Ecosystem-based management in the Great Bear Rainforest

Karen Price a, Audrey Roburn b, Andy MacKinnon c,*

a 12895 Cottonwood Road, Telkwa, BC, V0J 2X3 Canada
b Rainforest Solutions Project, 302-733 Johnson Street, Victoria, BC, V8W 3C7 Canada
c BC Ministry of Forests and Range, 4300 North Road, Victoria, BC, V8Z 5J3 Canada

1. Introduction

Ecosystem management emerged from concern that conventional resource management threatens ecological integrity. Over the past decade, the concept has permeated land management discussions worldwide, addressing a variety of ecosystems from oceans to savannahs and forests (e.g., Didion et al., 2007; Gillson and Duffin, 2007; Ariza et al., 2008; Ruckelshaus et al., 2008). Motivations driving ecosystem management have expanded from concern about loss of biodiversity and of the intrinsic value of ecosystems (Ludwig et al., 1993; Holling and Meffe, 1995; Hilborn et al., 1995) to concerns that conventional practices also limit social and economic options for future generations (Grumbine, 1994; Brussard et al., 1998) and to the realisation that stakeholder participation in management is crucial for success (e.g., Fabricius et al., 2007; Berghöfer et al., 2008).

Definitions of ecosystem management vary, but usually include a similar suite of concepts: an emphasis on ecosystem sustainability rather than ecosystem products, inclusion of humans within ecosystems, consideration of multiple spatial and temporal scales, understanding of the dynamic nature of ecosystems and human communities, the need for clearly defined management goals and objectives, the need for management strategies based on the best available knowledge of ecological systems, recognition of the limits of knowledge and uncertainty, and agreement on the need to learn and adjust (e.g., Grumbine, 1994; Christensen et al., 1996).

This paper describes how ecosystem management is defined and implemented for the area of coastal British Columbia termed the Great Bear Rainforest. Although the approach in general is similar to that used elsewhere, and includes the concepts listed above, several novel elements are involved in application of ecosystem-based management on British Columbia’s coast: shifts in power that have led to increased aboriginal control and the formation of coalitions between groups that were formerly in opposition; development of explicit models relating management strategies to land-use objectives and separating knowledge from values; use of ecological thresholds and natural variability to establish management targets. Current management is based on transitional targets that differ from science-based targets. Many challenges remain in moving to full implementation of ecosystem-based management, including the difficulties involved in moving from one management model to a fundamentally different one, limited resources for implementation, dealing with complex systems, the lack of freely available multi-disciplinary data, and the difficulty of bringing concepts of uncertainty and risk into public policy discussions in a transparent manner.

2. The Great Bear Rainforest

The Great Bear Rainforest, so named by environmental groups early in land-use planning (McAllister et al., 1997), includes 6.4
Coastal temperate rainforest is characterised by abundant precipitation (3–5 m annually in the Great Bear Rainforest), a moderate climate, and mountains (Schoonmaker et al., 1997). Coniferous forests dominate the British Columbia coast. Due to extremely low natural rates of stand-replacing disturbance – with

Fig. 1. The Great Bear Rainforest includes 6.4 million hectares on the central and north coast of British Columbia, Canada.
return intervals in the order of millennia – gap-phase dynamics dominate (Daniels and Gray, 2006; Gavin et al., 2003; Lertzman et al., 2002). Structural elements develop over centuries, resulting in a landscape dominated by ancient forests with large trees and complex structure (MacKinnon, 2003). While bears, wolves, salmon, and large trees are integral ecosystem components, inconspicuous species such as mosses, lichen, fungi, canopy and soil fauna comprise the majority of species in the region (Marcot, 1997).

About 22,000 people live in the Great Bear Rainforest (about 0.3 people/km²), half of them of aboriginal ancestry (generally referred to in Canada as First Nations). The region includes the traditional territories of 25 culturally (and often linguistically) distinct First Nations. As elsewhere in North America, European colonization devastated First Nations’ populations and cultures, and replaced subsistence economies with natural resource extraction.

The economies of the area are generally depressed. Many communities face high unemployment rates, low incomes, poor health, low high school graduation rates, substandard housing, and limited economic opportunities (Smith and Sterritt, 2007). Economic benefits of resource development have for the most part accrual to local residents. For example, in the period between 2003 and 2005, residents of the Great Bear Rainforest held about 10% of the direct harvesting jobs for timber harvested in the region (Persky, 2000).

Past logging has already removed much of the most valuable and easily accessible timber in the region (Prescott-Allen, 2005; Green, 2007), which in many cases is found on the highest productivity growing sites. High-productivity sites make up less than 10% of the forested land-base in the region. Little of this area remains as old forest (e.g., about 10% of productive cedar-leading ecosystems; Holt and MacKinnon, 2006).

3. Setting the stage: shifting power and coalitions

3.1. Power shifts

Two significant power shifts made ecosystem-based management possible in the Great Bear Rainforest (Smith and Sterritt, 2007).

The first major shift in power involved First Nations governance. A series of court decisions made clear that First Nations had rights to their traditional territories that had not been extinguished, and that any decisions about the management of these lands required the input of First Nations (e.g., Persky, 2000). As a consequence, land-use planning in the Great Bear Rainforest was, and continues to be, led jointly by the two governments—provincial and First Nations. This has been referred to as a government-to-government process.

The second major shift was a change in the power of environmental non-government organisations. For decades controversy had surrounded land-use decisions in the coastal regions of British Columbia: the most productive forests were sought after by both environmental groups and logging companies. In the mid 1990s, when it seemed as though most of the remaining valley-bottom stands would be logged, international market campaigns by environmental groups, targeting buyers of wood derived from old growth coastal temperate rainforests, brought global attention to the region. Over 80 companies, including IKEA, Home Depot, Staples and IBM, committed to stop selling wood products made from these forests, forcing logging companies to negotiate with environmentalists. With roughly a billion dollars of sales of BC wood products and their associated revenues to government at risk, environmental organisations that previously had little influence on decision-making became real power players in land-use planning processes (Smith and Sterritt, 2007).

3.2. Coalitions

The agreements that initiated ecosystem management in the Great Bear Rainforest would never have occurred without coalition-building of a kind never before seen in British Columbia resource management. Formal and informal coalitions arose within and among stakeholders, among First Nations, and between stakeholders and First Nations (Smith and Sterritt, 2007).

Following the market campaigns, the forest companies operating in the Great Bear Rainforest formed one coalition; the environmental groups formed another. And in an approach never before seen in BC, where environmental groups and forest companies have typically been locked in bitter conflict, the two coalitions agreed to work together to generate solutions. Perhaps even more remarkably, the environmental–industry coalition parties agreed to work out their differences together before discussing issues with the provincial government. That the environmental groups and the forest companies were conveying the same messages greatly increased their influence.

At the same time, First Nations leaders from communities in the Great Bear Rainforest were meeting to discuss their shared problems and potential solutions. The result was the formation of a broad coalition of First Nations of the Central and North Coast and Haida Gwaii, called Coastal First Nations. First Nations in the southern Central Coast formed a second coalition, now known as the Nanwakolas Council. In 2001, the Coastal First Nations and the Province of BC signed a protocol affirming that the parties would interact as governments, a fundamental shift in the Province’s rules of engagement with First Nations. Individual First Nations developed their own land-use plans for their traditional territories, then entered into negotiations with the Provincial government.

Previous land-use planning processes in BC have always been led by the provincial government. This fundamentally different planning model based on coalitions was unsettling for many in the provincial government, but in the end was essential in building a degree of consensus among historical antagonists.

4. The decision: ecosystem-based management

In 2001, the Coastal First Nations, industry–environment coalition parties, and other First Nations and stakeholders, agreed to a framework to guide land-use planning on the coast. The framework included commitments to ecosystem-based management, to logging deferrals in key areas while planning proceeded, to independent science to guide land-use decision-making, and to a new economy that would help shift the region’s reliance on natural resource extraction to a “conservation economy” that could support both healthy ecosystems and healthy communities. The term ‘ecosystem-based management’ was deliberately chosen over ‘ecosystem management’, to emphasise that the intent was to manage human activities, rather than to manage ecosystems.

The consensus definition for ecosystem-based management for the Great Bear Rainforest includes both ecological integrity and human wellbeing components: “Ecosystem-based management 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 wellbeing supported and improved.” This definition was an attempt to reconcile the recognition of ecosystem precedence (Grumbine, 1994, 1997; Christensen et al., 1996; Haynes et al., 1996; Noss, 1999) with the need to focus extensive effort on understanding and incorporating people and how they interact with ecosystems (Slocombe, 1993, 1998a,b), and on improving wellbeing in a region
where human communities are struggling with loss of languages and traditional cultures, serious social problems, and limited economic opportunities (Prescott-Allen, 2005).

To ensure separation of knowledge and values, the approach to ecosystem-based management was to be developed by an independent advisory body, the Coast Information Team. Altogether, 10 project teams and over 100 subject experts completed a comprehensive series of peer-reviewed reports, including an Ecosystem-based Management Handbook, by 2004 (www.citbc.org) for a total cost of $3.3 million.

Using the independent knowledge to inform their value-based decisions, two multi-stakeholder Land and Resource Management Planning tables, one for BC’s North Coast and one for the Central Coast, made consensus recommendations on land-use goals, objectives and strategies in the region (Central Coast LRMP completion table 2004; North Coast LRMP Final Recommendations 2005). These recommendations were adopted by BC’s provincial government as their bargaining position, and then fed into government-to-government negotiations between the provincial government and First Nations. Ultimately, the negotiated outcome was announced in February 2006 in the Great Bear Rainforest Land-Use Decisions, decisions which are now being implemented with oversight by the First Nations and provincial governments on a government-to-government basis.

5. Elements of ecosystem-based management

5.1. Addressing human wellbeing: conservation financing

Human wellbeing can only be addressed within the context of, and with leadership from, communities (Keough and Blahna, 2006). In order to stimulate a new economy in the Great Bear Rainforest, a conservation financing initiative was developed, ultimately securing $120 million: $60 million from private funders (raised by environmental non-governmental organisations), and $30 million each from the provincial and federal governments. Half of that amount forms a permanent conservation endowment, the interest from which will support work to protect and manage ecosystems. The other half will be spent over the next 5–7 years to support ecologically sustainable First Nations businesses and economic development within the communities of the Great Bear Rainforest.

This initiative is a cornerstone of ecosystem-based management in the Great Bear Rainforest, because it aims to address the human wellbeing element of the consensus definition in a way that does not compromise ecological integrity. Rather than feeding into the resource extraction paradigm of a trade-off between ecosystems and people, it “expands the pie” by providing new economic opportunities that do not rely on damaging ecosystems.

5.2. Addressing ecological integrity: protected areas

Similarly to approaches elsewhere, implementation of the ecological integrity component of ecosystem-based management relies on two general strategies: the creation of protected areas and other reserves off-limits to resource extraction, and management targets and practices elsewhere. The 2006 land-use decisions added 1.3 million hectares of protected areas and 297,000 hectares of “biodiversity areas” (logging, but not mining, is excluded) to the existing park network. These areas were selected via negotiations informed by an ecosystem spatial analysis developed by the independent advisory team (www.citbc.org). The ecosystem spatial analysis combined information on environmental gradients, special elements such as rare habitats, and models of focal species habitat to identify candidate areas. Most of the new area protected entire watersheds, or added to existing protected areas.

The protected areas fall under new legislation developed to allow for First Nations cultural uses within them, a significant change from past approaches to protected area management in British Columbia, and an explicit recognition that people have been part of these ecosystems for millennia.

The total area protected from logging in the Great Bear Rainforest is over 2 million hectares, 33% of the area. This proportion is similar to other examples of protection within large areas of global interest: for example, Costa Rica at 25% protection, and the Great Barrier Reef at 33% protection (Green, 2007).

5.3. Addressing ecological integrity: explicit management models

Beyond protected areas, forest management strategies recommended by the independent advisory body were designed based on a complete management model. They considered the full suite of objectives hypothesised to contribute to the overarching goal of maintaining ecological integrity, and designed management strategies for each one. Models of relationships among these objectives provide a high-level view of the full management model for ecological integrity (Fig. 2).

For each objective, the independent advisory body prepared explicitly drawn relationships between objectives (e.g., maintain water quality) and management strategies (e.g., harvest level per watershed). Strategies were represented by implementation indicators (e.g., equivalent clearcut area; Fig. 3). Indicators were selected for their ability to strongly influence an objective, to describe the full spectrum of a management activity, and to be measurable at an appropriate scale. In some cases, these relationships were based on peer-reviewed meta-analyses; others were based on expert workshops. Uncertainty around the relationships was described explicitly.

These relationships synthesised current knowledge and assumptions as hypotheses. They modeled the presumed shape of relationships, and expressed thresholds clearly. Exploring thresholds, particularly in the relationship between habitat and species response, has received considerable attention over the past 10 years because thresholds can indicate regions where ecological risk increases rapidly (e.g., Andren, 1994; With and Crist, 1995; Muradian, 2001; Huggett, 2005). One of the most important features of the explicit hypotheses is that they are presented in a manner that can be recorded, communicated and updated easily, facilitating learning (Bunnell and Dunsworth, 2004; Tear et al., 2005). Expressing targets quantitatively frequently clarified strategies during expert workshops and subsequent negotiations among interest groups.

The hypothesised relationships were used to determine strategies that had high and low probability of achieving objectives. “Precautionary targets” were defined as those management strategies that were fairly certain to achieve objectives; “high-risk limits” were defined as the upper extent of acceptable strategies. Precautionary targets were intended to be applied at the sub-regional scale. Management at smaller scales (landscape, watershed and stand) could exceed these targets, but could not exceed high-risk limits. In some cases, exceeding a precautionary target was permitted only if the area was subject to an adaptive management experiment. This approach was designed to allow flexibility and to provide an economic incentive to learn.

5.4. Ecosystem representation

Ecosystem representation provides a good illustration of the general methods and approach. Ecosystem representation is widely accepted as a primary objective of ecosystem-based management (Christensen et al., 1996). Maintaining representative ecosystems
in suitable abundance and distribution across watersheds, landscapes and regions may be the only way to maintain myriad unknown species and ecological processes (Franklin, 1993). Ecosystems were already classified and, to a lesser extent, mapped in the Great Bear Rainforest; British Columbia has a well-developed terrestrial ecosystem classification system based on climate, soil moisture, nutrients and vegetation (Banner et al., 1993).

In the Great Bear Rainforest, habitat loss is primarily a shift in seral stage and stand structure, as ancient forests with complex structure are converted to younger, more uniform forests by logging. (Conversion of forested habitats to non-forested use is almost non-existent in this area.) Estimates of the amount of forest over 250 years old in unlogged watersheds range from a low of 43–73% in inland fluvial ecosystems to 95–98% in upland hypermaritime areas (www.citbc.org). Because old forest dominates natural coastal landscapes and because it is the seral stage most altered by harvesting and with the longest recovery, representation targets focused on old forest.

Defining precautionary targets for old forest representation required answering the question “how much is enough?” Traditionally in BC, this question has often been answered on social or economic grounds—for example, a management system may be designed to generate a certain number of jobs, or to have a minimal effect on timber supply. Answering the question on ecological grounds was considerably more difficult. Literature on this question has centred on thresholds—points where ecological function shifts rapidly (Holling, 1973; Scheffer et al., 2001). Abundant evidence supports the existence of habitat thresholds, but there is no consensus on how much habitat is required to avoid thresholds, beyond an agreement that amount will vary among organisms and across ecosystems (Bender et al., 1998; Lindenmayer and Luck, 2005). Several authors have suggested using habitat thresholds relevant to the most sensitive regionally occurring species to set targets (Jansson and Angelstam, 1999; Monkkonen and Ruenan, 1999; Fahrig, 2001). In the Great Bear Rainforest however, no research into habitat thresholds had been conducted. Faced with little regionally specific information, independent advisors searched for an alternative approach suited for precautionary guidance. The solution was to review studies on thresholds where loss of suitable habitat in any landscape was shown to affect a population or community (Price et al., 2007).

This review indicated that more than one-third of species or communities crossed thresholds before their habitats dropped to 50% of total area; nearly two-thirds reached thresholds before their habitat dropped to 30%. Few species had thresholds above 60%, suggesting that maintaining more than 60% of suitable habitat would pose low risk to most species. There remains uncertainty about how the risk to ecological integrity increases as old forest levels drop below 60%, but the review suggested that risk is no longer known to be low below that point.

Other lines of evidence suggested similar targets. Theoretical work predicts similar thresholds (e.g., Gardner and O’Neill, 1991; Stauffer and Aharony, 1992; With et al., 1997; Boswell et al., 1998; Fahrig, 2002). The American marten, the best current candidate for a
sensitive, regionally occurring species in the Great Bear Rainforest, has been found to have a high threshold – about 60% – within regenerating clearcuts or natural openings (Hargis et al., 1999; Chapin et al., 1998; Potvin et al., 2000), although lower when harvest retains structure (Buskirk and Ruggiero, 1994; Chapin et al., 1997).

The representation targets in the Great Bear Rainforest were designed to be applied to different ecosystem types, as defined by the biogeoclimatic ecosystem classification (Bannen et al., 1993), separately. These ecosystem types are similar in concept to the International Vegetation Classification and Nature Conservancy’s ‘plant associations’ (e.g., Maybury, 1999), stratified by climatic zones. This approach was intended to ensure that all ecosystem types – including highly productive ecosystems targeted by forestry – are represented (Lindenmayer and Luck, 2005). In addition, 100% of ‘red-listed’ ecosystems (extirpated, endangered or threatened, typically with fewer than 20 high-quality occurrences in the province) are reserved.

Ecosystem management often uses the frequency and patterns of natural disturbance to inform management (e.g., Morgan et al., 1994; Haynes et al., 1996; Cissel et al., 1998; Landres et al., 1999; Swetnam et al., 1999). In the Great Bear Rainforest, old forest targets were designed to be applied as a proportion of the natural amounts of old forest in each ecosystem type. The risk associated with an absolute level of habitat loss is hypothesised to vary among ecosystems because these systems, and the species within them, have evolved with different levels of disturbance (Bunnell, 1995). Because natural disturbance rates are so low throughout the British Columbia coast, using estimates of the range of natural variation to set old forest targets is relatively simple (though also more constraining) compared to more disturbed ecosystems.

Precautionary targets for old forest were set at 70% of the area of old forest that would exist under natural disturbance conditions for each ecosystem, translating into 34–68% of the total forested area per ecosystem (and averaging about 60% across ecosystems). For example, the target for an ecosystem with 97% of the forest expected to be older than 250 years under natural disturbance regimes was set at 70% × 0.97 = 68% of the total area of that ecosystem.

No single scale is sufficient to assess or maintain ecological integrity. Because ecosystems exist at multiple spatial scales, conservation efforts at multiple scales increase chances of success (Poiani et al., 2000). The largest, sub-region scale (about 1000–30,000 km²) is the appropriate scale to consider cumulative impacts of maintaining representative ecosystems. To ensure that cumulative risks are precautionary, the guideline for sub-regions is the 70% target. Because natural amounts of old forest vary more in smaller areas (Wimberly et al., 2000), the guidelines for reserves in landscapes and watersheds are more flexible, allowing for retention levels down to 30% of natural (14–29% of total forested area, the high-risk limit), provided that sub-regional targets are met.

An additional strategy deals with retention at the smallest, stand scale, requiring 15–70% retention within harvested blocks.

5.5. Hydroriparian ecosystems

Traditionally, in BC and elsewhere, water and the adjacent land have been considered and managed separately as aquatic and terrestrial systems. Because the two are tightly coupled, and because the influence of water in the rainforest extends throughout watersheds, the term “hydroriparian ecosystems” is more appropriate (Clayoquot Sound Scientific Panel, 1995). Hydroriparian ecosystems consist of aquatic ecosystems plus those of the adjacent terrestrial environment that are influenced by, and influence, the aquatic system.

Hydroriparian ecosystems are particularly prevalent in wet coastal forests. In the hypermaritime lowlands, wetlands (bogs, ponds and small lakes) cover 51–75% of the landscape (Banner et al., 1986, 1988). Over a fifth of the area within the Great Bear Rainforest is hydroriparian.

The ecosystem classification system used to define the terrestrial ecosystems of the Great Bear Rainforest is largely a stand-level, terrestrial classification. It does not directly consider hydrological features, provide landscape context or combine sites into ecosystem complexes—all important aspects of hydroriparian ecosystems. Hence hydroriparian ecosystems were defined separately for the Great Bear Rainforest, and additional strategies were designed to represent these ecosystems.

The scientific advisory panel recommended that planning for hydroriparian reserves should occur at the watershed scale. Such plans would include protection of unstable terrain, reserves around a portion of small streams, and reserves, including buffers, of all areas where vegetation is influenced by water. The extent of influence of the terrestrial and aquatic ecosystems on each other differs depending on whether adjacent land remains forested or has been harvested (Brooks et al., 1997). As an initial practical hypothesis about the extent of hydroriparian ecosystems, boundaries were to be drawn at one and a half site-specific tree heights beyond the edge of vegetation influenced by water (45 m in the absence of inventory). The first tree height was intended to capture the influence of the terrestrial system on the aquatic system; the additional half tree height was intended to protect conditions within the buffer. In valleys, this definition of hydroriparian ecosystems includes the entire valley flat plus one and a half tree heights.

Hydroriparian reserves were designed to capture differences in ecosystem sensitivity. Particularly sensitive hydroriparian ecosystems (e.g., estuaries, steep streams with high susceptibility to debris flow) had high precautionary targets of 97% of natural levels of riparian forest; others ecosystems had lower targets down to 70% (equivalent to terrestrial ecosystems).

6. Discussion

Though ecosystem management is becoming increasingly common, implementation of ecosystem-based management in the Great Bear Rainforest is novel in several respects. The first is in its geographic scope: few other projects cover such a large area. Notable exceptions, also on the northwest Pacific coast, are the Northwest Forest Plan (e.g., Thomas et al., 2006), which covers approximately 10 million hectares in the northwestern United States, and the Tongass National forest management plan (e.g., Everest, 2005), which covers 6.8 million hectares in southeast Alaska. Neither of these management plans is explicitly premised on ecosystem management, though both incorporate aspects.

The second novel aspect of BC’s experiment in ecosystem-based management is the co-management of the process by BC’s provincial government and aboriginal peoples (First Nations). We cannot find other examples of aboriginal resource co-management on such a large scale.

A third element of the Great Bear Rainforest example that is of global interest is the leadership role of coalitions in defining ecosystem-based management in the region. It was ultimately an agreement reached by the environmental–industry coalition that formed the core of the consensus agreements at provincial land-use planning tables. In previous land-use planning processes in British Columbia, the provincial government had led, and managed, the process. In the Great Bear Rainforest, by contrast, stakeholder groups and First Nations often took leadership roles and worked together to reach consensus. This trend toward “smart regulation”, where groups resolve their differences and propose solutions to governments, is growing in North America, Australia, and elsewhere (Webster and Cathro, 2007).
Fourth, the scientific recommendations for management in the region have been based on explicit models developed to separate values from knowledge. In dealing with complex decisions about environmental management involving multiple parties, explicitly described relationships between management objectives and strategies are useful to replace the implicit models that all stakeholders hold in their heads. They document assumptions, data and knowledge transparently, and hence focus and clarify discussion. The benefits of explicit models are well recognised both for combining expertise and for involving stakeholders (e.g., Holling, 1978; Walters, 1986; Fall et al., 2001; Failing and Gregory, 2003). These explicit models also serve as clear testable hypotheses, thus providing a framework for an ongoing programme of adaptive management.

The ecosystem-based management experiment in the Great Bear Rainforest is still in its early stages. As a transitional strategy, an interim suite of legal targets has been adopted for the region, with agreement to move to full adoption of ecosystem-based management by 31 March 2009. Full adoption will be reached through additional planning processes and the revision of legal targets.

The interim legal targets differ from the scientific advisory committee’s recommendations in several ways. First, they do not adopt precautionary targets for old growth ecosystem representation. Instead, interim targets of 30% of natural levels of old forest (14–28% of total forested area) were applied to 94% of the landbase, with the precautionary 70% target applying only to the rarest ecosystems. Hence, management of most of the forested landbase could push representation of many ecosystems to the high-risk limit, at least in the interim phase. This decision was based solely on an analysis of timber supply because little information exists to examine the impacts of ecological targets on broader economic and human wellbeing goals. Second, the interim targets are not based on a flexible multi-scale planning system. Whereas the initial recommendations took a multi-scale planning approach that allowed for the application of a wider range of targets at successively finer scales, the current regulations apply a single target at each scale. Third, with the exception of grizzly bear, the interim targets do not account for protection of focal species habitat or populations. Fourth, the interim targets have dropped the understanding of integrated hydoriparian systems, instead, buffering “aquatic” features, and assigning management prescriptions on the basis of the presence or absence of designated fish—the standard approach in British Columbia that the scientific advisory committee explicitly attempted to avoid for consideration of more ecologically relevant measures.

The differences between the scientific advisory committee recommendations and the interim legal targets highlight some of the key challenges to implementation of ecosystem-based management in the Great Bear Rainforest. First, the inertia involved in such a large project is immense. As people and institutions become fatigued with the slow process, it is easy to fall back on status quo modes of thinking rather than tackling the challenges inherent in a complex, systems approach. In particular, the view that timber harvest rate is tightly linked with human wellbeing, and that ecological factors are merely constraints on timber harvest, is well entrenched (Bourgeois, 2008). Despite conservation financing efforts to provide new economic opportunities to local communities, some stakeholder groups continue to see measures to protect ecological integrity as opposing economic benefits. The lack of knowledge is problematic. There is no clear relationship between timber harvest and human wellbeing, especially in regions where most timber benefits have been exported. However, the relationships between human wellbeing and contributing factors are so complex and case-dependent (Rubus EcoScience Alliance, 2007) that it is difficult to replace the accepted old model with a new one. This problem is particularly intractable due to the temporal offset between changes that are required to improve human wellbeing and the shifts in ecological management that are required in the short term.

The perceived challenge of legally enforcing a flexible management approach has led to prescriptive, single target rules. Again, the complexity of a systems approach seems to challenge existing structures.

A second challenge has been lack of multi-disciplinary data, availability of which is a key factor required for successful implementation of collaborative ecosystem-based management (Keough and Blahna, 2006). There is a dearth of suitable cultural and socio-economic data, and incomplete ecosystem and focal species habitat inventories for the region. In other cases, forest companies that hold land-base data are reluctant to release existing information.

Although Great Bear Rainforest ecosystem types have been extensively sampled, classified and described (e.g., Banner et al., 1993), detailed ecosystem mapping (generally at a scale of 1:20,000) is available for only 20–25% of the area. The lack of inventories, coupled with lack of resources to complete inventories, has been one factor leading to reluctance to plan at large scales. Regional planning cannot currently use ecosystem maps to define target levels of retention. Planning thus is based on a surrogate system that considers tree species and timber productivity within climatic zones. Preliminary analyses have found inadequacies in the surrogate as it does not match well with the described ecosystem types (Price, unpublished data). This can lead to over-representation of low-productivity ecosystems and under-representation of high-productivity ecosystems in reserved areas if harvesting plans select the most productive stands first.

A last challenge is the difficulty in bringing uncertainty and risk to values of interest into public policy discussions in a transparent manner. Decision-makers have generally avoided explicit statements that they are willing to accept higher levels of ecological risk in exchange for increased timber harvest potential, although legal targets to date reflect tolerance for high ecological risk. There has been inconsistent willingness on the part of all parties to implement existing agreements. Although all parties intend to fully adopt ecosystem-based management by 2009— including a commitment to “seek to achieve low ecological risk” – it is not yet clear whether the outcomes will include the complete suite of precautionary targets.

Ecosystem-based management is being implemented in the Great Bear Rainforest in a complex and mercurial political context. Twenty-five individual First Nations with different cultures and interests and overlapping territories; a provincial government attempting to implement a fundamentally different management system; forestry companies facing tight global markets; and high-profile international environmental groups intent on protecting ecosystems, are all pulling the implementation of ecosystem-based management in different directions. Ecosystem-based management in the Great Bear Rainforest is an experiment in collaborative, adaptive ecosystem-based management on a grand scale—and the results will not be known for many years to come.

Acknowledgements

We thank Dave Daust, Jody Holmes and two anonymous reviewers for comments on the manuscript, and Dave Leversee for providing access to unpublished data.

References


