Coast Information Team

Review Report

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Overview

This five-part report is an account of the Coast Information Team (CIT) and its work.

Part 1 (pages 2–7) sets the scene, describing the CIT region—North and Central Coastal British Columbia, including Haida Gwaii/Queen Charlotte Islands—and its unique features (pages 2–3); outlining the policy context (pages 3–4); and summarizing the CIT's purpose and mandate, organization, and program (pages 4–7).

The CIT program made three major contributions. It expanded and refined the concept of ecosystem-based management (EBM) and elaborated it in a series of practical and measurable objectives and targets. It assessed the status of EBM in the region in relation to the objectives and targets. And it proposed the main elements of a strategy to implement EBM and reach the objectives and targets. These contributions are the subject of Parts 2, 3, and 4.

Part 2 (pages 8–12) discusses the foundations of EBM—ecological integrity and human wellbeing (pages 8–9); notes the guiding principles (page 9) and goals of EBM (page 10); and summarizes the objectives, indicators, and targets (pages 10–12).

Part 3 (pages 13–16) assesses the status of EBM in the CIT region, considering ecological integrity (pages 13–14), human wellbeing (pages 14–15), and both together (page 16).

Part 4 (pages 17–24) proposes six elements of a strategy to implement EBM: ecological protection (pages 17–18), cultural security (pages 18–19), economic development (page 19), EBM planning (pages 19–22), monitoring and research (pages 22–23), and governance (pages 23–24) .

Part 5 (pages 25–30) reflects on the CIT experience with respect to independence, knowledge communities, geographical scope, substantive scope, integration, and strategy, and makes recommendations.

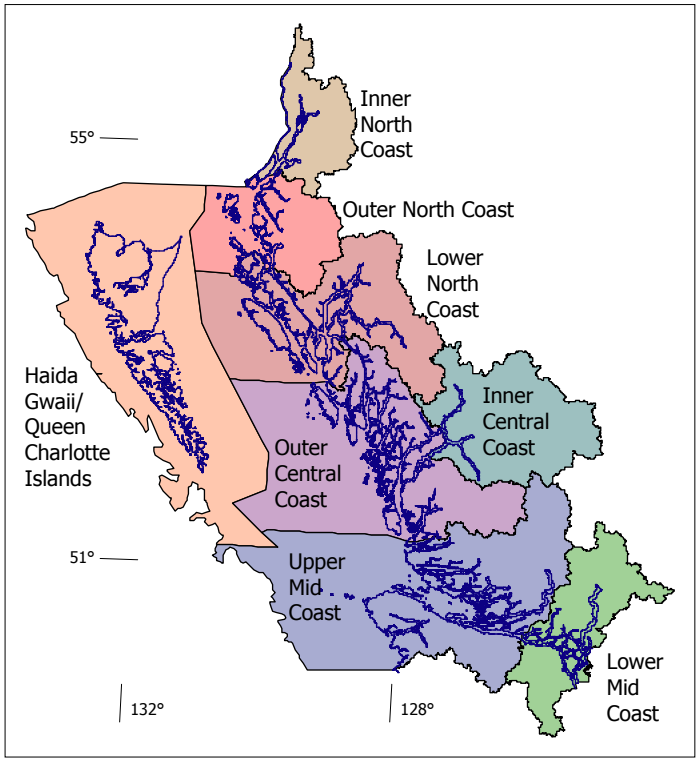
Full information on the CIT is available from www.citbc.org and on follow-up from the Central Coast LRMP (srmwww.gov.bc.ca/cr/resourcemgmt/lrmp/cencoast), North Coast LRMP (srmwww.gov.bc.ca/ske/lrmp/ncoast/), Haida Gwaii/Queen Charlotte Islands LUP (srmwww.gov.bc.ca/cr/qci/), Rainforest Solutions Project (www.savethegreatbear.org), and Coast Forest Conservation Initiative (www.coastforestconservationinitiative.com).

1. Scene, context, process

1.1 North and Central Coastal British Columbia: a unique region

North and Central Coastal British Columbia (BC) covers the coastal waters, islands, and watersheds of the Canadian Pacific from the Alaskan border south to the Strait of Georgia and from the summits of the coastal ranges west to the continental slope. It includes Haida Gwaii/Queen Charlotte Islands (QCI) and northern Vancouver Island (Figure 1). The region has a land area of 118,000 square kilometres—a bit bigger than the island of Newfoundland (or about the size of Eritrea)—and a sea area of 107,000 km², but a population of 90,000—under a sixth of Newfoundland's (and less than a 40th of Eritrea's).

Figure 1. Subregions of North and Central Coastal British Columbia.



The region is the heart of the Northeast Pacific archipelagic coast, one of only two large glaciated leading edge coastal realms (the other being southern Chile). These realms are on the leading edge or western collision margin of continental tectonic plates and have been sliced and diced by glaciation. Hence they have narrow to nonexistent coastal plains, drop sharply from mountain heights to ocean depths, and are incised by fiords, fissured by channels, and shattered into a myriad islands.

Biologically and culturally, the Northeast Pacific is the more diverse. In particular, North and Central Coastal BC includes 45% of North America's three temperate rain forest ecoregions and contains the world's largest tracts of intact temperate rain forest, much of the world populations of yellow-cedar (*Chamaecyparis nootkatensis*) and Sitka spruce (*Picea sitchensis*), and important populations of western redcedar (*Thuja plicata*)[1]. Survival from Pleistocene glacial refugia (Haida Gwaii/QCI and Brooks Peninsula on Vancouver Island), island isolation, and the barrier of the Coast Mountains have resulted in 12 endemic species and 41 endemic subspecies (16 plants, about 10 fishes, 3 birds, and 24 mammals)[2]. Other unusual or especially significant communities and habitats in the region include stopovers for migratory birds, exceptional marshes, estuaries, hotsprings (habitats for ancient bacteria), productive riparian plant associations, ocean-spray zones, karst habitats (above and below ground), and forests on recent postglacial volcanic landforms[3].

The region is home to all four of the world's hexactinellid sponge reefs (two in Hecate Strait and two in Queen Charlotte Sound). The reefs are formed by species of sponges with a skeleton of silica (hexactinellids) in troughs that cross the continental shelf. Up to 18 metres high and from 103 km² to

[1] CIT Ecosystem Spatial Analysis; Ricketts *et al.* (1999).

[2] Campbell *et al.* (1990 & 1997); Douglas (1996); Douglas, Meidinger, & Pojar (2002); Environment Canada (2003); Nagorsen (1990).

[3] CIT Ecosystem Spatial Analysis; Pojar (2003).

227 km² in area, the reefs are 8,500–9,000 years old (individual sponges are 100–200 years old). The fragile skeletons are easily broken and parts of the reefs have been damaged by bottom trawling. Although the reefs are now closed to fishing, trawling damage continues[4]. The habitat diversity of the shelf and slope is further enhanced by large corals, benthic complexity (how often the sea bottom changes slope), and channels and passages with highly productive fast currents (surface flow greater than 5.5 km/hour), which sustain distinctive assemblages of species[5].

Globally important seabird colonies and foraging areas support large percentages of the world populations of marbled murrelet (*Brachyrhamphus marmoratus*), ancient murrelet (*Synthliboramphus antiquus*) (74%), and Cassin's auklet (*Ptychoramphus aleuticus*) (almost 80%)[6]. The region has a great many major populations of six Pacific salmon species[7]—many severely depleted—and some of their most important spawning rivers (notably the Nass, Skeena, and Dean). The region is also the main home of the eulachon (*Thaleichthys pacificus*), which spawns in the lower reaches of coastal rivers from the southern Bering Sea to northern California. Most of the regular spawning runs are on the Northeast Pacific archipelagic coast and half are in North and Central Coastal BC[8]. Eulachon oil or "grease" plays an essential role in the cuisines of the region's First Nations, flavouring and enriching dishes of dried fish, seaweed, and berries.

The region includes the traditional territories of 29 First Nations (aboriginal peoples). The variety of aboriginal language groups is exceeded in North America only by California. Four groups are represented: Haida, Tsimshian, Wakashan, and Salishan. Haida consists of the one language with two surviving dialects (Masset and Skidegate) and is unique to Haida Gwaii/QCI and islands on the Alaskan side of Dixon Entrance. Tsimshian consists of two languages, found only on the North Coast and adjacent Nass and Skeena basins. Three of the six Wakashan languages: (Haisla, Heiltsuk–Oowekyala, and Kwakiutl [Kwakwala]) are restricted to the region; the other three are native to western Vancouver Island and the Cape Flattery area. Salishan languages were spoken primarily south of the region, Bella Coola being the one exception, spoken by the Nuxalk of Inner Central Coast[9]. The total aboriginal population is about 30,000: 13,000 on reserve; 17,000 off reserve (about 3,000 in the region, the rest in metropolitan centres in the south). The 74,000 nonaboriginal residents originate mostly from Europe with a number from China and the Indian subcontinent. Their ways of life are similar to other parts of rural and small town Canada. Only three communities have populations greater than 10,000 (Prince Rupert and Kitimat on the mainland, and Campbell River on Vancouver Island).

1.2 Policy context

The region's economy is dominated by resource industries and the public sector. Forest sectors lead the former—accounting for 69% of employment income from resource industries—followed by food sectors (15%), tourism (11%), and mining (6%)[10]. The forest industry is struggling with the challenges of the softwood lumber dispute with the United States (its main market), increased international competition, and stocks reduced by past harvesting. Consequently, forest sector employment levels have dropped greatly from their peak in the 1970s and 80s. The forest industry also faces increased local and international pressure to sell eco-certified forest products, including the threat of a European boycott unless it adopts forest management methods that are agreed to be ecologically sound and

[4] Conway (1999 & 2002); DFO (2000).

[5] Ardron (2002); CIT Ecosystem Spatial Analysis.

[6] Campbell *et al.* (1990).

[7] Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), pink (*O. gorbuscha*), sockeye (*O. nerka*), and steelhead (*O. mykiss*).

[8] Hay & McCarter (2000).

[9] Thompson & Kinkade (1990)

[10] CIT Wellbeing Assessment. Forest sectors: 51% logging, 41% paper and allied products manufacturing, 8% wood products manufacturing. Food sectors: 39% fishing, 33% food manufacturing, 28% agriculture and aquaculture.

sustainable. Fish and marine invertebrate stocks, depleted by past fishing and other factors, limit the fishing sector, although fishing still plays a vital role in the subsistence economy. Whether aquaculture will mitigate or exacerbate the plight of fisheries is a matter of dispute. Many foods gathered from land and ocean contribute to the local food supply, and a few (notably mushrooms) enter commercial markets and provide seasonal employment. Tourism is below its potential but increasing as visitors are drawn to the region's globally significant ecosystems, dramatic coastlines, and rugged landscapes. Uncertainty surrounds the development of minerals, and exploitation of offshore oil and gas is currently barred by a moratorium.

A relatively small proportion of the benefits from developing the region's natural resources flow to First Nations and local communities. Overall, unemployment is high and economic opportunities are few. Economic development is hampered by remoteness, limited infrastructure, lack of capacity, and inadequate access to capital and markets.

Fair and sustainable allocation and management of resources along with establishment of treaties with First Nations are the keys to the wellbeing of the region. First Nations, local communities, and environmental groups are concerned that allocation has favoured nonlocal corporations, resources have been managed unsustainably, and the ecosystem has been put at risk. First Nations in the region assert their aboriginal rights and title, which are acknowledged by the Canadian constitution and federal and provincial governments but (except for the Nisga'a) have yet to be translated into treaty settlements.

In an effort to resolve land resource issues, the Provincial Government initiated three major planning processes: the Central Coast Land and Resource Management Plan (LRMP), North Coast LRMP, and the Haida Gwaii/Queen Charlotte Islands Land Use Plan (LUP). Their purpose was to enable all parties—the Provincial Government, First Nations, and a variety of stakeholders (local communities and governments, forestry, environment, tourism, mining, recreation, labour, small business, fishing, and others)—to reach agreement on those lands and resources to be protected and those to be developed, where, and how. The Central and North Coast processes were managed by the Provincial Government. The former completed in December 2003, the latter completed at the end of March 2004. The Haida Gwaii/QCI process is managed jointly by the Provincial Government and the Council of the Haida Nation, and was still underway when the CIT was dissolved at the end of March 2004. The planning processes are restricted to land resources, marine resources being covered by other (less participatory) means.

In addition, several First Nations have prepared (or are preparing) their own land use plans, either independently or as part of "interim measures" agreements with the Provincial Government. Some are also developing marine use plans.

In April 2001, agreements[11] between the Provincial Government, First Nations governments, industry, environmental groups, and communities:

- Established a government-to-government relationship between the First Nations and the Province. This facilitated full engagement of First Nations in land-use and resource management decisions pending establishment of treaties.
- Committed all land use planning processes in the region to promote ecosystem-based management, defined as "…a strategic 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 and processes of whole ecosystems such that component species and human social, economic and cultural activities can

[11] The agreements, concerning land-use planning and interim measures along the British Columbia coast, were announced in April 2001. The most significant were the General Protocol Agreement on Land Use Planning and Interim Measures and the Central Coast LRMP Phase I Framework Agreement.

be sustained." This was designed to give priority to restoring and maintaining ecosystem integrity while assuring human wellbeing.

- Undertook to establish an independent, multidisciplinary information body and a transparent peer review process that would provide the best available information and expertise to support the development of an ecosystem-based management approach to natural resource management and planning on the Central and North Coasts and Haida Gwaii. This was intended to satisfy demands for a regional ecosystem-based perspective and for independent information that was both locally and internationally credible. The body was the Coast Information Team (CIT).

1.3 Coast Information Team (CIT)

1.3.1 Purpose and mandate

The Coast Information Team (CIT) was established to provide governments, stakeholders, and the provincial and First Nations planning processes with independent information on the region using the best available scientific, technical, traditional, and local knowledge. The CIT's task was to produce information to help governments and participants in the planning processes reach decisions that achieved ecosystem-based management, and specifically to provide:

- An ecosystem-based management (EBM) framework.
- Regional and subregional analyses.
- A hydroriparian decision tool.
- Technical support for pilot projects that investigate local applications of ecosystem-based management.
- Additional information to assist Land and Resource Management Plans and First Nations' Land Use Plans as provided under service agreements.

1.3.2 Organization

The CIT was set up by the Provincial Government of British Columbia, First Nations of the region, environmental groups, and forest products companies. It consisted of independent scientists and practitioners and traditional and local experts, overseen by a management committee and supported by a secretariat. The CIT became operational in mid-January 2002 and concluded its work at the end of March 2004. Its CA$3.3 million budget was funded by the Province (58%), environmental groups (18%), forest products companies (18%), and the Federal Government of Canada (6%).

The five-person management committee consisted of representatives of the founding partners (Provincial Government, First Nations, environmental NGOs, forest products companies) and the community at large, and was co-chaired by Provincial Government and First Nations representatives. The management committee interpreted the CIT's mandate, determined and oversaw the program and budget, decided the specifications of each project and the composition of the project teams, and assured the CIT's independence.

The secretariat included an executive director, a project manager, and other part-time staff. It was responsible for advising the management committee on the program, administering the projects, and liaising with the planning processes. Consultations with stakeholders (the communities and sectors involved in the planning processes) were organized by the planning processes concerned. Data were stored by the Ministry of Sustainable Resource Management, which also assisted with data processing and analysis.

The CIT program was carried out by ten project teams of scientists and practitioners, each led by an acknowledged expert. All projects were peer reviewed, following a procedure supervised by an independent peer review chair.

1.3.3 Program

The CIT program produced four ecosystem-based management (EBM) guides and six regional and subregional analyses.

EBM guides

Ecosystem-Based Management Framework. Defines EBM, sets out principles to guide EBM, defines goals and objectives of EBM, and outlines key elements of EBM planning and implementation. Prepared by a group of experts on terrestrial ecosystems, marine ecosystems, human (socio-economic) systems, integration of socioeconomic and environmental factors, adaptive management, and practical application of EBM at different scales, with the support of a reference group drawn from other CIT project teams and the Gitga'at and Kitasoo/Xaixais Pilot Project (a project investigating local applications of ecosystem-based management). *See sections 2.2 and 2.3.*

Ecosystem-Based Management Planning Handbook. Describes key concepts of conservation planning, socioeconomic planning, and their integration, including management direction, risk management, human vulnerability mapping, monitoring, knowledge and information management, and collaboration. Sets out an EBM (integrated conservation and socioeconomic) planning framework, covering planning scales, planning across scales, planning functions (assessment, design, integration, implementation), and adaptive co-management. Provides practical guidance on carrying out the planning functions at subregional (territorial), landscape/watershed, and site scales, specifying planning requirements and management targets. Discusses mechanisms for making the transition to EBM, including ecological restoration, institutional design, trade-offs, and economic diversification and innovation. Prepared by a team of experts on conservation planning, resource planning, and socioeconomic planning.

Hydroriparian Planning Guide. The hydroriparian decision tool called for in the CIT mandate (section 1.3.1). Supplements the *EBM Planning Handbook* by providing more detailed advice on how to maintain the functions of aquatic and riparian ecosystems, especially at the watershed level. Prepared by a team of hydrologists, ecologists, and practitioners.

The Scientific Basis of Ecosystem-Based Management. Provides the rationale and scientific background to the ecological aspects of the CIT's approach to EBM. Reviews the development of the concept of EBM, defines ecological integrity, describes the components of the integrity of terrestrial ecosystems of coastal British Columbia, elaborates the conceptual underpinnings of the *Ecosystem-Based Management Planning Handbook*, and provides the scientific justification of the thresholds and guidelines in the *Ecosystem-Based Management Planning Handbook*. Prepared by a team of ecologists and other ecosystem scientists, drawing on a series of in-depth background reports and working closely with the EBM Planning Handbook and Hydroriparian Planning Guide teams.

Regional and subregional analyses

Ecosystem Spatial Analysis. Identifies priority areas for biodiversity conservation and provides an information base and decision support for subsequent planning and management efforts designed to: (a) represent ecosystems across a range of environmental gradients; (b) maintain viable populations of native species; (c) sustain ecological and evolutionary processes within the natural range of variability; (d) build a conservation network that is resilient to environmental change. Identifies target land, freshwater, and marine special elements (rare or at-risk species and other features), ecosystem types (for ecosystem representation), and focal species (e.g., grizzly bear, black bear, marbled murrelet, northern goshawk, tailed frog, salmon). Sets protection goals for the targets. Summarizes human impacts. Analyzes different portfolios of sites that would meet the protection goals. Examines options and scenarios concerning alternative conservation solutions. Prepared by a team of conservation biologists and specialists in land, freshwater, and marine species and ecosystems.

Central Coast Coarse Filter Ecosystem Trends Risk Assessment – Base Case. Uses the abundance and extent of old forest (older than 250 years), by ecosystem type, to indicate the probability of maintaining coarse filter biodiversity, ecosystem function, and ultimately ecological integrity in the Central Coast. Estimates the highest and lowest likely natural percentages of old forest in each ecosystem type based on estimates of stand-replacing natural disturbance rates. Compares the likely natural percentages with projected percentages of old forest based on forest harvesting trends to assess the risk of degradation and biodiversity loss in each ecosystem type. Prepared by experts on ecosystem risk assessment.

Cultural Spatial Analysis. Identifies important places for sustaining the cultural values of First Nations and other communities, including sustenance, heritage, spiritual, and recreational values. Analyzes densities of valued places, comparing their occurrence with protected areas and with areas with positive timber value. Assesses rarity/abundance, threats, and condition of cultural features valued by other communities. Lack of information prevented an equivalent assessment of First Nations sites. Major gaps in coverage of traditional territories make it likely that many places important to First Nations have not been recorded. Prepared by a sociologist and anthropologist from data provided by First Nations or—in the case of other communities—gathered by individuals or small teams.

Economic Gain Spatial Analysis. Reports on timber and tourism—prepared by small teams led by an economist specializing in the sector concerned—identify areas with the highest potential for timber harvesting and tourism respectively, estimating the potential economic gain in terms of direct employment within and outside the region (jobs, full-time equivalents per year, and annual employment income), revenue to the Crown, and profit to enterprises (total revenues minus expenses). Working papers on nontimber forest products, fisheries and aquaculture, and minerals provide less detailed overviews of the potential for economic gain from those sectors.

Wellbeing Assessment. Measures current environmental and human conditions in each of the eight subregions of North and Central Coastal British Columbia to provide a context for decision making, a test of options and scenarios, and a baseline for monitoring implementation of plans and progress toward EBM and sustainability. Shows whether ecological integrity is being maintained, the level of human wellbeing, the distance to sustainability, and the main strengths and weaknesses of each subregion. Ecosystem integrity is measured via indicators of land, water, air, and species and genes. Human wellbeing is measured via indicators of population and health, wealth, knowledge and culture, community, and equity. Prepared by a small team led by an expert on sustainability assessment. Participants in the planning processes contributed substantially to the choice of goals, objectives, components to be measured, indicators, and performance criteria (standards of achievement).

Policy and Institutional Analysis. Identifies the main features of EBM that require institutional support. Discusses the design of institutions, institutional constraints and opportunities, and the design of policy instruments (regulatory, economic, legal, and voluntary), drawing lessons from three case studies. Examines policy and institutional issues relating to aboriginal title and rights, adaptive co-management, and local benefits from land use and resource extraction. Analyzes institutional opportunities and gaps with respect to five resource regimes: land use planning; forest resources and management; mineral resources; tourism and recreation; fisheries and fish habitat. Explores options for implementing EBM though regional institutions, First Nations territorial institutions, a funding body, and legal instruments. Makes recommendations on regional and territorial bodies, conservation financing, enforcing EBM objectives and targets, adaptive co-management, local benefits, and resource regimes. Prepared by a team of specialists in analysis and design of policies and institutions.

2. Developing the concept of EBM

2.1 First among equals

The concept of ecosystem-based management (or ecosystem management) emerged more than 60 years ago from a concern that conventional resource management threatens biodiversity. Since then, the motivation behind EBM has expanded from preventing loss of biodiversity and defending the intrinsic value of ecosystems to maintaining social and economic options for future generations. Of the many definitions of EBM, almost all include maintenance of ecological integrity (or ecosystem health) and continued human presence and use. Almost all recognize that humans are part of ecosystems. The main divergence is between those definitions that give precedence to maintaining ecological integrity and those that do not[12]. Among the former is the definition accepted by most proponents of EBM:

> "Ecosystem management integrates scientific knowledge of ecological relationships within a complex socio-political and values framework toward the general goal of protecting native ecosystem integrity over the long term."[13]

Advocates of EBM argue that protecting ecological integrity does not subordinate people to nature because ultimately humans cannot be sustained unless ecosystems are sustained—the key to which is protecting ecological integrity. If ecosystems are put last (as, historically, they have been), people may benefit in the short term but eventually they will suffer. But if ecosystems are put first, human wellbeing will be secure.

However, if socioeconomic needs are not met, ecosystem protection is likely to fail. Maintaining ecological integrity *and* human wellbeing requires a strong emphasis on both. The CIT's definition of EBM recognizes this:

> "…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."[14]

In the first part of the definition, "healthy, fully functioning ecosystems" and "healthy, fully functioning human communities" are equal. In the second part, supporting and improving human wellbeing is conditional on sustaining species and ecological processes. In other words, ecosystem integrity and human wellbeing are equal but, if a conflict between them is unavoidable, ecosystem integrity comes first.

These strictures beg several questions. What do we mean by "ecological integrity" and "healthy, fully functioning ecosystems"? What do we mean by "human wellbeing" and "healthy, fully functioning human communities"? Maintaining what levels of species and processes will allow persistence of ecosystem integrity that in turn will support socioeconomic systems? And how do we do it all?

Ecological integrity is defined as:

> "The abundance and diversity of organisms at all levels and the ecological patterns, processes, and structural attributes responsible for that biological diversity and for ecosystem resilience."[15]

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[12] CIT report on the Scientific Basis of Ecosystem-Based Management.

[13] Grumbine (1994).

[14] CIT Ecosystem-Based Management Framework. The definition refines the one in the April 2001 agreements (footnote 11).

[15] CIT Ecosystem-Based Management Framework. The Scientific Basis of EBM expressed dissatisfaction with this definition because it does not explicitly compare the diversity and structural attributes with those found naturally. An alternative definition, which meets this need and is consistent with the Framework's definition is: "A condition in which the ecosystem maintains its natural diversity of components (communities, species, genes), functions, and structures, and its ability to absorb and recover from disturbance."

Human wellbeing is defined as:

> "A condition in which all members of society are able to determine and meet their needs and have a large range of choices and opportunities to fulfill their potential."[16]

The job of the CIT's EBM guides and analyses was to answer the remaining questions by setting out guiding principles (section 2.2), defining goals (section 2.3), identifying objectives and targets (section 2.4), and proposing an EBM strategy (part 4).

2.2 Guiding principles

The Ecosystem-Based Management Framework proposed seven principles to guide implementation of EBM:

- Ecological integrity is maintained—by sustaining the biological richness and services provided by natural terrestrial and marine processes, including the structure, function, and composition of natural terrestrial, hydroriparian, and coastal ecosystems at all scales through time.
- Human wellbeing is promoted—by assessing risks and opportunities for communities, by facilitating and enabling a diversity of community economic and business activity, and by planning for local involvement in existing and future economic activities.
- Cultures, communities, and economies are sustained within the context of healthy ecosystems—by sustaining the biological richness and ecological services provided by natural ecosystems while stimulating the social and economic health of the communities that depend on and are part of those ecosystems.
- Aboriginal rights and title are recognized and accommodated—by respecting First Nations governance and authority, and by working with First Nations to achieve mutually acceptable resource planning and stewardship and fair distribution of economic benefits.
- The precautionary principle is applied—by recognizing uncertainty and by working to establish and implement management objectives and targets that err on the side of caution. The onus is on the proponent to show that management is meeting designated objectives and targets.
- EBM is collaborative—by encouraging broad participation in planning; by clearly articulating collaborative decision making procedures; by respecting the diverse values, traditions, and aspirations of local communities; and by incorporating the best of existing knowledge including traditional, local, and scientific knowledge.
- People have a fair share of the benefits from the ecosystems in which they live—by acknowledging the cultural and economic connections that local communities have to coastal ecosystems and by ensuring that diverse and innovative initiatives increase the share of employment, economic development, and revenue flowing to local communities and also maintain cultural and environmental amenities and other local benefits derived from land and water resources.

[16] CIT Wellbeing Assessment; CIT Ecosystem-Based Management Planning Handbook.

2.3 Goals

Reflecting the dual emphasis on ecological integrity and human wellbeing, the Ecosystem-Based Management Framework defined two goals of EBM:

- Maintain the ecological integrity of land, freshwater, and marine ecosystems and the atmosphere[17].
- Achieve high levels of human wellbeing.

2.4 Objectives, indicators, and targets

Objectives, indicators, and targets make the goals concrete and help to translate them into practical action. Much the most significant—in terms of its influence on decision making—were the ecological targets based on risk thresholds.

2.4.1 Ecological objectives, indicators, and targets

Ecological objectives, indicators, and targets were developed by the Ecosystem-Based Management Framework, Ecosystem-Based Management Planning Handbook, Hydroriparian Planning Guide, Scientific Basis of Ecosystem-Based Management, and Wellbeing Assessment. Appendix 1 presents a consolidated set of objectives together with measurable indicators and targets applicable at subregion/territory level (500,000–5,000,000 hectares), landscape level (30,000–100,000 hectares), watershed level (1,000–50,000 hectares), or in a few cases site level (under 250 hectares).

1. In general, the targets are based on risk curves that combine information from several sources, including natural reference points or benchmarks (e.g., natural streamflow rates), research reports and empirical data, and instances of collapse (e.g., local or expert knowledge of species extirpation). The CIT's approach relies on "range of natural variability" (RONV)—the range of dynamic change in natural systems over historic time periods—as a benchmark for risk assessment. The assumption is that risk increases in proportion to the amount that management causes patterns and processes to depart from their natural range. Thresholds are identified to aid risk interpretation and develop management targets. This involves dividing risk for each indicator into classes ranging from very low to high: the low risk threshold is the point where detrimental ecological changes can be observed; the high risk threshold is the point where ecologically significant loss of function occurs. "Precautionary" management targets should have a high probability of maintaining ecological integrity and therefore be equal to or below the low risk threshold. Management should not exceed the high risk threshold because, beyond that point, ecological degradation is highly likely.

The targets for objective 2 in Appendix 1 ("The natural diversity of land, freshwater, and marine ecosystems, and of ecosystem functions and structures, is maintained") exemplify this approach. The benchmark for the objective is the natural disturbance regime. The natural disturbance regime of most forest ecosystems in the region is the frequent creation by wind and pathogens of small canopy gaps of 10 trees or fewer, punctuated by stand-replacing landslides, debris flows, and avalanches and much less frequent (on the scale of millennia) larger openings by wind and fire. In floodplain and estuarine forests, flooding has a major role[18]. The return interval—the time taken for a forest ecosystem to recover from disturbance—ranges from 300–900 years for Inner Coast fluvial sites to 4,500–33,300 years for Hypermaritime upland sites. The natural percentage of old growth forest (older than 250 years) varies accordingly: from 43–76% to 85–99%[19] (Table 1).

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[17] The wording in the EBM Framework is "maintain the ecological integrity of terrestrial, marine, and freshwater ecosystems." The Wellbeing Assessment added "the atmosphere" to provide complete coverage of the ecosystem and changed "terrestrial" to "land" to avoid the overlap between terrestrial (= land + freshwater) and freshwater. Maintenance requires restoration wherever enological integrity has been impaired.

[18] Dorner & Wong (2003); CIT report on the Scientific Basis of Ecosystem-Based Management.

[19] Price & Daust (2003).

Table 1. Estimated return intervals and natural proportion of old forest in different disturbance units as defined by physiographic region and site series group (CIT region except Vancouver Island)

Region	Site series group	Area (ha)*	Return interval#	% of forest > 250 years	mean % > 250 years	70% of mean =
Hypermaritime	upland	1,841,841	4,500–33,300	95–99	97	68
	fluvial	24,218	2,200–11,100	89–98	93.5	65
	ocean spray	26,594	1,000–5,600	78–96	87	61
Outer Coast North	upland	590,139	1,800–10,000	87–98	92.5	65
	fluvial	8,446	500–2,100	61–89	75	53
	ocean spray	628	--	--	--	--
Outer Coast South	upland	924,554	900–2,500	76–90	83	58
	fluvial	20,388	400–1,400	54–84	69	48
	ocean spray	93	--	--	--	--
Inner Coast	upland	397,040	500–5,600	61–96	78.5	55
	fluvial	9,056	300–900	43–76	59.5	42
mean %					82	57
fluvial mean %					74	52

* Area of the three subregional plans, not including nonforested area, some hypermaritime pine analysis units, fume-killed forest, or unreliable data areas. # To nearest 100 years. Source: Price & Daust (2003).

The main events shaping freshwater and hydroriparian ecosystems are floods and geomorphic disturbances (avalanches, debris flows, landslides) , which modify stream channels and floodplains[20]. Marine regimes are characterized by changes in temperature, salinity, winds, waves, tides, currents, and influxes of fresh water from the Skeena and Nass Rivers in the north and (to a much lesser extent) Homathko River in the south. Climate events—notably the El Niño/La Niña cycle—are a major factor and other less predictable influences may also be at work, including the impacts of carbon dioxide emissions.

Setting targets for maintaining the natural diversity of ecosystems requires identifying the thresholds at which disturbance greater than the natural range results in detrimental change. The scientific search for such thresholds is relatively new; and, because of time lags, it takes a while for the harmful impacts of habitat change to become apparent. Consequently, empirical evidence of thresholds is restricted to a limited number of ecosystems. In a small number of landscape-level studies, habitat thresholds in temperate and boreal forests range between 10% and 80%, occurring most frequently between about 30% and 70%. Simulation modelling produces similar results: in a theoretical landscape, habitat patches start to become isolated at 30% habitat loss and all patches are isolated at 70% loss.[21] Accordingly, the target for old growth maintenance is at least 70% of the natural proportion—the natural proportion being the mean of the natural range (Table 1).

This target applies to the subregional level. Less stringent versions apply to landscape and watershed levels. Ecological and social values are not evenly distributed across the landscape; nor are resource development opportunities. If precautionary targets were applied everywhere, it would be hard to fulfill socioeconomic objectives and would probably spread resource development more widely over the landscape at any point in time (assuming harvest or use levels remain constant). Instead, allowing management flexibility at lower scales can direct economic development to areas where ecological or cultural values are not as great, and environmental protection to areas with significant ecological values. The aim, therefore, is to secure a high probability of maintaining ecological integrity overall at the subregional scale and in landscapes and watersheds with significant cultural and ecological values, while allowing for greater focus on economic activity in landscapes, watersheds, and sites with lower conservation value. Accordingly, the old growth target at landscape level is 50% of the natural proportion, *provided the average across all landscapes is 70%* (the subregional target); and at watershed level 30%, *provided the average across all watersheds is 50%* (the landscape target). Similar variation across scales applies to targets for natural riparian forest.

[20] CIT Hydroriparian Planning Guide.

[21] CIT report on the Scientific Basis of Ecosystem-Based Management.

Background or natural rates also influence the target for at-risk species and derived targets for introduced species and resource populations of conservation concern. But in many cases information on thresholds and background rates is lacking; guidance must be sought elsewhere. The target for conversion to a built or cultivated state reflects international performance. Other targets are based on existing standards, set or proposed by IUCN–The World Conservation Union, the United Nations Economic Commission for Europe and North America, the World Health Organization, or the governments of Canada or British Columbia. Still others are based on expert opinion and are hypotheses that the target is necessary and sufficient to achieve the objective.

2.4.2 Human objectives, indicators, and targets

Human (socioeconomic) objectives, indicators, and targets were developed by the Ecosystem-Based Management Framework, Ecosystem-Based Management Planning Handbook, and Wellbeing Assessment. Appendix 2 presents a consolidated set of objectives together with measurable indicators and targets applicable at subregion/territory level (500,000–5,000,000 hectares).

Some human values (health, sufficient wealth to meet needs and provide security, peace) are universal. Most are determined or strongly influenced by culture. There is no value-free basis for choosing objectives or setting targets. Consequently, the set in Appendix 2 was strongly influenced by three rounds of workshops held with participants in each of the subregional planning processes to select objectives, indicators, and targets for the Wellbeing Assessment. If information was available, the targets were subsequently adjusted on the basis of comparisons with performance elsewhere in British Columbia or the world. In the absence of such information, a linear scale was usually applied and the target placed in the top fifth of the scale.

3. Assessing the status of EBM

3.1 Ecological integrity

The status of ecological integrity in the region was assessed by the North Coast and Central Coast Coarse Filter Ecosystem Trends Risk Assessments, Ecosystem Spatial Analysis, and Wellbeing Assessment.

The Ecosystem Trends Risk Assessments found that—in all biogeoclimatic ecosystem classification (BEC) variants—the current abundance of old forest in high productivity ecosystems was much lower than its predicted abundance under natural disturbance regimes. There was a correspondingly high to very high risk to coarse filter biodiversity within these ecosystems. Old forest abundance was moderately lower than predicted abundance in medium productivity ecosystems. This suggested a moderate risk to those ecosystems, but expected harvesting pressure increased the risk to high in most variants over the next 50 years. The abundance of old forest in low productivity ecosystems was very similar to that predicted under natural conditions. However, age typing of some of these ecosystems is known to be inaccurate. Of 146 Central Coast forest ecosystems larger than 200 hectares, 60 (41%) were at very high risk, 14 (10%) at high risk, 6 (4%) at medium risk, 3 (2%) at low risk, and 63 (43%) at very low risk. The number of ecosystems in the very high and high risk groups was projected to decline over time. Of 47 North Coast forest ecosystems, 3 were at very high risk, 5 at high risk, 4 at medium risk, 15 at low risk, and 20 at very low risk. But the number of ecosystems in the very high and high risk groups increased to 9 over 50 years and 19 over 250 years.

The Ecosystem Spatial Analysis found that ecosystem types are underrepresented in protected areas—freshwater ecosystems moderately so, land ecosystems extremely underrepresented, and marine ecosystems virtually absent. Apart from seabird colonies, herring spawning areas, and hexactinellid reefs, special elements (rare and endangered species and features) were recorded too patchily and unreliably to determine how well they are represented. Among focal species (black bear, grizzly bear, mountain goat, marbled murrelet, northern goshawk, tailed frog, Pacific salmon, steelhead, and eulachon), population data were inadequate for all but the fishes. Habitat protection of non-fish focal species ranged from 0% (black bear Lower North Coast; mountain goat Inner North and Lower Mid Coasts; marbled murrelet and northern goshawk Inner and Lower North Coast; tailed frog Upper Mid Coast) to 35% (grizzly bear Inner Central Coast). Of the fish focal species, eulachon were worst off, with 85% of populations declining, followed by sockeye (71%), coho (70%), summer steelhead (68%), chum (66%), and chinook (60%). The other species were generally in a better (or, rather, less poor) state: even-year pink (43% of populations declining), odd-year pink (36%), and winter steelhead (19%). Subregionally, mean percentages of declining populations ranged from 36% in Outer North Coast to 71% in Upper Mid Coast. (See also section 4.2 on ecological protection.)

The Wellbeing Assessment provides the fullest assessment of the ecological objectives and targets (Figure 2). Except in Haida Gwaii/QCI (19% converted), the proportions of land and coast converted to structures and cultivation is small—from 3% to 12%. Nonetheless, 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. Air quality is monitored in half the subregions, water quality in one, and soil quality in none. Where measured, however, air quality is extremely good. Fishery and timber populations—the sources of major provisioning and cultural services such as sustenance, employment, and income—are declining sharply. Scores for these factors were combined to produce an ecological integrity index (EII). No subregion is close to the goal of ecological integrity. Most have a medium EII; Upper and Lower Mid Coast have a poor EII (Table 2).

Table 2. Ecological integrity index (EII). The EII is the unweighted average of scores for four element groups: ecosystem diversity; species and genetic diversity; land, water, and air quality; and provisioning and cultural services. Green = good; blue = fair; yellow = medium; pink = poor; red = bad; grey = no data. Subregions with no data on air were given a dummy score of 91 (the score of Lower Mid Coast, the lowest of the recorded subregions).

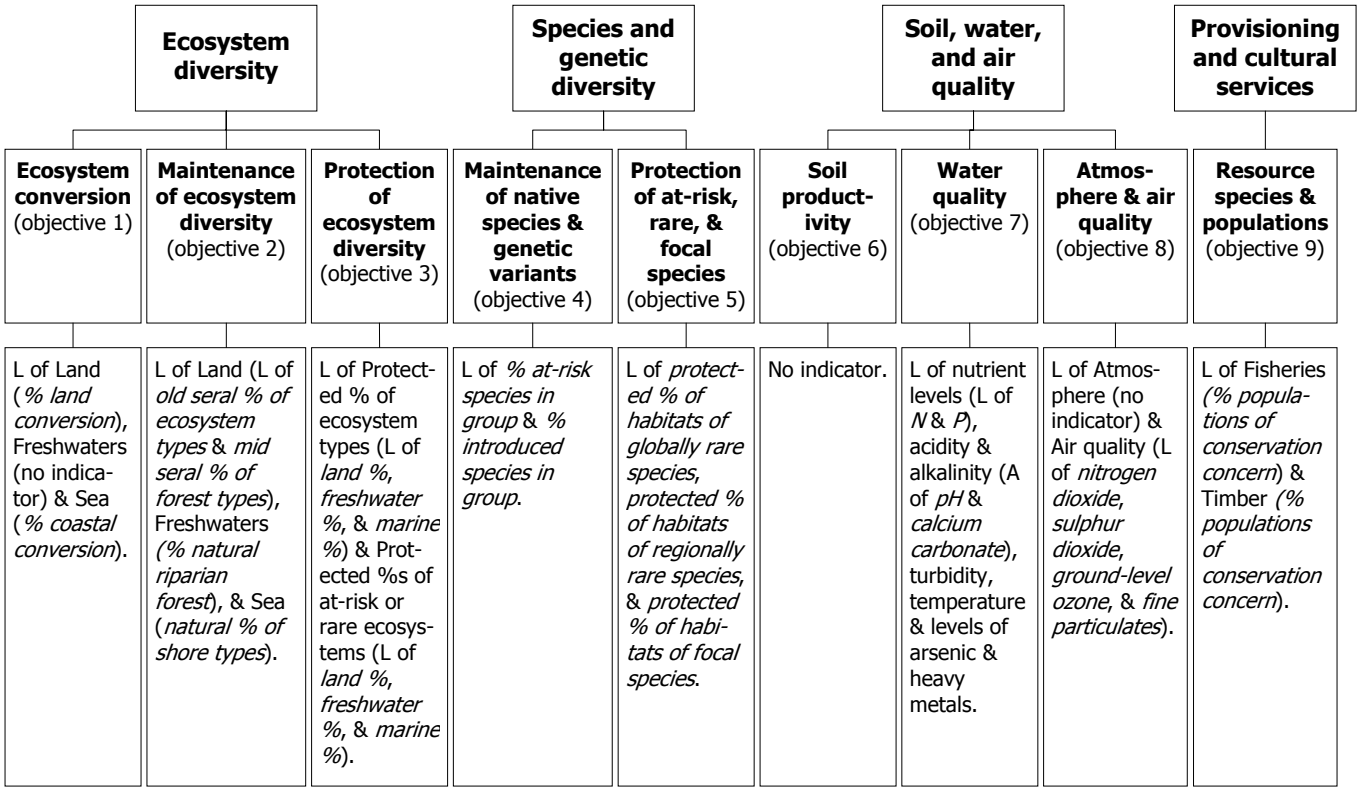
Subregion	Ecosystem diversity	Species and genetic diversity	Land, water, and air quality	Provisioning and cultural services	Ecological integrity index (EII)
Haida Gwaii/QCI	44	40	[91]	27	**50**
Inner North Coast	51	0	[91]	22	**41**
Outer North Coast	63	0	95	23	**45**
Lower North Coast	56	0	93	21	**42**
Outer Central Coast	62	0	[91]	17	**42**
Inner Central Coast	57	0	[91]	17	**41**
Upper Mid Coast	28	3	93	13	**34**
Lower Mid Coast	36	0	73	11	**30**

Source: CIT Wellbeing Assessment.

3.2 Human wellbeing

The status of human wellbeing in the region was assessed by the Cultural Spatial Analysis and Wellbeing Assessment. (The Economic Gains Spatial Analysis did not assess the status of the sectors concerned. Logging and wood production, fisheries and food production, and tourism are major sources of income in the region, contributing from 17% of employment income in Inner North Coast to 56% in Upper Mid Coast. The contribution declined during the 1990s, except in Upper Mid Coast, where it rose. The biggest source is logging and wood production, apart from fisheries and food production in Outer Central Coast. The role of logging and wood production has grown in Upper Mid Coast, lessened in Inner North, Inner Central, and Lower Mid Coast, and fluctuated elsewhere. The second biggest source of employment income from economic ecosystem services is fisheries and food

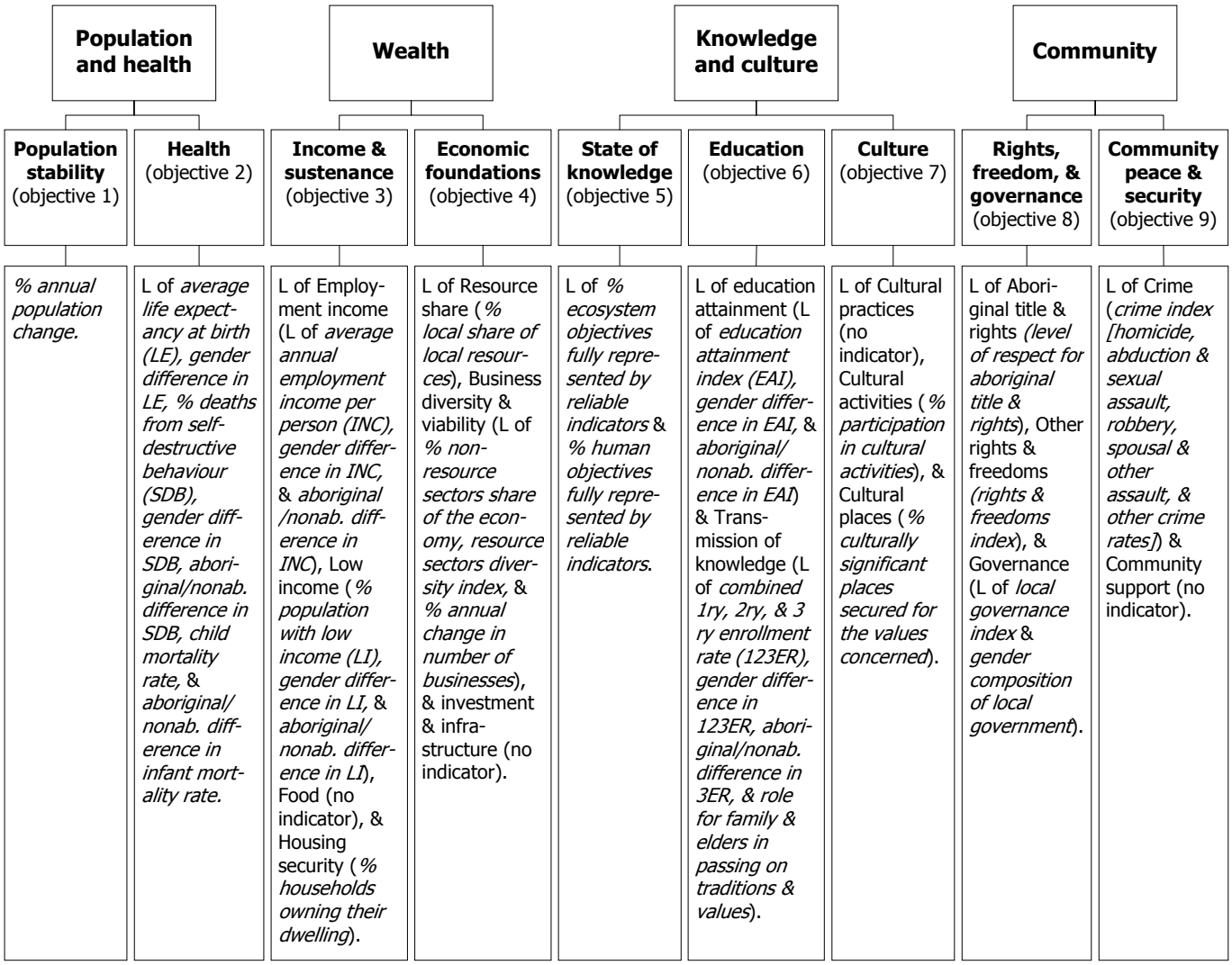
Figure 2. Element groups (top row), elements (middle row), and indicators (bottom row), used to measure ecological integrity. Each element relates to one of the objectives in Appendix 1, which also gives details of the indicators. Element group scores are the unweighted average of element scores. Element scores are the lowest indicator score. L = lower/lowest. A = average.



production in Haida Gwaii/QCI, Outer North Coast, and Mid Coast, and tourism in Inner North, Lower North, and Inner Central Coast. Fisheries and food production have declined somewhat in all subregions except Inner North Coast, whereas tourism has remained essentially unchanged.)

In the Cultural Spatial Analysis, First Nations and other communities identified places they use for spiritual, sustenance, heritage, and recreational/visual values. The analysis was incomplete because most First Nations in Inner and Outer North Coast chose not to participate and nonaboriginal communities in Inner and Lower North Coast were not surveyed. Furthermore, the cultural maps of participating First Nations cover only parts of their traditional territories. Gaps in the maps are large—signs not of low value but of unfinished research and documentation. Securing culturally significant places requires guaranteeing access to those places needed for sustenance and protecting those places needed for other values (spiritual, heritage, nonconsumptive recreation). Sites where sustenance and nonsustenance values overlap call for a combination of protection and guaranteed access. Even with the limited data on cultural features, protection is clearly wanting. Only 13% of the area of cultural features is protected in Haida Gwaii/QCI, 8–9% in North Coast, and 7–8% in Central and Mid Coast. (See also section 4.3 on cultural security.)

Figure 3. Element groups (top row), elements (middle row), and indicators (bottom row), used to measure human wellbeing. Each element relates to one of the objectives in Appendix 2, which also gives details of the indicators. Element group scores are the unweighted average of element scores. Element scores are the lowest indicator score. L = lower/lowest. A = average.



The Wellbeing Assessment measured a broad array of human objectives and targets (Figure 3). Scores were combined to produce a human wellbeing index (HWI). No subregion is close to the goal of high levels of human wellbeing. All have a medium HWI (Table 3). The main reasons for this modest performance are: excessive population fluctuations, inadequate employment income, high proportions of low-income households, weak economic foundations (poor access to resources and limited business diversity), mediocre knowledge and education, insecure access to cultural places, lack of power over decisions that affect local livelihoods, low expectations of local governance, and social problems manifested by a high proportion of deaths from self-destructive behaviour (drugs, alcohol, suicide) and high rates of domestic violence. Over the past decade, most of these factors have worsened (notably population fluctuations, employment income, low-income households, economic foundations), although other conditions have improved (education levels and crime rates).

Table 3. Human wellbeing index (HWI) for 2001. The HWI is the unweighted average of scores for four element groups: population and health; wealth; knowledge and culture; and community. Green = good; blue = fair; yellow = medium; pink = poor; red = bad.

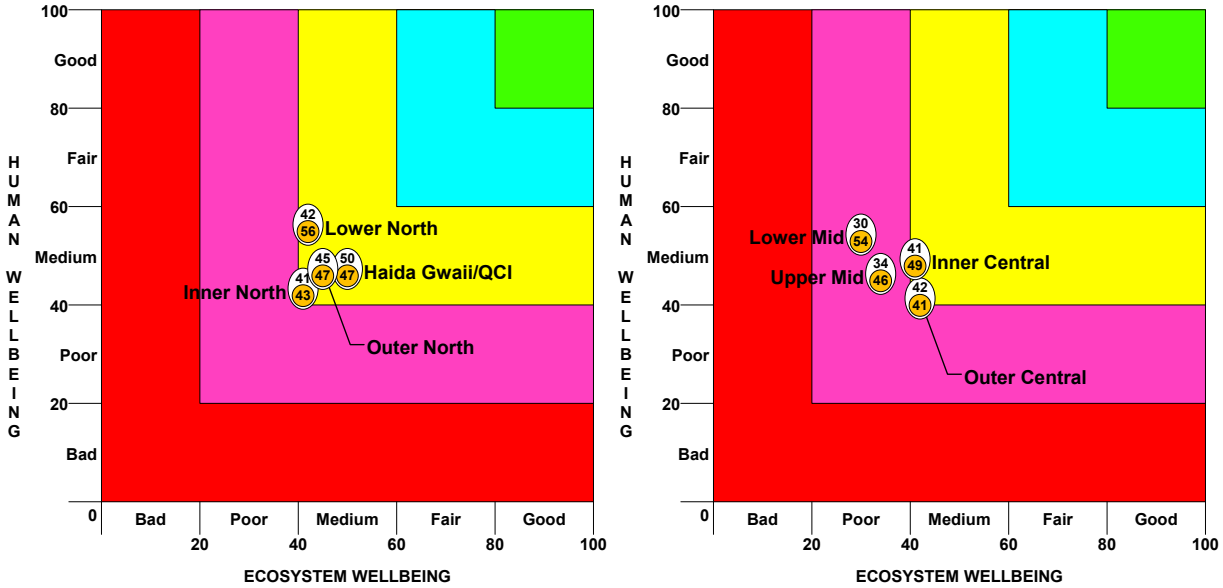
Subregion	Population and health	Wealth	Knowledge & culture	Community	Human wellbeing index (HWI)
Haida Gwaii/QCI	31	61	43	54	**47**
Inner North Coast	43	37	31	63	**43**
Outer North Coast	44	50	35	59	**47**
Lower North Coast	54	71	36	63	**56**
Outer Central Coast	45	34	30	55	**41**
Inner Central Coast	56	45	35	62	**49**
Upper Mid Coast	40	53	33	59	**46**
Lower Mid Coast	70	57	33	57	**54**

Source: CIT Wellbeing Assessment.

3.3 Ecological integrity and human wellbeing together

Figure 4 combines the EII and HWI and shows that all subregions have quite a way to go to achieve EBM. Progress will require much better maintenance and protection of ecosystems and species, together with stronger income generation, a bigger share of local resources, increased knowledge and education, and greater protection of cultural resources.

Figure 4. Distance to the goals of ecological integrity and high human wellbeing of the subregions of north and central coastal BC. Ecological integrity index in white of egg. Human wellbeing index in yolk. Ecosystem-based management (achievement of both goals) is the green square in the top right corner. Source: CIT Wellbeing Assessment



4. Proposing an EBM strategy

4.1 Elements of an EBM strategy

The CIT was set up to provide information that would help the Provincial and First Nations governments and other participants in the planning processes reach decisions that achieved ecosystem-based management. The focus of the planning processes was on land use and the allocation and management of natural resources. Neither the CIT nor the planning processes were charged with developing an EBM strategy, although a strategy is needed to establish EBM and reach its goals.

The CIT's EBM guides and regional and subregional analyses meet part of this need by proposing elements of a strategy:

- Ecological protection.
- Cultural security.
- Economic development.
- EBM planning.
- Monitoring and research.
- Governance: institutions and policy instruments.

4.2 Ecological protection

The CIT Ecosystem Spatial Analysis proposed protection strategies for land, freshwater, nearshore marine, and offshore marine biodiversity. The land targets consisted of rare and at-risk species and plant communities, ecosystem types (Biogeoclimatic Ecosystem Classification units and productivity classes), and the habitats of focal species (marbled murrelet, northern goshawk, mountain goat, grizzly bear, and black bear). The freshwater targets consisted of the endemic giant black stickleback, ecosystem types (classified by size, biogeoclimatic zone, geology, stream gradient, glacial connectivity, and presence of dominant lake or wetland features), and the habitats of focal species (tailed frog and the six species of Pacific salmon and steelhead).

Nearshore marine targets were spawning aggregations of herring, breeding colonies of at-risk seabirds (thick-billed murre, common murre, Cassin's auklet, ancient murrelet, horned puffin, tufted puffin, and Brandt's cormorant), and shoreline ecosystem types (classified by substrate, exposure, and vegetation). Offshore marine targets were focal plant and algal species (eelgrass, kelp, marsh grasses, and surf grasses), breeding seabird populations and colonies (ancient murrelet, black oystercatcher, Cassin's auklet, cormorants, glaucous-winged gull, pigeon guillemot, puffins, rhinoceros auklet, and storm petrels), moulting sea ducks (scoters and harlequin ducks), anadromous streams, Steller sea lion haul-outs and rookeries, herring spawn shorelines, rare or at-risk elements (hexactinellid sponge reefs, eulachon estuaries, sea otter, estuaries with red- or blue-listed species, marbled murrelet marine habitat, and large habitat-forming corals), and ecosystem types (based on current speed and benthic topographical complexity).

Site-selection goals for land and freshwater ecosystem types were set at 30%, 40%, 50%, 60%, and 70% representation of total area based on historical abundance of each ecosystem type[22]. Nearshore marine goals were set at 10%, 20%, and 30% of the entire shoreline. Site-selection aimed to meet the goals using the fewest and least scattered areas and occupying the smallest total area with the shortest boundary length. Site-selection also favoured undeveloped areas (areas with no or low human impact); but, if the goal exceeded the undeveloped area, the difference was made up from the

[22] The land analysis did not set goals for rare and at-risk species and plant communities because of large gaps and biases in the survey data.

developed area. Land, freshwater, and offshore marine planning units were 500 hectare hexagons. Nearshore marine planning units were shoreline segments of varying length.

Between 44% and 50% of the terrestrial area is required to satisfy land and freshwater goals at the 30% level. Achieving the 50% goals for most of the targets calls for 60–70% of the terrestrial area. Thereafter, incremental increase in goal attainment declines: improvements above 60% demand even larger areas of land and water. Marine findings are similar.

The site selection procedures identify potential protected areas that, because of the frequency with which they occur in different solutions (combinations of ways of meeting different goal-settings), are likely to contribute most to the efficient achievement of the goals. For instance, the offshore marine analyses consistently identify priority areas such as the hexactinellid sponge reefs; Naden Harbour, Masset Inlet, and Skidegate Inlet (Kagan Bay) in Haida Gwaii/QCI; the Nass River mouth, Kitkatla Inlet, and Kitimat Arm in the North Coast; and the Broughton Archipelago and Bardswell, Goose, and Scott Islands in the Central Coast.

The site selection method also provides a means of testing whether solutions proposed by planning tables and governments meet EBM objectives. It shows, for example, that the protected areas agreed to by the Central Coast LRMP table would increase protection of focal species' habitat by three to five times (depending on the species) and make important gains in the representation of land and freshwater ecosystem types, but that major gaps remain in some ecosections such as the Outer Fiordlands and (to a lesser extent) the Northern Pacific Ranges.

4.3 Cultural security

The CIT Cultural Spatial Analysis identified concentrations of cultural features. Central and Mid Coast First Nations (Heiltsuk, Kwakwala[23], Kitasoo/Xaixais, Nuxalk, and Wuikinuxv) provided their own data, except for the Nuxalk which were obtained by Nuxalk consultants. Of the Haida Gwaii and North Coast First Nations (Gitga'at, Gitxaała, Haida, Haisla, Lax-kw'alaams, Metlakatla, and Nisga'a), only the Haisla provided data. Thus there were substantial gaps in territorial coverage. Moreover, the information that was provided came from surveys that are far from complete. All First Nations stressed that their entire traditional territory is important and that blank spaces on maps merely signify unsurveyed areas. Data on features of cultural value to non-First Nation communities came from community consultations in Haida Gwaii/QCI, Outer North Coast (Prince Rupert, Port Edward, and outlying communities), Bella Coola valley, and northeast Vancouver Island, supplemented by provincial inventories of outstanding recreation and visual quality features.

Cultural features included natural features valued for recreation and aesthetic quality (trails, water routes, picnic areas, landscape and seascape views, wildlife viewing areas); sustenance places (fishing, hunting, shellfish collecting, plant and seaweed gathering, and tree cutting areas, and the sites of fishing and other sustenance camps); archeological and historical relics of past occupation or use; places featured in stories, songs, or dances and the origin sites of dances and clan crests; petroglyphs and other sites of artistic expression; sites of ritual observances and spiritual experiences; and gathering places and sites of community activities.

Concentrations of First Nation and other community cultural features were mapped by watershed and coastal water body and by landscape and seascape. Little overlap was found between these concentrations and either protected areas or areas of positive timber value (likely to yield positive returns on investment in logging). This suggests that, in general, cultural features are neither secure nor greatly at risk. In an evaluation of the condition of, and threats to, other community features in the North, Central, and Mid Coasts, 66% of features were rated high condition and low threat; 19% low

[23] Kwakwala comprise the Da'naxda'xw, Gwa'Sala-Nakwaxda'xw, Gwawaenuk, Kwakiutl, Kwiakah, Kwicksutaineuk-ah-kwaw-ah-mish, Mamalilikulla-Qwe'Qwa'Sot'Em, Namgis, Quatsino, Tlatsikwala, Tlowitsis, Tswataineuk, Wei Wai Kai (Cape Mudge), and Wei Wai Kum (Campbell River).

condition and low threat; 8% high condition and high threat; and 7% low condition and high threat. A strategy for maintaining cultural features and access to them is clearly needed but none is proposed.

4.4 Economic development

The strategy behind the CIT Economic Gain Spatial Analysis was to identify areas with the highest potential for economic gain from timber, tourism, nontimber forest products, fisheries and aquaculture, and minerals, in terms of direct employment within and outside the region (jobs, full-time equivalents per year, and annual employment income), revenue to the Crown, and profit to enterprises (total revenues minus expenses). This ambitious undertaking met with limited success due to methodological issues, limited data, and the inherent difficulties of forecasting future economic conditions and opportunities. Timber and tourism were given the fullest treatment. The other sectors were incompletely addressed, and the conclusions of the studies concerned are considered as provisional.

The timber analysis evaluated the likely gain from each landscape on the basis of the top of the price cycle value of the timber, the cost of harvesting, and the harvestable volume under the conservation constraints of EBM. Harvests and economic gains were projected 200 years into the future.

The tourism analysis rated groups of landscapes and seascapes for their suitability (low, medium, high, or very high) for development for the built and nonbuilt subsectors. The built subsector consists of lodges and resorts. The nonbuilt subsector includes land-based activities (camping, hiking, hunting, wildlife viewing), snow-based activities (skiing and snowmobiling), water-based activities (canoeing, fishing, kayaking, river rafting, wildlife viewing), cultural activities (mainly First Nations interpretation), and cruise ship visits.

The paper on nontimber forest products considered one medicinal plant species, two edible fungi, and five medicinal fungi to be the best bets for development. It identified areas worth exploring for economic concentrations of the species, and proposed pilot projects to test their sustainable commercial potential in Haida Gwaii/QCI, the Kitasoo/Xaixais territory, and the Bella Coola valley.

The fisheries and aquaculture paper proposed community-based management to enable First Nations and other local communities to obtain a sustainable economic return from fisheries at sites where populations return to spawn or stocks and runs are concentrated. The paper argued that productivity could be increased through ocean ranching, seeding of hanging lakes, reviving traps and fish wheels as the gear for catching fish.

The minerals paper divided the region into subtracts of 100,000 hectares or less and assessed each subtract for its potential for metallic mineral and industrial mineral deposits. The assessment tabulated discovered resources, constructed deposit models (standard descriptions of the grade and tonnage distribution of each deposit-type); estimated the number of undiscovered deposits by deposit-type and subtract; estimated quantities of metallic commodities remaining to be discovered (using geological data and Monte Carlo simulation); and calculated the gross in-place value (GIPV) of each subtract based on the known and undiscovered commodities it contains[24]. The subtracts were then ranked by total GIPV per hectare. However, whether the estimate of undiscovered deposits is a reasonable reflection of actually existing undiscovered deposits, whether and when the undiscovered deposits will be found, and whether they can be extracted economically, are unknown.

4.5 EBM planning

Achieving the objectives and targets of EBM requires protecting major areas identified by the ecosystem and cultural spatial analyses and developing the most promising areas identified by the economic gain spatial analysis. Marrying protection and development calls for EBM planning, which

[24] Industrial mineral deposit-types were given a "relative deposit-value score" based on commodity unit-value, size and location of potential market, deposit grade and size, transportation costs, existing infrastructure, and extraction costs.

combines conservation planning and socioeconomic planning in a multi-scale interactive process of assessment, design, integration, and implementation.

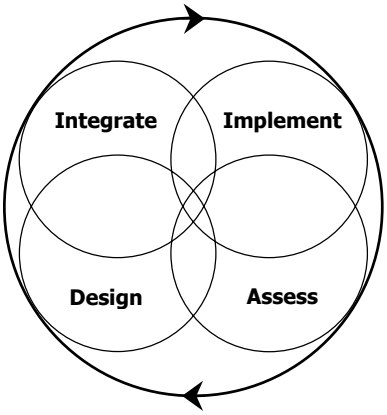
Conservation planning develops a system of protected areas and reserves that will protect and help to sustain important ecological, cultural and social values, establishing:

- *Protected areas*—relatively large undeveloped areas, identified at regional and subregional scales and designated for protection by governments (Federal, Provincial, First Nations) under specific legislation or authority. Protected areas may be established to protect representative samples of all native ecosystems and seral stages; provide critical and seasonal habitat to sustain viable populations of all native species; protect regionally rare or unique landforms and biophysical features; protect culturally and socially significant areas and values; or provide a benchmark against which to evaluate and compare managed landscapes.
- *Landscape, watershed, and site reserves*—areas where no, or very little, extractive resource use takes place but the land is not formally designated under legislation. Reserves are established to protect specific resource values or biophysical features (e.g., cultural heritage resources and features, unstable terrain, scenic areas, and recreation features) or achieve objectives to maintain ecosystem representation, wildlife habitat and movement corridors, riparian forest and other landscape design elements.
- *Site retention and management*—in which individual trees, groups of trees, plant communities, or other features are retained or managed on the site to maintain ecological structures in the unprotected landscape (e.g., wildlife habitat, old forest structure). Site planning and management should focus on maintaining biological legacies (e.g., coarse woody debris, snags, understory plants), maintaining connectivity between landscape and watershed reserves, providing for seasonal and critical wildlife habitats, and protecting special ecological elements (e.g., bear dens, endangered plants, small wetlands, etc.).

Socioeconomic planning seeks to create and implement plans that will generate wealth, provide sustainable livelihoods, distribute benefits and burdens equitably, and enhance cultural, community, and household wellbeing. Key elements include:

- Development of cultural and socioeconomic objectives based on collaborative assessment of socioeconomic conditions and community, sectoral, or organizational vision and goals.
- Land and resource use plans that support a variety of economic activities (formal and informal) and provide for cultural and social use opportunities.
- Resource use objectives for the managed landscape that best meet socioeconomic goals while recognizing ecosystem thresholds.
- Considering the tradeoffs and complementarities involved in allocating the managed landscape to different sectors and identify opportunities to reconcile differing land and resource uses.

Figure 5. EBM planning functions



- Fine-tuning plans by assessing the socioeconomic implications of proposed land uses and by developing new arrangements that will enable economic transitions.
- Development of institutional and planning arrangements through which communities and businesses seek to innovate and find new ways of generating wealth, for example by reconciling legislative and regulatory regimes with EBM goals and objectives, reducing barriers by sharing information and removing subsidies, developing protocols and agreements between communities and businesses which define roles and benefits and provide stable access to resources, building capacity by providing training and on-the-job learning, and supporting innovation through local means such as business incubators or government programs.

EBM planning is an interactive, ongoing cycle of four overlapping planning functions— assessment, design, integration and implementation (Figure 5) — at and across several scales (Table 4). EBM planning is interactive because it is rarely a sequential, step-by-step process: plan design and integration often require new assessments and consideration of planning at other scales. EBM planning is ongoing in the sense that, even when plans are finalized and implemented, adaptive co-management (see below) and monitoring will yield new information that over time will be used to revise resource policies and management objectives and targets, adjust resource harvest levels, and where necessary modify existing land use plans.

Table 4. Planning scales, processes, and outputs

Scale	Size (ha)	Map scale	Process	Outputs
Region	10,000,000 +	1:1,000,000 +	Policy making Institutional design Strategic development	Regional agreements and policies Regional economic strategies Regional land use strategies
Subregion/ Territory	500,000 to 5,000,000	1:100,000 to 1:250,000	Strategic planning (First Nations LUPs, LRMPs)	Strategic land use zoning/management direction Timber supply determination/allocation Community socioeconomic development plans Resource development planning First Nation/local community/business agreements
Landscape	30,000 to 100 000	1:50,000	Tactical planning (Sustainable Resource Management Plans, Forest Stewardship Plans)	Sustainable resource management plans Forest stewardship plans Landscape reserves Business and project plans Community–business partnerships
Watershed	1 000 to 50,000	1:20,000	Tactical planning (watershed planning)	Watershed reserves Resource use/development plans Business and project plans
Site	Less than 250	1:5,000	Site planning	Site ecosystem reserves Resource use or harvesting plans Business and project plans Site tenure/management plans

Assessment refers to the range of ecological, biophysical, cultural, and socioeconomic inventory and analysis that is carried out to develop information needed to engage in design, integration, and implementation at various planning scales, and also to monitor the outcomes of management activity. It comprises:

- *Context assessments*—pre-planning inventory and analysis performed to assess the ecological, institutional and economic character of the planning area, evaluate current ecological and human conditions, assess and forecast the impact that management practices may have on identified resource values.
- *Planning assessments*—field assessments and technical analyses performed to fill information gaps and develop information relevant to the management decisions at hand. They include cultural heritage impact assessment, ecosystem inventories, and terrain stability assessments.
- *Implementation and effectiveness assessments*—performance audits and research projects carried out to evaluate whether planning and management procedures are being followed and to monitor whether management practices achieving established objectives and targets.

Design is a creative step in EBM planning in which inventories, traditional, local and scientific knowledge, and technical analysis are synthesized to develop initial proposed plans. The goal is to develop draft plans that achieve ecological objectives on the one hand and provide for cultural, social, and economic objectives on the other. These initial designs provide a reference point for assessing the risks and trade-offs of alternative plans. Ecological design has two interrelated components. The first involves use of coarse filter, fine filter, and landscape conservation planning approaches to develop initial plans for protected areas, ecosystem reserves, and management of site retention as appropriate at each scale The second involves developing management objectives and targets that will maintain the ecological integrity and cultural values within landscapes, watersheds, and sites in the unprotected landbase. Design to meet community and socioeconomic objectives involves the

development of draft land use allocations, management objectives, community and business economic development strategies, and transition plans.

Integration is the process whereby planning participants and/or decision makers assess initial designs in relation to ecological, cultural, and socioeconomic objectives and targets, and engage in consultation or negotiation to develop final plans that address core EBM principles and goals (i.e., promote human wellbeing within the context of maintaining ecosystem functions and processes), achieve a balance among competing uses, and secure commitments and arrangements to support plan implementation.

I*mplementation* is the process of carrying out plans and may include: establishing protected areas, reserves, and retention and other land use zones; pursuing social and cultural activities and business operations; developing and engaging in adaptive co-management; monitoring and research; and pursuing transition strategies, capacity building, communication, and public education.

4.6 Monitoring and research

The recommendations of the planning processes and the outcomes of government-to-government negotiations between the Province and First Nations should be assessed against the objectives of EBM to see how well they meet the targets. Thereafter, regular monitoring and periodic assessment are required to determine progress toward the objectives and targets and to make any necessary course corrections.

In addition, a research program is need to fill major knowledge gaps and reduce uncertainty. The CIT report on the Scientific-Basis of Ecosystem-Based Management notes the lack of empirical studies of ecological thresholds in the region; the great uncertainty about the risk of loss of ecological integrity between very high and very low levels of disturbance; and the absence of information on ecological differences (especially at regional and subregional scales) between old forest and selectively harvested forest. For example, how does retention of stand-level attributes influence ecological integrity at the subregional level? How do different groups of organisms, elements, or processes respond to different retention amounts or patterns? Hence, what is the minimum percentage of stand-level retention necessary to maintain biodiversity?

The Hydroriparian Decision Guide draws attention to several important information needs:

- Rate-of-cut criteria in roaded and non-roaded watersheds to assure maintenance of hydroecological functions. Development of such criteria depends on a long term project that applies different cut rates (including zero harvest) to a set of comparable drainage basins and monitors water outputs.
- Criteria to identify reliably watersheds that are prone to yield excessive amounts of sediment if logged or roaded.
- How log jams change over time and the ecological and physical roles of various sizes of downed wood in small streams.
- Impacts of forestry operations on marine ecosystems.
- The extent of riparian forest, effective buffer widths, impacts of partial cutting, and the recovery time for riparian organisms.
- Natural levels of connectivity along streams, and the value of continuous strips of riparian vegetation as corridors.

Estimates of the range of natural variability (RONV) of structure and disturbance in forest ecosystems vary by up to 29% depending on author. They are also sensitive to choice of ecosystem classification, Price (2003) expressing greater confidence in SSPEM units and Banner (2003) in BEC variants and analysis units. The RONV of structure, disturbance, and composition of nonforest land ecosystems (notably alpine tundra and parkland) and of freshwater and marine ecosystems is unknown. Other major ecological knowledge gaps are: the location and status of at-risk or rare ecosystems and species

(land, freshwater, and marine); soil, water, and air quality; and the extent of conversion of riparian (freshwater and marine) ecosystems.

Sustainable harvest levels of timber, fish, and other living resources are not known; nor is the status of harvested populations of land animals and plants; nor (with respect to fishery species) are the relative impacts of harvesting, habitat loss or degradation, and climate change.

On the human side, the main knowledge gaps are:

- Sustenance sources and levels, food sufficiency, and the composition of the food supply.
- Local share of resources, local investment and infrastructure, and the financial strength of communities.
- Cultural practices and the location and condition of cultural features.
- Support networks.
- Gender equality and societal equity

4.7 Governance: institutions and policy instruments

To facilitate the transition to EBM and ensure its full implementation, the CIT Policy and Institutional Analysis recommended:

- A regional steering body that will, at a minimum: monitor and assess the implementation of EBM; resolve high level political disputes arising from the implementation of EBM; design the priorities and objectives for adaptive co-management; appoint members to other regional institutions; and oversee the implementation, ongoing practices, and evolution of EBM. With the appropriate composition and mandate, the regional steering body could also have decision-making authority over whether the EBM Planning Handbook (or its content) should be legally binding within the region and over revisions to CIT products or legal instruments that embody them.
- Territorial land use decision-making bodies that are co-jurisdictional in nature (i.e., involving at least equal decision-making authority between the Crown and First Nations), with significant staff support and sufficient resources. These bodies would have jurisdiction over approval of all land use plans (strategic, tactical, and operational) and tenures in the territory. Provincial representatives should be selected from diverse constituencies in the nonaboriginal community, including local government officials.
- An independent regional science body, to ensure that the best science is used throughout the EBM process. This body would manage the adaptive co-management of EBM, particularly the assessment, design, monitoring, evaluation, and adjustment of EBM, and provide technical support for EBM planning and monitoring. It would take responsibility for the revision of EBM standards (i.e., as set out in the EBM Planning Handbook or in regional level legal instruments implementing EBM) in light of its adaptive co-management activities These revisions would become effective unless the authoritative decision-making body decided otherwise.
- Ongoing public and private conservation financing, including the establishment of a Coast Opportunities Foundation.
- Making legally binding EBM objectives and management targets set out in the tables in the EBM Planning Handbook and contained in EBM plans. This includes the adoption of one or more of legal instruments to require the spatial application of risk thresholds and management targets from the EBM Planning Handbook through planning at the subregional (or territorial), landscape, and watershed levels.
- An independent dispute resolution body to support EBM implementation.

- An assessment of the analytical, financial, organizational, and human capacity requirements for implementing EBM in the region.

The CIT Wellbeing Assessment contrasted the widespread and unmistakable declines in populations of resource species—and the consequent imperative to reduce harvest levels—with the clear need of First Nations and the other local communities for resources for economic development. The region's resources may or may not be able to support both local and nonlocal enterprises. But until this can be shown, prudence and equity dictate that local businesses and communities be given first cut and a bigger share of timber and fishery licences. At the same time, local governments and other local bodies merit a greater say in the allocation and management of local resources; and, along with it, programmes to improve local management skills and expand knowledge of ecosystems, resources, and communities and monitor their status.

Accordingly, the Wellbeing Assessment endorsed the Policy and Institutional Analysis's recommendations on conservation financing, dispute resolution, capacity assessment, and an independent regional science body (with the provisos that it be responsible for monitoring and assessing the implementation of EBM, designing the priorities and objectives for adaptive co-management, and developing and managing a research program to reduce key uncertainties and fill major knowledge gaps).

However, instead of a regional steering body plus territorial decision-making bodies (which would impose an excessive amount of bureaucracy and inflate management costs), the WA proposed four subregional decision-making bodies—one each for Haida Gwaii/QCI, North Coast (Inner + Outer + Lower), Central Coast (Inner + Outer), and Mid Coast (mainland + Vancouver Island)—to ensure implementation of ecological protection, cultural security, economic development, and EBM planning. The four bodies would be mandated to cover marine as well as terrestrial ecosystems. Each would oversee the implementation, ongoing practices, and evolution of EBM and have jurisdiction over approval of all land and marine use plans and tenures in their subregion. The bodies would be co-jurisdictional in nature (i.e., involving at least equal decision-making authority between the Crown and First Nations), with significant staff support and sufficient resources. Provincial representatives should be selected from diverse constituencies in the nonaboriginal community, including local government officials. The WA also recommends making legally binding the consolidated set of EBM objectives and incorporating them in the mandates of the subregional decision-making bodies and the regional science body. The targets should also be binding—but, because they are likely to change with improved knowledge, should preferably be treated as regulations set by the decision-making bodies. Ways of achieving the objectives and targets should be flexible.

5. Reflections and recommendations

5.1 Independence

Reflections

The CIT's mandate called for it to provide "independent information on the region...", implying a distinction between "independent" and "dependent" knowledge. The latter was recognized as knowledge derived from or reflecting the perspective of a particular stakeholder, be it the provincial government, a First Nation, a forest products company, an environmental organization, or any other participant in the planning processes.

Two measures were taken to ensure that information was independent. The first measure was to ask all members of teams involved in the EBM guides and regional and subregional analyses to sign letters affirming that they would (a) contribute as independent individuals, unconstrained by the policies or positions of their employer, constituency, community, or interest group, and (b) disclose significant influences (including values, assumptions, judgements, sources, and methodology). Team members were genuine in their commitment to (a) but erratic in their implementation of (b).

The second measure was to subject the guides and analyses to independent peer review, following a procedure recommended by the Millennium Ecosystem Assessment. One aspect of the procedure that did not work well was nomination of reviewers by stakeholders in the assessment. In two cases this led the peer review chair to select (in good faith) reviewers who were not the most knowledgeable or who favoured the viewpoint of a stakeholder. We had to include additional criteria to ensure that reviewers were genuinely expert and independent.

The CIT successfully assured the independence of its information, particularly in comparison with other BC resource and land use planning processes, in which diverse stakeholders have complained that scientific products were unavailable or had been influenced or censored by the party commissioning the study. The constitution of the management committee (representatives of major interests involved in the planning processes—provincial government, First Nations, other communities, environmental NGOs, forest companies) ensured that no one interest had an overbearing influence on terms of reference or on signing off on final products. Furthermore, while the management committee played a role in providing quality control for CIT products (ensuring terms of reference were met, and suggesting but not dictating changes to improve final products), the teams retained authorship, suggestions could and were rejected (as also occurred with peer reviewer comments), and the management committee did not substitute content with its own. However, the makeup of the management committee also had its penalties. Achieving agreement on terms of reference or on a single set of review comments on draft products often required laborious discussion and slowed the process; and he need for consensus sometimes reduced clarity in the management committee's decisions or commentary.

In future assessments, it would be preferable to further increase independence by focusing the management committee more on management proper (fundraising, budgeting, oversight) and putting in place a small board of respected members of the various "knowledge communities" to guide the development of projects and review products for consistency.

The CIT's commitment to providing independent information and its efforts to honour that commitment were acknowledged by many participants in the planning processes. But it was easier to recognize independence when participants liked the message. When they disliked the message, it was not difficult to find fault with the messenger.

Unexpectedly, the mandate to provide independent information conflicted with the mandate to use knowledge from a diversity of sources—technical and traditional, as well as scientific (see next section). Partly, this was because independence was loosely (and naively) equated with "scientific", although scientists are human and have their points of view and biases. Partly, it was because

technical and practitioner knowledge seemed too close to the corporations and other interest groups from whence they came. To provide the most useful information possible for the social choices of planning processes and decision making, assessments should aim for neutrality and independence. At the same time—given that knowledge is value-rich rather than value-free—they should also try to accommodate multiple values.

Recommendations

R1. Establish an independent board to design and manage the information/assessment program. The board should consist of respected members of the various "knowledge communities", striving for a balance among the knowledge communities—science, humanities, technical/practitioner, and local—and within each community (e.g., biophysical sciences and socioeconomic sciences, aboriginal and nonaboriginal).

R2. Use methods of research and validation appropriate to each knowledge community. (Scientific research follows scientific procedures and is reviewed by scientists; other forms of investigation require different procedures and involve a different set of peers.) This implies at least one assessment by each knowledge community.

R3. Organize each assessment to minimize bias and reveal any bias that is unavoidable: (a) Ensure that information providers have explicit and detailed terms of reference that have been developed through a social choice process so that all values are identified in the questions or requirements. (b) If information or information providers come from a group that is likely to be affected by decisions based on the assessment, identify the group concerned (e.g., aboriginal, corporate, environmental). (c) Ensure both that the standard of "expertise" is appropriate for the knowledge community concerned and that information providers and "experts" meet the test of expertise for the questions they are asked to address (e.g., having operational expertise is appropriate for certain questions and not for others). (d) Ensure that the expectation is clearly and repeatedly made to information providers that the information be as free of bias as possible and that they document any and all assumptions and bias in methods and sources (creating this expectation through both signed independence forms and independent facilitation was key to maintaining a level of "neutrality" and credibility for the CIT products).

5.2 Knowledge communities

Reflections

The CIT's mandate called for it to use "the best available scientific, technical, traditional, and local knowledge". Thus it recognized four knowledge communities: "scientific" (knowledge held by biophysical and socioeconomic scientists), "technical" (knowledge held by professionals, practitioners, and technicians), "traditional" (knowledge held by aboriginal communities), and "local" (knowledge held by nonaboriginal communities).

The CIT used all four of these knowledge communities to some extent. However, the timetable imposed on the CIT, the ready availability of scientists, the relative ease with which their qualifications could be authenticated, and their apparent independence, favoured the use of the scientific community. Technical practitioners were harder to use without controversy because they were so closely associated with their sectors. In addition, some private sector (scientific and technical) information was proprietary and difficult to obtain.

Traditional knowledge posed five challenges:

a. First Nations' information on their traditional territory will be used to support their position in treaty negotiations. Some First Nations think they will put their case at risk if they reveal the information in advance.

b. Some information about especially spiritual sites or sites closely associated with the identity of a clan or household is highly sensitive and must not be made public.

c. Some information is not available to the First Nation as a whole but is owned by particular clans or families.

d. Aboriginal world views and knowledge classifications differ from those of science and may be difficult or impossible to integrate with science.

e. Time is required to observe rules of behaviour, negotiate with the owners of information, and grasp different world views and classifications—time that may not be available to an assessment.

Nonaboriginal local knowledge is easier to use, provided special provision is made to accommodate it—notably taking the time to identify sources of local knowledge and employ locally acceptable modes of investigation. Regrettably, we did not devote the time and resources required.

Recommendations

R4. Determine the time and resources required to engage aboriginal and nonaboriginal knowledge communities and budget the required time and resources.

R5. Use expert-based approaches to accommodate information from different knowledge communities. For example, local experts and practitioners, as well as scientists, can provide estimates of the status and trend of ecosystems and species and their contributions to human wellbeing. Several techniques exist for showing the convergence and variance of such estimates.

5.3 Geographical scope

Reflections

The CIT was formed to provide information for the subregional and First Nations planning processes on the Central and North Coasts and Haida Gwaii/QCI. Accordingly, it would have been reasonable to define the CIT's geographical scope as the areas covered by the subregional planning processes plus the traditional territories of the First Nations.

In addition, it was expected that each subregional and First Nations plan would benefit from a "regional" perspective. Given the aim of EBM, it was also expected that the region would be ecologically coherent.

Initially, however, both First Nations territories and ecological coherence were ignored. Instead, the region was assumed to the aggregate of the three subregional planning areas, thereby excluding much of the territory of the Kwakwala (and of other First Nations as well). It took several months for the management committee to agree on a more inclusive region. Partly this was because of disagreement over the definition of ecological coherence, which varied with the approach used, whether a terrestrial ecoregion, marine ecoregion, freshwater basin, or coastal basin. Partly it was because, however defined, the larger region required more time and resources to cover.

By the time the region was defined, many of the analyses had started and were unable to cover territory outside the three subregional planning areas.

Recommendations

R6. Define the geographical scope at the outset, making sure that all areas of concern to users of the information/assessment are included. Biophysical and socioeconomic coherence are desirable but less important than encompassing the territories of the users.

5.4 Substantive scope

Reflections

EBM is as applicable to marine as to terrestrial ecosystems. Moreover, in the coastal zone (such as the CIT region)—where marine/terrestrial interactions are a crucial aspect of ecological integrity and where local communities depend as much on the sea as on the land—marine ecosystems deserve as much attention as terrestrial ones. In addition, a wide range of socioeconomic factors make up human wellbeing and influence interactions between people and ecosystems. The main factors need to be addressed as well, and not just the economics of resource use.

However, the terms of reference of the three subregional planning processes restricted them to terrestrial resource issues; and a similar limitation was assumed for the CIT. Consequently, although the regional analyses attempted to cover marine as well as terrestrial ecosystems and adopted a broad view of human wellbeing, the EBM guides concentrated on terrestrial ecosystems and a cursory set of human issues.

Recommendations

R7. Design the information/assessment program to cover all ecosystems and all the main elements of human wellbeing.

5.5 Integration

Reflections

The EBM guides and the individual regional and subregional analyses were prepared independently of each other with little cross-fertilization. As a result, the EBM guides and the Wellbeing Assessment produced separate and somewhat different pictures of EBM, neither of which was fully addressed by the regional and subregional analyses. Instead, aspects of EBM were analyzed in a fragmented way, with no overall integration.

One reason for the lack of integration was the absence of a suitable framework. The CIT was mandated to produce a "framework for EBM that reflects the definition, principles, [and] goals of EBM... [including] a methodology that incorporates western science and traditional knowledge, as well as economic, social and community transition factors"[25]. This idiosyncratic concept of a framework was eventually translated into the EBM Framework, consisting of a definition of EBM, EBM principles, goals, and objectives, and key elements of EBM planning and implementation. At the same time, planning table participants produced a framework for the Wellbeing Assessment, consisting of a set of elements and objectives. Neither is dynamic in the sense of showing how the elements relate to each other, along the lines of Figure 6, the salient features of which are:

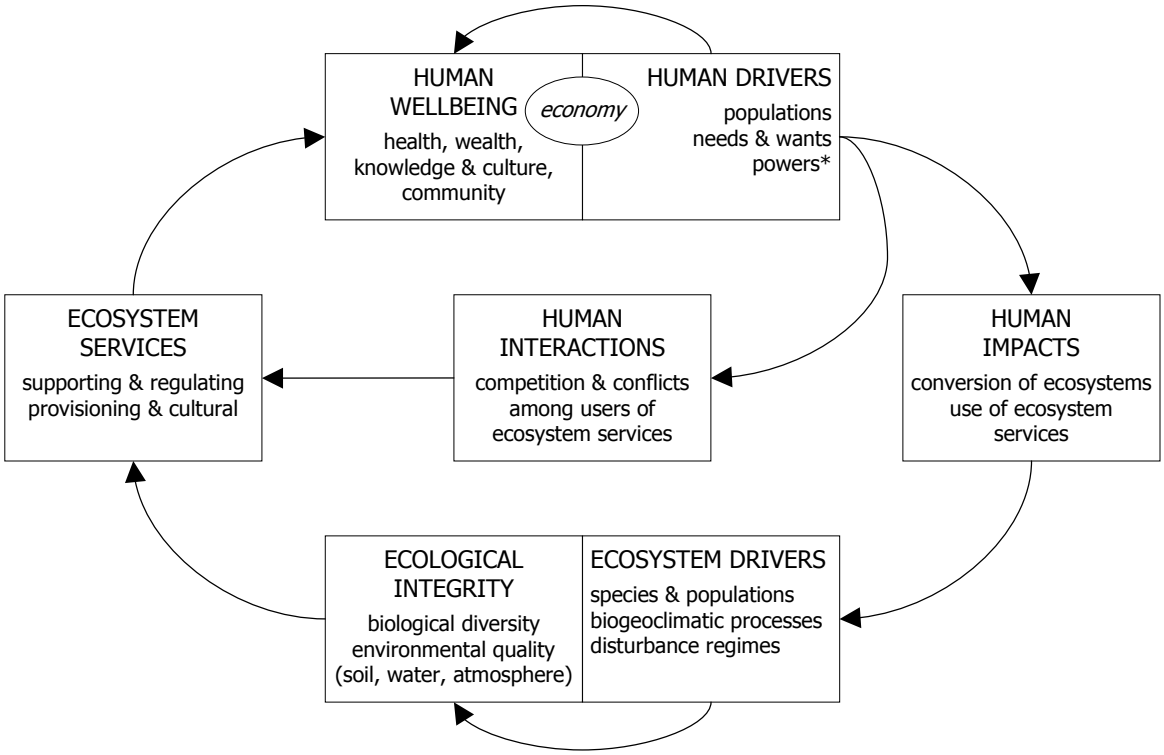
a. Ecological integrity is essential for the supply of ecosystem services. Supporting and regulating services include soil formation and regeneration, nutrient cycling, primary production, water regulation and purification, maintenance of resilience and adaptive capacity, the chemical balance of the atmosphere, and climate regulation. Provisioning and cultural services include the provision of food, fibre, and biochemicals and the supply of spiritual, recreational, and educational benefits.

b. Ecosystem services are vital for human wellbeing.

c. The economy is a set of human drivers (economic processes) that contribute to human wellbeing.

[25] Coast Information Team terms of reference.

Figure 6. EBM framework showing links between ecological integrity and human wellbeing.
* Powers include technology, money, knowledge, access, rights.



d. The main human drivers of change are populations, needs and wants, and powers (such as technology, money, knowledge, access, and rights).

e. Powers fuel competition and conflict among the users of ecosystem services and amplify the combined impact on the ecosystem of populations and their needs and wants.

f. Human drivers act on the ecosystem through conversion of ecosystems (to structures and cultivation) and through use of ecosystem services (such as resource use and pollution).

g. These impacts may be dampened or intensified by ecosystem drivers of change (species and populations, biogeoclimatic processes, disturbance regimes) to alter ecosystem conditions.

h. Hence, uses of ecosystem services strongly affect ecological integrity and hence the supply of services.

Ecosystem services, human drivers and interactions, human impacts, and ecosystem drivers are the links between ecosystem integrity and human wellbeing They are integrating elements. Including them in the assessment makes for an integrated analysis. Neglecting them leads to isolated treatments of ecosystem integrity on the one hand and human wellbeing on the other.

Another reason for the lack of integration was that integration was not built into the program. The EBM guides, Wellbeing Assessment, and spatial analyses were initiated and developed separately. Scenarios were not thought about deeply until the analyses were well advanced, by which time it was too late to change them. With hindsight, it is clear that the second step (after the adoption of a single dynamic framework) should have been to develop the set of objectives, indicators, and targets—as a combined exercise rather than the separate initiatives of the EBM Planning Handbook, Hydroriparian Planning Guide, and Wellbeing Assessment. The crucial role of objectives, indicators, and targets is that by elaborating the goals they clearly define what it is we want to achieve.

The third step should have been to define the data requirements for scenarios. Scenarios can chart *plausible* futures (alternative outcomes of different combinations of conditions, drivers, and responses) or they can chart *desirable* futures (alternative ways of achieving desired outcomes). The latter are more useful, and would have allowed us to explore with the planning tables alternative ways of achieving the objectives and targets. The data required to do this could have been provided by the regional analyses had they been designed accordingly. The fourth step, then, should have been to draw up the terms of reference of the spatial and other analyses to provide the required data.

Recommendations

R8. Adopt a dynamic framework, integrating ecosystem integrity and human wellbeing with their linking elements, such as ecosystem services, human impacts, human interactions, and drivers of change.

R9. Organize the information/assessment program according to the following steps: (i) adopt the framework; (ii) develop a set of goals, objectives, indicators, and targets; (iii) define the data requirements for scenarios that explore alternative ways of achieving the goals, objectives and targets; (iv) develop and implement projects to provide the data; (v) develop the scenarios; (vi) develop a strategy with the assessment users to achieve the preferred scenario.

R10. Work out the time and resource requirements for these steps. Go ahead with the program only when those requirements are assured. "Risk management" (i.e., starting without such assurance and trying to gain the time or resources while undertaking the program) does not work. If either the time or the resources is uncertain, consider a less ambitious program or none at all.

5.4 Strategy

Reflections

The least complete and integrated part of the CIT's work is the strategy. Strategy development was outside the CIT's mandate; the CIT was unable to develop the scenarios that would have guided the strategy; and the regional and subregional analyses that would have provided the building blocks for the strategy were not completed in time. Nonetheless, an integrated strategy is still needed. The following recommendations are specific to the north and central coast of BC (including Haida Gwaii/QCI).

R11. Establish the proposed decision-making bodies and regional science body. As well as moving forward with EBM planning, monitoring, and research, these bodies should address the other governance recommendations of the Policy and Institutional Analysis and Wellbeing Assessment.

R12. Work out the optimum configuration of terrestrial and marine protected areas to meet EBM ecosystem and species targets. Supporting information required for this includes: incorporation of the EBM subregional and landscape ecosystem and species targets into the spatial analysis; analysis of connectivity between protected areas and an examination of their size, configuration, and management; identification of ecosystem types and special elements that are insufficiently protected; comprehensive occurrence data on special elements; integration of terrestrial, nearshore marine, and offshore marine assessments into a single analysis. Also desirable: alignment of terrestrial classification systems; temporal and cross-scale modelling.

R13. Propose a strategy to maintain and secure access (by both First Nations and nonaboriginal communities) to cultural features. Supporting information required for this includes: comprehensive mapping of cultural features; analysis of the biocultural diversity of local food supply, components at risk, and how to maintain them; analysis of a culture of EBM

and sustainability (i.e., what are the cultural characteristics that would internalize and reinforce commitment to human wellbeing while maintaining ecological integrity, which characteristics existed or persist within aboriginal and nonaboriginal communities, and how can such characteristics be fostered).

R14. Work out an economic development strategy. Supporting information required for this includes: a global review of the characteristics of a sustainable economy (one that maintains ecological integrity while delivering human wellbeing); analysis of the level of economic activity (e.g., jobs, government revenue, community revenue, nonmarket activity) needed to achieve human wellbeing; analysis of the economic opportunities and strategies that can be pursued within EBM constraints under evolving market and policy conditions.

Appendix 1. Ecological objectives, indicators, and targets

Objective	Level	Indicator: target	Basis of target
1. Conversion of land, freshwater, and marine ecosystems is limited; converted ecosystems are kept in good condition	subregion/territory	1.a. Land ecosystem conversion to a built or cultivated state: less than 6% of total land area	curve based on performance of 180 countries (less than 6% = performance of 13% of countries)
	subregion/territory	1.b. Coastal ecosystem conversion to structures or aquaculture: less than 6% of total shore length	land conversion target (1.a.)
2. The natural diversity of land, freshwater, and marine ecosystems, and of ecosystem functions and structures, is maintained	subregion/territory	2.a.i. Proportion of old seral in each ecosystem type: at least 70% of natural	= 30% loss threshold: theoretical point at which habitat patches start to become isolated (supported by some empirical evidence)
	landscape	2.a.ii. Proportion of old seral in each ecosystem type: at least 50% of natural (across all landscapes, apply the subregional target [2.a.i.])	relaxed version of subregional target (2.a.i.)
	watershed	2.a.iii. Proportion of old seral in each ecosystem type: at least 30% of natural (across all watersheds, apply the landscape target [2.a.ii.])	relaxed version of landscape target (2.a.ii.)
	landscape, watershed	2.b. Mid seral proportion of each forest ecosystem type: less than 50%	expert opinion
	subregion/territory	2.c.i. Natural riparian forest next to estuaries or in karst landscapes: at least 97% of natural 2.c.ii. Natural riparian forest next to floodplains, fans, forested swamps, and small steep streams or gullies with unique microclimate: at least 90% of natural 2.c.iii. Natural riparian forest next to other aquatic ecosystems: at least 70% of natural	expert opinion
	watershed	2.c.iv. Natural riparian forest next to estuaries or in karst landscapes: at least 90% of natural (across all watersheds, apply the subregional target [2.c.i.]) 2.c.v. Natural riparian forest in the source zone: at least 70% 2.c.vi. Natural riparian forest next to floodplains, fans, forested swamps, and small steep streams or gullies with unique microclimate: at least 50% of natural (across all watersheds, apply the subregional target [2.c.ii.]) 2.c.vii. Natural riparian forest next to other aquatic ecosystems: at least 30% of natural (across all watersheds, apply the subregional target [2.c.iii.])	expert opinion
	subregion/territory	2.d. Undisturbed proportion of each shore ecosystem type: at least 70%	riparian forest target (2.c.iii.)
	watershed	2.e. Reserved proportion of wetlands, active floodplains, active fluvial units, high value fish habitat, riparian forest around streams in the transportation and deposition zones, including buffer (= 1.5 times the height of the dominant trees): 100%	expert opinion
	watershed	2.f. Equivalent clearcut area: less than 20% of a roaded watershed and less than 30% of an unroaded watershed	20% = recorded 1%/year rate-of-cut threshold averaged over 20 years; 30% based on expert opinion
	site	2.g. Retained proportion: 15%–70% depending on watershed risk targets and site objectives	expert opinion
	site	2.h. Biological legacies (e.g., wildlife trees, snags, coarse woody debris, understory vegetation): maintain	expert opinion

Objective	Level	Indicator: target	Basis of target
3. The diversity of land, freshwater, and marine ecosystems is represented in a system of protected areas; and at risk and rare ecosystems are protected	subregion/territory	3.a. Protected proportion of each ecosystem type: at least 20% (weighted by size of protected area)	international target of 10% (not weighted by size of protected area); performance of top 10% of countries
	subregion/territory, landscape, watershed	3.b. Protected proportion of endangered (red-listed) or globally rare ecosystems (including plant communities): 100%	expert opinion
	subregion/territory, landscape, watershed	3.c. Protected proportion of vulnerable (blue-listed) or regionally rare ecosystems (including plant communities): at least 70%	expert opinion
4. Viable populations of all native species and genetic variants are maintained across their natural range together with their habitats; habitat connectivity is maintained	subregion/territory	4.a. At-risk species: less than 2% of all species in a phylum (division) or class	estimated background rate of extinction less than 0.01% per century (Reid & Miller 1989); background % of species at risk assumed to be less than 200 times extinction rate or less than 2%
	subregion/territory	4.b. Introduced species: less than 6% of all species in a phylum (division) or class	triple the at risk % point (target 4.a.) because introduced species account for at least a third of known causes of species loss (UNEP World Conservation Monitoring Centre 1992)
5. At-risk, rare, and focal species and their habitats are protected	subregion/territory, landscape, watershed	5.a. Protected proportion of the habitats of endangered (red-listed) or globally rare species: 100%	endangered or globally rare ecosystem protection target (target 3.b.)
	subregion/territory, landscape, watershed	5.b. Protected proportion of the habitats of vulnerable (blue-listed) or regionally rare species: at least 70%	vulnerable or regionally rare ecosystem protection target (target 3.c.)
	subregion/territory, landscape, watershed	5.c. Protected proportion of the habitats of focal species: at least 20% (weighted by size of protected area) or at least 16% unweighted	representative ecosystem protection target (target 3.a.)
6. Soil productivity is conserved and soil degradation is close to natural rates	watershed	6.a.i. Reserved proportion of areas with class V slope stability: 100%	expert opinion
	site	6.a.ii. Reserved proportion of areas with moderate to high risk of slope failure: 100%	expert opinion
	site	6.b.i. Permanent access structures: no more than 7% of cutblock area 6.b.ii. Other detrimental site disturbance: no more than 5% of cutblock area	expert opinion
7. Water quality is close to natural levels	landscape	7.a. Total nitrogen per litre: less than 0.30 milligram	UNECE draft water quality class I (excellent)
	landscape	7.b. Total phosphorus per litre: less than 0.010 milligram	UNECE draft water quality class I (excellent)
	landscape	7.c. pH: more than 6.5	UNECE draft water quality class I (excellent)
	landscape	7.d. Calcium carbonate per litre: more than 200 milligrams	UNECE draft water quality class I (excellent)
	landscape	7.e. Turbidity: less than 10 nephelometric turbidity units (NTU)	BC water quality guidelines maximum for aquatic life if background is ≤ 8 NTU
	landscape	7.f. Temperature: 3.3–12.0 °C	Minimum and maximum of lowest optimum temperature range for salmon life stages (migration, spawning, incubation, rearing)
	landscape	7.g. Arsenic per litre: less than 5 micrograms	UNECE draft water quality class I (excellent)
	landscape	7.h. Cadmium per litre: less than 0.03 microgram	UNECE draft water quality class I (excellent)
	landscape	7.i. Chromium per litre: less than 0.5 microgram	UNECE draft water quality class I (excellent)
	landscape	7.j. Copper per litre: less than 1 microgram	UNECE draft water quality class I (excellent)

Objective	Level	Indicator: target	Basis of target
	landscape	7.k. Nickel per litre: less than 7.5 micrograms	UNECE draft water quality class I (excellent)
	landscape	7.l. Lead per litre: less than 0.05 microgram	UNECE draft water quality class I (excellent)
	landscape	7.m. Zinc per litre: less than 22 micrograms	UNECE draft water quality class I (excellent)
8. The chemical balance of the atmosphere is restored and local air quality is maintained	landscape	8.a. Annual mean ambient air concentration of nitrogen dioxide: less than 40 micrograms per cubic metre	World Health Organization guideline
	landscape	8.b. Annual mean ambient air concentration of sulphur dioxide: less than 25 micrograms per cubic metre	BC level A
	landscape	8.c. Annual mean ambient air concentration of ground-level ozone: less than 15 micrograms per cubic metre	half the Canada maximum acceptable level
	landscape	8.d. Annual mean ambient air concentration of fine particulates (PM_{10}): less than 25 micrograms per cubic metre	point at which there is a 2% increase in mortality (World Health Organization 2000)
9. The diversity and abundance of resource species and their habitats are maintained; all harvesting is sustainable	subregion/territory, landscape	9.a.i. Fishery populations of conservation concern: less than 6% of all populations of a resource species 9.a.ii. Timber populations of conservation concern: less than 6% of all populations of a resource species	triple the species at risk % point (target 4.a.) because stocks and populations more likely than species to be at risk
	subregion/territory, landscape	9.b. Proportion of harvesting that is sustainable: 100%	expert opinion (logic of objective)

Appendix 2. Human objectives, indicators, and targets

Objective	Level	Indicator: target	Basis of target
1. Populations are stable and sustainable	subregion/territory	1.a. Annual population change: less than 0.5%	performance of top fifth of countries; 0.5% per year = a doubling/halving time of 138 years
2. People enjoy long lives in good spiritual, mental, and physical health	subregion/territory	2.a.i. Average life expectancy at birth: more than 75 years	performance of top fifth of countries; 75 years = UN target for all countries by 2015
	subregion/territory	2.a.ii. Gender difference in life expectancy:	
	subregion/territory	2.b.i. Deaths from self-destructive behaviour: less than 8% of all causes of death	performance of top fifth of Local Health Areas in British Columbia
	subregion/territory	2.b.ii. Gender difference in % deaths due to self-destructive behaviour:	
	subregion/territory	2.b.iii. Aboriginal/nonab. difference in % deaths due to self-destructive behaviour:	
	subregion/territory	2.c. Deaths of children under 5 years: below 20 deaths per 1,000 live births	performance of top quarter of countries
	subregion/territory	2.d. Aboriginal/nonab. difference in infant mortality rate:	
3. Income and sustenance levels are sufficient for people to meet their needs, achieve security, and pursue opportunities	subregion/territory	3.a.i. Average employment income per person per year: at least 3 times the "single low income measure" ($8,323 in 2000)	performance of top fifth of Local Health Areas in British Columbia
	subregion/territory	3.a.ii. Gender difference in annual employment income:	
	subregion/territory	3.a.iii. Aboriginal/nonab. difference in annual employment income:	
	subregion/territory	3.b.i. Proportion of population with low income: below 12%	performance of top fifth of Local Health Areas in British Columbia
	subregion/territory	3.b.ii. Gender difference in low income population (% total population):	
	subregion/territory	3.b.iii. Aboriginal/nonab. difference in low income population (% total population):	

Objective	Level	Indicator: target	Basis of target
	subregion/territory	3.c. Proportion of households owning their dwelling: at least 79%	performance of top fifth of Local Health Areas in British Columbia
4. Local people have a fair share of local resources; businesses are diverse and profitable; investment and infrastructure are sufficient for future prosperity	subregion/territory	4.a. Local share of local resources: at least 50%	equity
	subregion/territory	4.b. Non-resource-sectors' share of the economy: more than 80%	performance of top quarter of Local Health Areas in British Columbia
	subregion/territory	4.c. Resource sectors diversity index: more than 5.75	logic of objective: 5.75 = 6 sectors with slightly unequal %s
	subregion/territory	4.d. Annual change in number of business establishments: 0% or an increase	logic of objective: nondeclining business viability
5. People have the knowledge to maintain ecosystem integrity and achieve high levels of human wellbeing	subregion/territory	5.a. Ecosystem objectives fully represented by reliable indicators: more than 80%	logic of objective: good knowledge of ecosystem integrity
	subregion/territory	5.b. Human objectives fully represented by reliable indicators: more than 80%	logic of objective: good knowledge of human wellbeing
6. Education and skill levels are high; knowledge is transmitted to all members of society	subregion/territory	6.a.i. Education attainment index: more than 70	logic of objective: 70.8 = two-thirds grades 9-12 with secondary school graduation certificate, one-third with tertiary (equal mix of levels)
	subregion/territory	6.a.ii. Gender difference in education attainment index:	
	subregion/territory	6.a.iii. Aboriginal/nonab. difference in education attainment index:	
	subregion/territory	6.b.i. Combined primary, secondary, and tertiary school enrollment: more than 80% of the population aged 5–24	performance of top fifth of countries
	subregion/territory	6.b.ii. Gender difference in combined primary, secondary, and tertiary school gross enrollment rate (ages 5-24):	
	subregion/territory	6.b.iii. Aboriginal/nonab. difference in tertiary school gross enrollment rate (ages 19-24):	
	subregion/territory	6.c. Proportion of population affirming a very important role for family and elders in passing on traditions and values: more than 80%	matches school enrollment target (6.b.i.)
7. Cultural practices that promote ecosystem integrity and human wellbeing are strengthened and maintained; culturally significant places are secured	subregion/territory	7.a. Participation in cultural events and activities (weighted for frequency): more than 60%	top fifth of linear 0-75 scale
	subregion/territory	7.b. Proportion of culturally significant places secured for the cultural values concerned: at least 70%	vulnerable or regionally rare ecosystem protection target (target 3.c.)
8. Aboriginal title and rights and the rights of all members of society are fully respected; decisions are shared by the community; decision-making bodies are open, clean, effective, and learn from experience	subregion/territory	8.a. Level of respect for aboriginal title, right to self-government, right to decision making on resource use, sacred and spiritual rights: completely respected	logic of objective
	subregion/territory	8.b. Proportion of the population agreeing that there is equal treatment by the police and justice system, equal opportunity to earn a decent living, and freedom of belief and expression: more than 80%	top fifth of linear 0-100 scale
	subregion/territory	8.c. Local governance index (proportion of the population stating that local organizations have some–a lot of weight in decisions on local resources, local officials are doing a good–very good job in representing community interests, local government is open and clean, and they trust local officials): more than 80%	top fifth of linear 0-100 scale
	subregion/territory	8.d. Gender composition of local government:	

Objective	Level	Indicator: target	Basis of target
9. Communities coexist peacefully, are secure from crime and violence, and have strong support networks	subregion/territory	9.a. Homicide rate (homicides and attempted murders per 100,000 people): below 5	performance of top third of countries (and top 71% of BC jurisdictions)
	subregion/territory	9.b. Sexual assault rate (sexual assaults per 100,000 people): below 10	performance of top two-thirds of countries (and top 96% of BC jurisdictions)
	subregion/territory	9.c. Robbery rate (robberies per 100,000 people): below 20	performance of top 40% of countries (and top 55% of BC jurisdictions)
	subregion/territory	9.d. Assault rate (assaults per 100,000 people): below 100	performance of top half of countries (and top 1% of BC jurisdictions)
	subregion/territory	9.e. Abduction rate (abductions per 100,000 people): below 5	performance of top 84% of BC jurisdictions
	subregion/territory	9.f. Spousal assault rate (spousal assaults per 100,000 people): below 100	performance of top 15% of BC jurisdictions
	subregion/territory	9.g. Break and enter incidents per 100,000 people: below 700	performance of top 18% of BC jurisdictions
	subregion/territory	9.h. Drug offences (except cannabis) per 100,000 people: below 25	performance of top 25% of BC jurisdictions
	subregion/territory	9.i. Impaired driving incidents per 100,000 people: below 300	performance of top 16% of BC jurisdictions