

The Ministry recognizes that in many regions, because of present overcutting, the actual rate of cut in the future will need to be reduced below the long-run cut until the forests recover. For instance, in the Queen Charlotte Timber Supply Area, the extraction rate in 1996 was 192% of the long-run cut and it would need to be reduced by 12% per decade until it reaches 17% below the long-run cut, where it will have to stay for a century until the inventory of mature timber recovers. Only in the 2100's will extraction levels be increased to the long-run cut. Overall, the provincial current cut is 22% over the long-run cut (BC Wild, 1998).

The Ministry is clear that the long-run cut is not intended to be ecologically sustainable, but rather it is merely a level of cut where timber flows can be maintained in perpetuity, even if other indicators of environmental quality decline (Dellert, 1998). Studies by the Ministry of Forests document that current forest management regimes and proposed long-run rates of cut are predicted to negatively impact biodiversity and other indicators of ecosystem health (see Green, 1998 for a review). Leaked Ministry of Environment, Lands and Parks documents show that government scientists concur with many of the concerns identified by researchers working for environmental organizations such as the David Suzuki Foundation (Marchak et al., 1999), BC Wild, the Sierra Legal Defense Fund and Greenpeace (Sierra Legal Defense Fund, 1996, 1997a,b; Greenpeace, 1997; BC Wild, 1998). These organizations have documented how industrial forestry and the high rate of cut are leading to the following problems in BC:

- a downward trend in the quality of timber, the size, and the age of trees being cut;
- soil erosion due to clearcutting, landslides due
to cutting on unstable terrain (much of it unlawful though officially approved);
- restoration costs of over $1 billion for damaged watersheds;
- species endangerment — in BC 743 plants and animals are either endangered, threatened or vulnerable — with logging as one of the leading causes;
- many salmon stocks are threatened with extinction, with logging being one of the main contributory factors;
- looming timber shortages in most areas of BC; and
- rising logging and silvicultural costs as timber must be sought in more remote and difficult terrain with poorer growing conditions.

BC’s long-stated commitment to sustained yield has not worked (Dellert, 1998). In part this is because sustained yield policies were premised on the faulty assumption that replacing ‘decadent’ old-growth forests with thrifty young stands of scientifically managed trees (tree farms) actually represented an investment in natural capital. Experience shows, however, that management intended to maximize the production of a single resource (e.g. fiber) leads to brittle ecosystems that are prone to ecological deterioration and require increasing management effort and resources (Holling, 1994). Just as forest management needs to take ecosystem complexity into account, so too should efforts to account for the costs and benefits of the timber industry.

Given that all parties acknowledge that any extraction above the long-run cut will result in falldown, decreased environmental quality, and increased need for management interventions, even the most conservative economic analysis should account for natural capital depletion where the actual cut exceeds the long-run cut. The Ministry’s long-run cut can therefore be used as a ‘weak’ extraction ceiling. From an ecological economics perspective, it is preferable that the extraction ceiling be set at a level where ecosystem integrity is likely to be maintained, and the Ministry’s long-run cut is clearly overly optimistic and ecologically risky.

3.3. Extraction ceiling is contentious

It should be obvious that defining an extraction ceiling will be contentious. Some will insist that tighter standards are necessary, while others will argue that nature is more resilient or that a greater loss of ecosystem integrity can be accepted. Yet this is a strength, not a weakness, of this approach. It forces debate on a key issue: what level and method of extraction is sustainable. For the purposes of economic analysis, several extraction ceilings can be specified, the assumptions behind each documented, and the results compared. The principle behind each of these ceilings should be that, given a certain set of ecological assumptions, extraction within the ceiling is expected to provide for a constant level (accepting natural ecosystem fluctuations) of ecological function, environmental services, and desired outputs.

3.4. Limitations of existing methods for accounting for depletion

Given an extraction ceiling, the relevant question for the economist is how best to account for natural capital depletion. I reviewed the literature on accounting for natural capital depletion, including:

- the change in productivity approach, where the analyst seeks to capture the opportunity costs of degrading natural capital (see Bojö, 1996, for an example);
- the replacement cost and shadow project approaches, where the analyst calculates the cost of replacing degraded natural capital or of installing a project intended to replace lost flows of raw materials and environmental services;
- depreciation approaches, where natural capital depletion is estimated on the basis of the change in the net market value of natural capital stocks during the accounting period (Repetto, 1992), or by deducting the rents (price minus marginal cost) on the physical amount that the natural resource is run down in the accounting period (Hartwick, 1990);
contingent valuation approaches, where the analyst seeks to determine either the public's willingness-to-pay to maintain natural capital intact or willingness-to-accept natural capital depletion, and applies these imputed values to the amount by which natural capital was depleted over the accounting period;

- the user-cost approach (El Serafy, 1989, 1993; Liu, 1998), where the analyst seeks to determine the proportion of current income from unsustainable resource exploitation that would need to be set aside and invested in a sustainable project in order to provide for a permanent stream of income as the resource is exhausted;

- the sustainability standard approach (Hueting, 1991) where the analyst deducts from current income the estimated cost of meeting a sustainability standard given current practice.

The above techniques were rejected as inappropriate or impractical for one or more of the following reasons:

- the technique was more suitable to capture the perspective of a private owner of a single resource rather than the perspective of a society interested in the broader stream of flows and environmental services provided by natural capital;

- the technique required that ecological cause-effect relationships be established where this would be onerous or impossible;

- the technique required that the analyst determine the amount by which natural capital was depleted during the accounting period or the year in which natural capital would be completely depleted at current rates of extraction (whereas estimating actual rates of natural capital depletion can be difficult, and the actual state when a forest is considered depleted covers a continuum from when irreversible loss in ecological integrity might be expected to occur to actual exhaustion of standing timber);

- the technique was based on overly simplistic rules for sustainable resource management, a simplistic conception of forest ecosystems, or assumed substitutability between natural and cultivated or manufactured capital;

- the technique was likely to provide society with confusing or even perverse signals in working towards sustainability;

- the technique introduced new economic or moral issues into the debate (such as the choice of the appropriate discount rate or valuation technique), rather than focusing the issues;

- the technique required implausible assumptions or conflicted with economic theory; and

- the basis for the technique and the results of the analysis would not be accessible to the public or policy makers, or the technique made such heavy analytical demands that the analysis was unlikely to be completed and the correction to account for natural capital depletion was therefore unlikely to be made.

Given the limitations of existing methods of accounting for the depletion of natural capital, my desire to use a pragmatic technique that would allow the analysis to incorporate more recent ecological knowledge, and my emphasis on a technique that would improve the portrayal of the economic benefits generated by the forest sector, I devised a new approach, the interest/depletion approach.

3.5. The interest/depletion approach

The interest/depletion approach defines the proportion of extraction that is taken to be interest as the ratio of the extraction ceiling to the actual extraction level. This is the proportion of current benefits that is consistent with maintaining natural capital intact. The proportion that is considered to involve depletion is set at 1 — the interest ratio.

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6 An alternative label for this ratio would be the income/depletion ratio, but because economic analysis in BC looks at income levels, e.g. total wages, when applied to the wage stream it would result in the awkward term ‘income income’.

7 If extraction levels are lower than the extraction ceiling, giving a ratio larger than 1, the ratio is set at 1, and 100% of extraction is considered interest. I do not address the case where through ecological restoration there is investment in natural capital.
To illustrate this approach, if the current cut is 100 000 m$^3$, while the extraction ceiling is 60 000 m$^3$, the interest ratio is 60% while the depletion ratio is 40% (1–60%). Using this method, the economic benefits of a given extraction regime can now be corrected in an economic analysis to account for natural capital depletion. For instance, if the scenario just mentioned generated $1 000 000 in government revenue, the analysis would indicate that $600 000 could be considered interest revenue, while $400 000 was depletion revenue. Ideally, an economically cautious administration would only spend the interest revenue to provide for current services. The depletion revenue should be set aside as a heritage fund, since such revenue is not true income and it will eventually dry up as the forest is exhausted.

I also extended the interest/depletion approach from the correct estimation of government revenue to the analysis of jobs and wages, as these numbers carry great weight in public debates. The same ratios are multiplied by total jobs and wages to indicate interest jobs versus depletion jobs, and interest wages versus depletion wages, as the case study below shows.

The interest/depletion approach is obviously an accounting device, intended to portray the economic consequences of capital consumption. Like all accounting devices, it is imperfect, but it does offer several appealing characteristics which the following hypothetical example should help to illustrate. Table 1 shows two timber extraction scenarios for a given landscape starting with a common history. In the first scenario, managers gradually shift towards a sustainable regime, while in the second scenario, aggressive extraction leads to ecological collapse. A first useful characteristic to note is that the analysis required to determine if natural capital depletion is occurring provides managers with some of the information that they will need to manage the resource sustainably (e.g. what areas should be excluded from harvesting, and what the appropriate rate of cutting should be).

In the first scenario depicted in Table 1, managers realize that extraction has been excessive and take steps to reduce the cut to a sustainable level. The reduction in total revenue is significant, but behaviour is changed before the forest is irreparably damaged as a source of economic benefits. In the second scenario, the depletion stream grows and the interest stream shrinks as managers fail to adjust extraction levels. The accountant provides society with a warning signal that depletion revenue is fleeting. While the total amount of revenue is impressive in early years, the relative amount that comes from depletion warns that ecological deficit financing is taking place. Eventually, the landscape generates no revenue.

A first glance at Table 1 might suggest that an oversight has occurred and that true income is understated, since depletion revenue could hypothetically be reinvested in a separate renewable resource, thereby generating an income stream that would be part of total income. However, this potential for a second resource to generate income through reinvestment would be more than offset by the erosion of the extraction ceiling in future years implied by excessive extraction. Therefore, the fact that this approach does not take into account the potential for sustainable income from the reinvestment of the proceeds of capital liquidation is counterbalanced by the fact that the erosion of the extraction ceiling is not addressed in the current year.

Conversely, it may seem that true income is overstated by this method. For a given ceiling, the interest revenue remains constant, while the level of depletion revenue varies with the extraction level. At first, this suggests that there is little loss involved with excessive rates of extraction: the depletion component will merely be higher, while the interest component seems to be unaffected by poor stewardship. The rational for allowing an amount of extraction equivalent to the ceiling to still be considered as interest for a given year independent of extraction above and beyond the ceiling is that this portion of the timber extracted could have been logged without consuming natural capital. In such a scenario, the manager has dipped into the sustainable cuts available for future years, and this excess shows up as depletion.

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8 If the extraction ceiling is exceeded significantly for several years, a new extraction ceiling will need to be calculated for the degraded forest. If the rate of cut is not reduced, the interest proportion will decline with time.
Table 1
Hypothetical application of the interest-depletion approach

<table>
<thead>
<tr>
<th>Year</th>
<th>Extraction rate ceiling (000s m³)</th>
<th>Actual extraction (000s m³)</th>
<th>Total revenue $000s</th>
<th>Interest revenue $000s</th>
<th>Depletion revenue $000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>102</td>
<td>110</td>
<td>1100</td>
<td>1020</td>
<td>80</td>
</tr>
<tr>
<td>2000</td>
<td>100</td>
<td>200</td>
<td>2000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>2005</td>
<td>95</td>
<td>200</td>
<td>2000</td>
<td>950</td>
<td>1050</td>
</tr>
<tr>
<td>2010</td>
<td>90</td>
<td>200</td>
<td>2000</td>
<td>900</td>
<td>1100</td>
</tr>
</tbody>
</table>

Extraction is initially unsustainable...

2015 70 200 2000 700 1300
2020 64 100 1000 640 360
2025 62 75 750 620 130
2030 61 61 610 610 0
2035 62 60 600 600 0
2040 63 61 610 610 0
2100 95 93 930 930 0
2150 102 102 1020 1020 0

Either management adjusts towards a sustainable extraction level...

2015 70 200 2000 700 1300
2020 64 100 1000 640 1360
2025 55 200 2000 550 1450
2030 47 180 1800 220 1580
2035 47 140 1400 150 1250
2040 5 50 500 50 450
2045 5 25 250 20 230
2050 5 5 50 0 50
2100 0 0 0 0 0
2150 0 0 0 0 0

Or, management continues along an unsustainable path until collapse...

2015 70 200 2000 700 1300
2020 64 100 1000 640 1360
2025 55 200 2000 550 1450
2030 47 180 1800 220 1580
2035 47 140 1400 150 1250
2040 5 50 500 50 450
2045 5 25 250 20 230
2050 5 5 50 0 50
2100 0 0 0 0 0
2150 0 0 0 0 0

The interest-depletion approach applied to a hypothetical landscape over many decades. This table shows how the benefits from unsustainable extraction would be adjusted to take into account natural capital depletion. Two extraction scenarios are compared. In the first, managers gradually make adjustments to reduce the extraction level to a sustainable cut. With time, the extraction ceiling increases as forests recover from past abuse. In the second, aggressive extraction leads to collapse. The extraction ceiling is shown to be recalculated every 5 years to take into account the impacts of past management on the ecologically sustainable extraction level (calculations shown for representative years rather than all years). Government revenue is held constant at $10 m³.

4. Applying the interest/depletion approach in BC

Each year, the accounting firm Price Waterhouse publishes a report assessing the BC forest sector’s economic performance. This report is used by industry in public forums to underline the importance of the forest industry to the provincial economy in order to gain sympathetic treatment from government. Environmental organizations have long felt that these annual reports painted an inaccurate portrait of the industry, charging that the benefits and economic spin-offs are carefully tabulated, but none of the subsidies or other costs are included. I was part of a study team commissioned by the Sierra Club of BC to critique Price Waterhouse’s methodology and to suggest appropriate improvements (Gale et al., 1999).
Table 2
Accounting for natural capital depletion at the provincial level using 1997 data

<table>
<thead>
<tr>
<th>Category of benefits</th>
<th>Total</th>
<th>Weak extraction ceiling: Ministry of Forest’s long-run cut</th>
<th>Strong extraction ceiling: ecosystem-based management and ecoforestry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Extraction ceiling</td>
<td>Actual cut</td>
</tr>
<tr>
<td></td>
<td></td>
<td>53 million m³</td>
<td>69 million m³</td>
</tr>
<tr>
<td>Interest/depletion ratio</td>
<td>53/69 = 0.78</td>
<td>1 – 0.78 = 0.22</td>
<td>21/69 = 0.3</td>
</tr>
<tr>
<td>Government revenue (millions $)</td>
<td>4600</td>
<td>3588</td>
<td>1012</td>
</tr>
<tr>
<td>Direct employment (full-time equivalents)</td>
<td>78 000</td>
<td>60 800</td>
<td>17 200</td>
</tr>
<tr>
<td>Direct wages (millions $)</td>
<td>6100</td>
<td>4760</td>
<td>1340</td>
</tr>
</tbody>
</table>

*This table illustrates a recent application of the interest/depletion approach to more cautiously demonstrate the benefits from unsustainable industrial forestry in BC. Depending on the analyst’s assessment of the extraction ceiling, or the output of timber that can be sustained without depleting natural capital, the proportion of benefits involving interest and depletion will vary. If the ecosystem-based extraction ceiling is accepted, it is clear that current economic analysis greatly overstates the contribution of the forest industry to the provincial economy (note that direct employment figures shown here are lower than in the Price Waterhouse report because the latter has an overly-broad definition of forestry workers).*

One area where we immediately identified a deficiency was the failure to account for the depletion of natural capital. We used the 1997 annual report (Price Waterhouse, 1998) to illustrate how appropriate corrections might be made. Our report calculated the net contribution of the forest industry to government finances by subtracting government subsidies to the forest sector and by accounting for natural capital depletion.

In 1997, the Ministry of Forest’s long-run cut for the province was estimated at 53 million m³ (BC Wild, 1998). We adopted this extraction rate as our ‘weak’ extraction ceiling. The actual annual cut in 1997 was 69 million m³. Accordingly, 53/69 million m³ or 78% of the economic benefits were deemed consistent with maintaining natural capital intact, and the remaining 22% were deemed dependent on depletion. Based on past involvement in ecosystem-based planning efforts, and the effects that the implementation of the scientific panel’s ecosystem-based management recommendations had on the extraction rate for Clayoquot Sound, I estimated that province-wide adoption of an ecosystem-based management and ecoforestry standards would require the extraction level to be reduced by 70% to 21 million m³. This figure was used as our ‘strong’ extraction ceiling. Accordingly, 30% of the cut in 1997 could be considered interest, while 70% could be considered depletion. These ratios were applied to the benefits generated by the industry in 1997, as shown in Table 2.

While the detailed tabulation of subsidies is not reproduced here, Table 3, adapted from our report, illustrates how correcting for natural capital depletion provides a very different perspective of the industry’s contribution to government finances. It appears that provincial finances might well be better off over the longterm if the forest industry were shut down rather than to continue to subsidize the industry and to allow such high rates of natural capital consumption. When our report was released at the same time as the Price Waterhouse© report, it helped spur debate over the industry’s real contribution to the provincial economy and to government finances. It has contributed to a growing perception that the industry is generating costs which outweigh the benefits,
creating the political space for ecosystem-based alternatives.

5. Prospects for reformed economic analysis in BC

In the face of mounting criticism at home and abroad, the province enacted in 1995 the Forest Practices Code, supposedly to ensure that BC met ‘world-class forestry standards’. The Code has turned out to be an elaborate exercise in public relations; in 1998 its already weak provisions were further watered down (Sierra Legal Defense Fund et al., 1999). The BC government has been captured by the forest industry, and it resists making any substantive changes in forestry practices or reducing the annual cut (M’Gonigle, 1997). In competitive global markets, the industry’s very survival (in the short term) depends upon uninterrupted access to high volumes of timber, even if this means that communities and ecosystems will suffer in the long run. In this context, it is difficult to be optimistic about prospects for reforming either the forest industry or for ensuring that economic analysis of the forest sector accounts for the depletion of natural capital.

The corrections advocated here, while helpful, do not represent a panacea. They are likely to be resisted by government and industry so that economic analysis of BC’s forest industry will continue to neglect sound accounting principles. If adopted, the proposed reforms may be weakly interpreted (e.g. setting the extraction ceiling close to the present unsustainable cut) so as to weaken any position that involves more than minor adjustments to the status quo. Yet the need to account for natural capital depletion has been accepted by such conservative institutions as the United Nations in its revisions to the System of National Accounts (United Nations, 1993).

Table 3
Net contribution of forest sector to government finances when subsidies and natural capital depletion are taken into account ($ millions Cdn)\(^a\)

<table>
<thead>
<tr>
<th>Category of revenue or expense</th>
<th>Natural capital depletion at 22% (based on Ministry of Forests long-run cut)</th>
<th>Natural capital depletion at 70% (based on ecosystem-based management and ecoforestry standards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross industry contribution to federal revenue(^b)</td>
<td>108</td>
<td>108</td>
</tr>
<tr>
<td>Less allowance for natural capital depletion</td>
<td>–23</td>
<td>–76</td>
</tr>
<tr>
<td>Less federal subsidies(^c)</td>
<td>–421</td>
<td>–421</td>
</tr>
<tr>
<td>Gross industry contribution to provincial revenue(^b)</td>
<td>2336</td>
<td>2336</td>
</tr>
<tr>
<td>Less allowance for natural capital depletion</td>
<td>–513</td>
<td>–1635</td>
</tr>
<tr>
<td>Less provincial subsidies(^c)</td>
<td>–2511</td>
<td>–2511</td>
</tr>
<tr>
<td>Payments to government by direct employees(^c)</td>
<td>1738</td>
<td>1738</td>
</tr>
<tr>
<td>Less allowance for natural capital depletion</td>
<td>–382</td>
<td>–1217</td>
</tr>
<tr>
<td>Net contribution of forest industry to provincial and federal finances</td>
<td>332</td>
<td>–1678</td>
</tr>
</tbody>
</table>

\(^a\) This table shows how the interest/depletion approach demonstrates how government revenues are inflated through natural capital deficit financing. Once subsidies and natural capital depletion are taken into account, it appears that the BC forest industry may actually be eroding the provincial treasury over the longer term.


\(^c\) As per Table ES-2 of Gale et al. (1999).
Accounting for natural capital depletion as proposed in this paper invites debate on a number of issues:

- what level of extraction is truly consistent with sustainability and with maintaining natural capital intact?
- what can be done about a government dependent on the proceeds from capital consumption, to get it to live off the interest alone?
- how secure are jobs, given that they involve excessive rates of extraction and will not be sustainable over the long term?
- how can enough jobs be provided if the cut is lowered?
- how can society make the transition to sustainable levels of extraction?

In comparison, current analysis portrays reductions in cut levels as economically harmful and focuses management efforts on maintaining the cut through intensive management.

6. Conclusion

The concerns raised in this paper are not new. The problems created when capital is consumed have been noted in BC since at least 1954, when the Royal Commission on Dominion-Provincial Relations wrote the following about BC’s economy (Royal Commission on Dominion Provincial Relations, 1954):

Services and a standard of living established and financed by treating capital depletion as current income will be subject to extreme pressures when the first phase of exploitation passes. Major economic and social adjustments will be necessary... in no other province are the problems of depreciation and depletion as important to the provincial economy and public finance.

Treating capital depletion as income was unacceptable in the 1950s. Given current ecological knowledge, and the degraded state of many of the province’s forests, it is inexcusable today. It turns out that the forest industry is not the engine powering BC’s economy, but the locomotive carting off the province’s natural wealth, the building blocks for a sustainable economy. The BC forest industry is now in crisis; the liquidation phase of forestry is abruptly coming to an end.

Let us return to the debate in BC about moving to a more sustainable forest industry. Those who benefit from the status quo frighten the public with tales of reduced government revenue and services if the level of cut goes down. Many counter arguments are offered, but if the improper treatment of capital consumption is not challenged, the debate takes place on an unlevel playing field. The modest, but long-term benefits from ecoforestry, which maintains natural capital, are compared to the short-term benefits of industrial forestry, which consumes natural capital. The faster industrial forestry uses up natural capital, the greater the apparent benefits, and the less that ecoforestry appears as an attractive alternative.

Ecoforestry advocates have implicitly been arguing for good forestry economics since they seek to maintain the forest’s capital intact. As El Serayf has noted, it is ‘a poor economist indeed who is unable to tell capital from income’ (El Serayf, 1989, p. 11). Any analysis that does not refer back to the ecological base on which the forest sector depends to determine if capital is maintained intact or not is indeed poor economic analysis. If economic analysis in BC paid attention to natural capital depletion, resource managers would face pressure to ensure resource management regimes maintained ecological integrity and natural capital. It would broaden notions of good economic performance in the forest industry (Gale et al., 1999).

Referring back to Hicks, good economics should give humankind an indication of how much can be consumed without impoverishing ourselves — or future generations. Whether we impoverish ourselves by consuming human-made or natural capital, the principle remains the same. Economic theory aside, in the long run, it is natural capital consumption that should cause society and economists the greatest concern. For without natural capital, the manufactured capital of sawmills and value-added facilities will have to be written off as scrap — if there are any economists left to correct the books.
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