

Old forest remnants contribute to sustaining biodiversity: The case of the Albert River valley

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Abstract

The Albert River valley hosts the only old-growth stands of western redcedar in the Invermere Timber Supply Area (TSA). This portion of the Interior Cedar Hemlock moist cool (ICHmk1) biogeoclimatic variant is spatially disjunct from the rest of the ICHmk1 in British Columbia and lies on calcareous soil. Surveys of lichens and vascular plants in the valley bottom of the Albert River revealed an uncommonly rich area, including about 10% of the vascular plant species known to British Columbia. Eight of these are either Blue- or Red-listed in the province. Nine of the lichens found are either new to North America, western North America, or British Columbia, and seven may be new to science. Four more species have a predominantly oceanic distribution, and one is mainly Arctic. Conserving remnants of old-growth forest from forest harvest can play a critical role in sustaining biodiversity, particularly those in rare and poorly represented ecosystem types, so these areas merit careful consideration in the designation of reserves. Such significant remnants are easily overlooked when assessment of potential conservation areas is restricted to coarse-scale approaches that focus on intact landscapes. Coarse-filter approaches can identify potential rare ecosystems and guide field surveys, but are no substitute for field surveys.

KEYWORDS: *biodiversity, coarse filter, conservation area, ecosystem representation, fine filter, forest management, old-growth remnants.*

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Introduction

A well-supported strategy for conservation in forested landscapes is to ensure that a full range of ecosystem types is well represented in the conservation areas of the management unit (Dasmann 1972; United Nations Education, Scientific and Cultural Organization 1974; Austin and Margules 1986; Pressey *et al.* 1993; Noss and Cooperrider 1994). We use the term “management unit” generically, recognizing that resource planners must consider a variety of scales from site prescription to the entire tenure and address other significant units throughout this planning (e.g., Landscape Units and Biogeoclimatic Ecosystem Classification [BEC] units). Conservation areas include formally protected land (e.g., parks and ecological reserves) and areas reserved from harvest within sustainable forest management plans. The permanence of the latter can shift with changes in operability or more refined analysis of representation of ecosystem types in the management unit (e.g., Bunnell *et al.* 2003).

Analysis of ecosystem representation for an area typically divides the landscape into ecosystem types and identifies those that are under-represented (see Huggard [2004] for a full explanation of this process). The analysis can be used to select conservation areas in under-represented ecosystems and preserve them from harvest. According to Arcese and Sinclair (1997), Lindenmeyer and Franklin (2002), Huggard (2004), and Wells *et al.* (2004), this “coarse-filter” approach in planning forest practices has three main functions:

1. it acts as a buffer against any errors committed on the harvested portion;
2. it sustains poorly known ecological functions and many species whose specific habitat requirements are unknown; and
3. it provides an ecological baseline in conservation areas to compare with managed landscapes.

Given projected vegetation shifts with climate change, effective management outside of formal protected areas will become increasingly important to species shifting their distributions as ecosystems change (Noss 2001; Hannah *et al.* 2002).

About two-thirds of British Columbia (95 million hectares) is forested and 3.6 million hectares (5.7%) are protected by provincial and national parks (B.C. Ministry of Forests and Range 2004). Some ecosystems are greatly under-represented within the formal protected areas network; for example, those that lie at valley bottoms or in areas in direct conflict with human

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development (Bunnell *et al.* 2003; B.C. Ministry of Forests and Range 2004; Wells *et al.* 2004). To ensure adequate representation of unharvested forest ecosystem types, additional habitat protection from harvest is required in many regions. Selecting such reserves requires careful consideration of which ecosystem types are well represented in protected areas and areas otherwise constrained from forest harvesting.

While representativeness is the key criteria for establishing new protected habitat, other criteria may be used to determine the potential value of a proposed conservation area in forested land. In general, larger mature forests, well distributed across the landscape with more interior habitat, fewer edge effects, and less impacts from development activities, such as harvesting or grazing, are considered more desirable (Margules and Pressey 2000; Huggard 2004). Areas that contain a high number of rare and endangered species, or potential habitat for these species, should also be prioritized (Margules and Pressey 2000; Groves *et al.* 2002).

The British Columbia Conservation Data Centre (BCCDC) (B.C. Ministry of Environment n.d.) maintains lists of rare, endemic, and endangered species of the province. Forest managers often presume that unless an area is officially designated by the government for hosting species of concern, it has no high priorities for conservation. Further, because of the costs associated with collecting additional field data, choosing additional conservation areas to complement what already exists in a forest management unit often relies solely on coarse-scaled Geographic Information System (GIS) data. Pre-harvest fine-scaled data collection, which is needed to locate occurrences of rare species communities, is frequently lacking. The cheaper GIS-based approaches more commonly employed can miss potentially high-value habitat that does not meet desired criteria for forest continuity or size, but does contain rare species assemblages. In particular, fragments of remnant old-growth forest

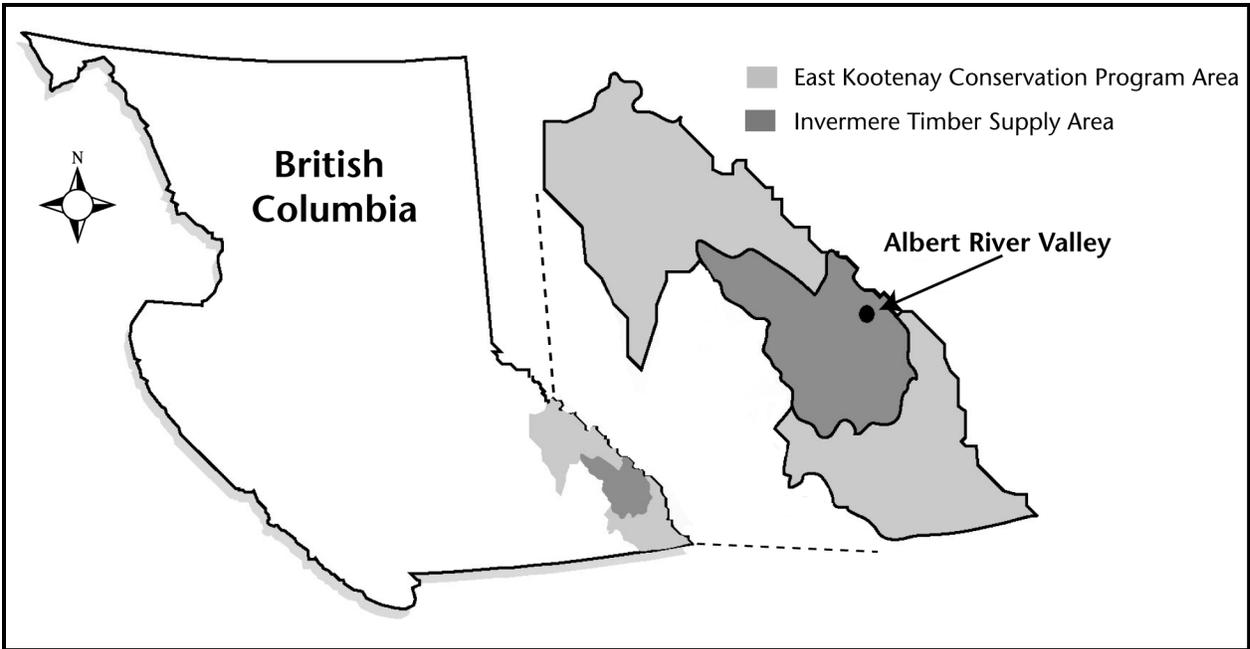


FIGURE 1. Boundaries of the East Kootenay Conservation Program (EKCP) area and the Invermere TSA in southeastern British Columbia.

within an otherwise disturbed environment can be important refugia for rare plant communities that are dependent on late-seral conditions (Bratton 1994; Meier *et al.* 1995; Moola and Vasseur 2004).

We examine the role of species community data in the evaluation and selection process for forest reserves. Specifically, we report on the high richness of lichen and plant species found within the Albert River valley—a fragmented, interior old-growth rainforest located in the Interior Cedar Hemlock (ICH) biogeoclimatic zone (Meidinger and Pojar [editors] 1991) of the Invermere Timber Supply Area (TSA). These data were collected as part of a larger study on lichen associations with woody substrates in four BEC zones (e.g., Bunnell *et al.* 2007, [2008]; Houde *et al.* 2006). Using the findings in the Albert River valley as a case study, we discuss the importance of small forest remnants to biodiversity, particularly how these areas are considered when evaluating the need to set aside conservation areas.

This paper illustrates the importance of field surveys in assessing the value of old-growth forest remnants in sustaining biodiversity. Many regulations, policies, and approaches are applicable to selecting appropriate stands. We do not discuss all of these, but do report what has happened in the example presented.

Study Area and Methods

The Albert River valley is located within the Invermere TSA in southeastern British Columbia (Figure 1). The TSA includes five forested BEC zones: Engelmann Spruce–Subalpine Fir, Mountain Spruce, Interior Douglas–fir, Ponderosa Pine, and Interior Cedar–Hemlock. Interior Cedar–Hemlock forests are scarce in the TSA, and only 5% of the area is in this zone (238 995 ha). In the Rocky Mountains, the Albert River flows at low elevation (< 1100 m) in the cool moist variant (mk1) of the ICH zone. The valley bottom is a mosaic of 20–60-year-old stands and patches of remnant old-growth forest dominated by western redcedar (*Thuja plicata*) and hybrid white spruce (*Picea glauca* × *engelmannii*). The east side of the Columbia River valley, including the Albert River valley, is underlain by limestone that increases soil pH. Some portions of the old-growth remnant forest within the Albert River valley are candidates for old-growth management areas (OGMAS) for the Invermere TSA. The rarity of ICH forests in the TSA, the old age of the remnant forest, the calcareous soil, and our initial sampling of the Albert River valley all indicated the area warranted study.

The project was part of a larger study evaluating species accounting systems for the East Kootenays (see

Vernier and Bunnell [2007] for examples of a species accounting system). One aspect of the work related lichens to specific substrates commonly modified by forest practices within old stands of four BEC zones (Houde *et al.* 2006). A sampling protocol was established to focus on microsites whose lichen assemblages were likely indicators of environmental conditions at different successional stages. These included trunks and branches of mature trees, overhanging tree trunks, snags (lowest 1.8 m), rotten logs, and branches of large forest floor shrubs. Three individuals of each microsite or substrate type were sampled at each sample site (when available). For each, a full inventory was made of all macrolichen and microlichen species. The cover of each lichen species was estimated in percent relative to the area sampled. Specimens that could not be identified were collected for identification in the laboratory.

In 2004, species experts Curtis Björk, Toby Spribille, and Trevor Goward (Curator of Lichens, University of British Columbia, Botany Department) noted that, compared to other studies in similar ICH forests of the Kootenays, the Albert River valley had unusual species richness. Thus, in 2005–2006, we further assessed species richness of lichens and vascular plants in the valley.

To evaluate species richness, we employed a modified rapid assessment procedure (RAP) developed and used by Conservation International and the Smithsonian Institution/Monitoring and Assessment of Biodiversity Program (e.g., Alonso *et al.* [editors] 2001). RAPs were developed to effectively use scarce expertise over large and scattered areas. Our modifications included:

- limiting the focus to vascular plants and lichens, and
- focussing lichen sampling on the major substrates identified in 2004 (Bunnell *et al.* 2005).

During a second visit in 2005, C. Björk and T. Spribille searched out and identified species over 8 hours. Unknown lichen and plant species were collected for subsequent laboratory identification. In 2006, 8 hours of searches conducted by T. Spribille allowed us to collect more specimens of rare and unknown lichens to help document their microsites. Because the objective was to provide an initial species list for the Albert River valley bottom, searching was opportunistic, relying on expert opinion to best encompass the area. Searching included one old-growth redcedar stand (49 ha), one old-growth spruce stand (67 ha), and the adjacent river banks for a distance of 5 km (Figure 2).

Results

We found at least 109 lichen species in the Albert River valley (Houde *et al.* 2006: Appendix 7). Some were found on substrates such as humus, pebbles, soil, turned-over roots, and plant detritus. Consistent with our concentration on epiphytic lichens, about 90% of the species identified were found on bark or wood. We also found 236 species of vascular plants (Houde *et al.* 2006: Appendix 8).

Seven lichen species appear new to science. A further three species are first records for North America and six are new to British Columbia (Table 1). Two species, *Bacidina chlorotricula* and *Schismatomma pericleum*, are otherwise known only from eastern North American hardwood forests (Tehler 1993; Ekman 1996). *Lecidea carnulenta*, a poorly known species described from New England, may represent a third species, but more detailed comparisons are needed.

The BCCDC has not estimated status of lichen taxa for the province; however, several of the species we found in the Albert River valley are rarely documented. For instance, *Biatora hypophaea* is known from only one other published record in British Columbia (Printzen and Tønsberg 1999).

The occurrence of several species of oceanic macrolichens is also noteworthy. *Lobaria scrobiculata*, *Nephroma isidiosum*, *Pseudocyphellaria anomala*, and *Stictia fuliginosa* are all cyanolichens¹ that can only survive in sufficiently humid conditions. Thus, they are typically coastal species, and uncommon to rare in inland British Columbia. Their occurrence in the Albert River valley represents the easternmost localities known for these taxa in western Canada. This suggests the persistence of continuously cool, moist conditions capable of sustaining habitats comparable with local “rainforest islands” (see also Goward and Spribille 2005).

We found several lichens that cannot be assigned to any known species. Five of these, which have provisionally been assigned numbers within their respective genera (*Agonimia* sp. 1, *Bacidina* sp. 1, *Cliostomum* sp. 1, *Lecanora* sp. 1, and *Pertusaria* sp. 2), are also known from other sites in inland British Columbia, but are infrequent to rare (with the exception of the *Lecanora* sp. 1). *Lecanora* sp. 1 is described as *Bellemerrella ritae* (Perez-Ortega and Spribille [2007]), and *Bacidina* sp. 1 is discussed in a

¹ Species associated with a cyanobacterium as a photosynthetic partner.

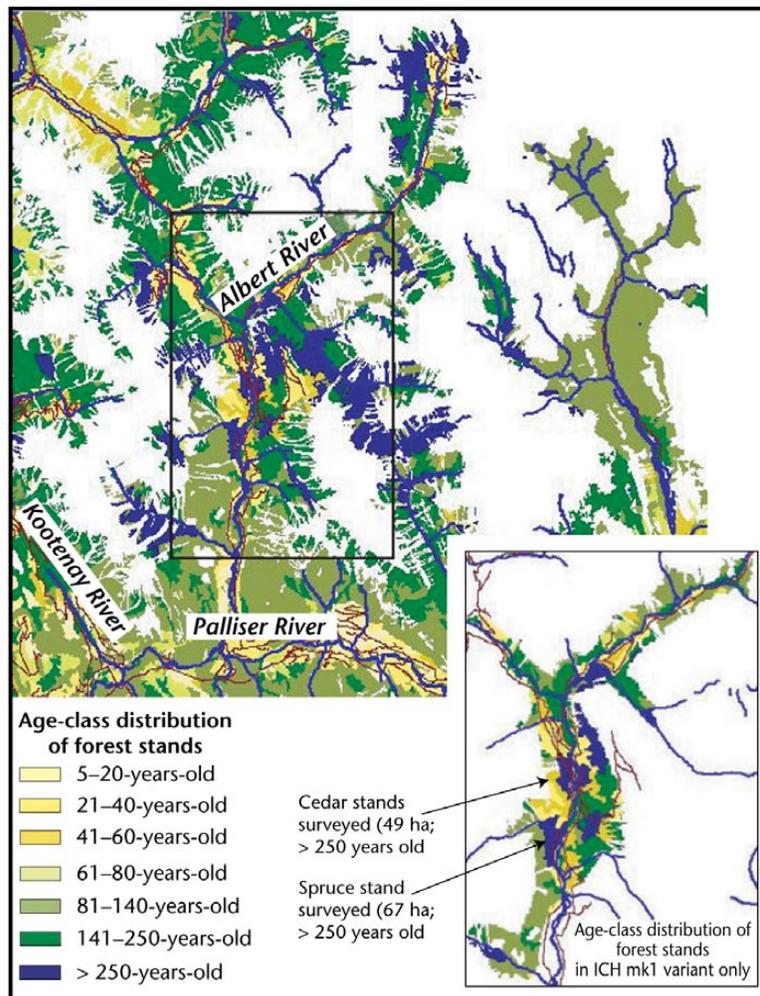


FIGURE 2. Age class distribution of forest stands in the Albert River valley for all forested bec zones and in the ICHmk1 variant only. Forest cover data are from January 2003. Red lines indicate logging roads. Age classes were determined by the forest cover data.

forthcoming paper by Spribille *et al.* [n.d.]. *Micarea* sp. 1, a species related to *Micarea synotheoides*, may be restricted to old-growth forests (Spribille 2006). A seventh species is a small macrolichen that is described as *Santessoniella saximontana* (Spribille *et al.* 2007). It occurs on the bases of trees and plant detritus on forest edges. Unlike the other species, it is currently known only from the single site in the Albert River valley, with a similar species known only from Japan. This occurrence is notable. *Santessoniella* is a rarely documented genus anywhere in the world and contains relatively few species (Henssen 1997).

Among the vascular plants, an unidentifiable *Cerastium* species appeared to fit in the *C. alpinum/C. arcticum* complex, otherwise unknown in western North America. Six species are Blue-listed and two are Red-listed in British Columbia (British Columbia Ministry of Environment. n.d.; Table 1).

In addition to the rare taxa, in the valley bottom (elevation < 1100 m) we found 11 species of vascular plants and one lichen species typically occurring at high elevations or in cold climates (Table 1). We attribute the latter finding to a flow of cool air draining into the valley bottom, creating microclimates where Arctic-alpine/subalpine species can survive.

TABLE 1. Rare and new taxa of lichens and vascular plants found in the Albert River valley, British Columbia, 2004–2006

Lichens ^a	Vascular plants
SPECIES NEW TO SCIENCE	
<i>Agonimia</i> sp. 1	
<i>Bacidina</i> sp. 1 (Spribille <i>et al.</i> , ined.)	
<i>Cliostomum</i> sp. 1	
<i>Lecanora</i> sp. 1 (' <i>schizochromatica</i> '; Perez-Ortega and Spribille, ined.)	
<i>Micarea</i> sp. 1	
<i>Pertusaria</i> sp. 2	
<i>Santessoniella saximontana</i> (Spribille <i>et al.</i> , ined.)	
SPECIES NEW TO NORTH AMERICA	
<i>Arthonia ligniariella</i>	
<i>Lepraria eburnea</i>	
<i>Micarea micrococca</i>	
SPECIES NEW TO BRITISH COLUMBIA	
<i>Arthothelium orbelliferum</i>	
<i>Bacidina chlorotricula</i>	
<i>Caloplaca sinapisperma</i>	
<i>Clauzadea monticola</i>	
<i>Lecidea</i> cf. <i>carnulenta</i>	
<i>Schismatomma pericleum</i>	
HIGH-ELEVATION SPECIES (ARCTIC-ALPINE/SUBALPINE)	
<i>Caloplaca tirolensis</i>	<i>Agrostis thurberiana</i>
	<i>Eurybia pygmaea</i>
	<i>Minuartia rubella</i>
	<i>Minuartia stricta</i> ^b
	<i>Poa alpina</i>
	<i>Polystichum lonchitis</i>
	<i>Salix brachycarpa</i>
	<i>Salix farriae</i>
	<i>Tofieldia pusilla</i>
	<i>Trichophorum pumilum</i> ^b
	<i>Vaccinium scoparium</i>
RARE, AND BLUE- AND RED-LISTED SPECIES IN BRITISH COLUMBIA	
<i>Biatora hypophaea</i> (few published records in BC)	<i>Botrychium montanum</i> (Red-listed)
<i>Lobaria scrobiculata</i> (cyanolichen/oceanic species, rare in SE BC)	<i>Draba cinerea</i> (Blue-listed)
<i>Nephroma isidiosum</i> (cyanolichen/oceanic species, rare in SE BC)	<i>Draba lactea</i> (Blue-listed)
<i>Pseudocyphellaria anomala</i> (cyanolichen/oceanic species, rare in SE BC)	<i>Epilobium halleanum</i> (Blue-listed)
<i>Sclerophora peronella</i> (COSEWIC-tracked species: data deficient in BC) ^c	<i>Melica smithii</i> (Blue-listed)
<i>Sticta fuliginosa</i> (cyanolichen/oceanic species, rare in SE BC)	<i>Minuartia stricta sensu stricto</i> ^b (Blue-listed)
	<i>Muhlenbergia racemosa</i> (Red-listed)
	<i>Trichophorum pumilum</i> ^b (Blue-listed)

a A detailed account of new lichen records including specimen characteristics and citations will be provided in other journal publications.

b Peripheral species in British Columbia. Distribution is circumpolar and northern and occurs in the subalpine and alpine zones. *Minuartia stricta* is rare in northern British Columbia, where it is at the southern tip of its range. *Trichophorum pumilum* is widely scattered in the Interior.

c Committee on the Status of Endangered Wildlife in Canada (2005).

Discussion

The Albert River valley is very rich in lichens and vascular plants and hosts many rare or previously unknown species. Within only 24 person-hours of field-searching we recorded about 10% of the vascular plant species known in British Columbia (Douglas *et al.* 1998), including eight species either Blue- or Red-listed in the province (according to the BCCDC). We also found 16 species of lichens either new to northwest America, or that appear as yet undescribed.

Wells *et al.* (2004) analyzed the representation of ecosystem types in the East Kootenay Conservation Program (EKCP) area that includes the Albert River valley. They examined how well various ecosystem types were represented within the non-harvestable landbase (NHLB) and formal protected areas. A detailed description of their methodology is available on-line. They considered the ICHmk1 variant, within which the Albert River valley is located, to be a vulnerable and under-represented ecosystem type in the East Kootenay. In their analysis, 35 ecosystem types were defined by grouping BEC site series (Meidinger and Pojar [editors] 1991). Mesic ICHmk1 had relatively low representation within the NHLB (< 30%) and only 1.3% was protected by provincial park regulations. Although 49% of the subhygric ICHmk1 was in the NHLB, only 1.4% was protected by provincial park regulations (Wells *et al.* 2004). The analysis suggested that the ICHmk1 was an under-represented ecosystem type, and should be considered a candidate for additional conservation areas in the EKCP area. However, without field data, the exceptional status of the old-growth forest remnants in the Albert River valley would be overlooked. Moreover, these fragments do not appear to be among the better candidates for conservation areas. The portion of the valley that falls within the ICHmk1 is a fragmented mosaic of all stand age classes with only patches of remnant old-growth forest (Figure 2). A conservation strategy, guided by concepts pursuing large unfragmented forests (Forest Stewardship Council Canada 2005), could eliminate the area from consideration, or promote other areas ahead of it because of fragmentation. Our data (Table 1) illustrate how limiting those features can be when designating areas of high conservation value. The problem arises from reliance on cheaper, coarse-filter approaches and the lack of more expensive, fine-scale approaches involving field verifications that expose conservation values. Albert River valley clearly has high conservation value, but we encountered it only

serendipitously through fieldwork relating lichens to their preferred substrates.

Three general conditions lead to the omission of small, but conservation-worthy, sites such as the Albert River valley.

1. Larger forested areas of well-represented ecosystem types are favoured over highly fragmented, but poorly represented, ecosystems.

When only the coarse data are available, the simplest guidelines (such as large, unfragmented mature forests) tend to be invoked and favoured over small remnant stands as conservation areas. The degree to which habitat fragmentation is negative depends greatly on the natural history characteristics of the species present (Simberloff 1986; Lindenmayer and Franklin 2002). Our data showed that the Albert River valley contributes significantly to biodiversity, despite the effects of fragmentation.

2. Fine-filter selection criteria are either not included or are used minimally in the assessment process.

Even when less crude data are available, assessment of a management unit to determine potential conservation areas tends to be restricted to the large spatial scale of available data (e.g., forest cover type), a scale that is usually too coarse to reveal the biodiversity value of small remnant stands. Wells *et al.* (2004) showed that the Albert River valley was located in the ICHmk1 variant, and that this variant was under-represented in the EKCP area. However, the analysis could not have detected the richness of Albert River valley without additional data from field surveys. When selecting additional conservation areas, field assessment in under-represented ecosystems should be mandatory before harvest to prevent losing rich ecosystems and rare species.

3. Small remnant forests may not overlap with known habitat boundaries of species of management concern.

The tendency to overlook areas of conservation value persists even when the species-level fine filter is applied. Species of management interest typically are selected from among those terrestrial vertebrates for which we have sufficient data to describe their range or habitat (e.g., flammulated owl, grizzly bear, and caribou). These species may be used to direct management decisions. Typically they occupy distinctive habitats or range widely. Wide-ranging species may be championed as “umbrella species” whose needs encompass those

of many other species, but the concept works better in theory than in practice (Roberge and Angelstam 2004). Small conservation-worthy areas such as the Albert River valley may be judged unfit for the habitat connectivity required by some large mammals or may not overlap with specialized habitat of the selected management species.

It is apparent that, applied on their own, neither coarse-filter nor fine-filter approaches based on a few individual species are adequate to capture all opportunities for sustaining biodiversity. The vexing issue of the cost of fine-scaled inventory is not readily surmountable. Should costs be borne by the landlord, the Crown, or the developer? How should costs be shared? It is apparent that the developer cannot assume that the government has adequately inventoried the bulk of biodiversity, driven as it is by social pressures to allocate funds to the rarest portions. A well-executed coarse-filter assessment is cost-effective and should successfully identify some of the potentially rare ecosystems in a management unit. The assessment can then efficiently indicate where to focus the more expensive fine-scale inventory. Ecological representation analysis (a coarse-filter approach) revealed that the Albert River valley hosted old-growth remnant patches in an under-represented and vulnerable ecosystem type (Wells *et al.* 2004). The analysis aided our search for old-growth sites, but was necessarily silent on the richness present in the valley because it could not capture fine-scale information.

Approaches to Protect Rare Ecosystems in Albert River Valley

Early in 2005, findings from the Albert River valley were communicated to the B.C. Ministry of Environment and to Canadian Forest Products (Canfor), in whose Defined Forest Area it is located. In 2005, a portion of Albert River valley was proposed as an ecological reserve by the B.C. Ministry of Environment, and as an OGMA by the B.C. Ministry of Forests and Range. While ecological reserves are intended to be maintained in perpetuity to protect typical or rare and unique assemblages of species, OGMAs are not permanent conservation areas. They can be harvested depending on the economic and social status of the region. Old-growth management areas are designated by the Government of British Columbia to help meet the provincial objectives for old-growth retention and

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biodiversity management. They are composed mainly of old-growth and (or) mature forest, and are ranked in four classes from “poor and moderate” to “good and excellent.” The selection for potential OGMAs is done at a coarse-filter level using forest cover data. Ranking is usually completed through reconnaissance by air or ground.

Concurrently, the old-growth retention plan for Invermere TSA was developed by Canfor and the Golden Integrated Land Management Bureau, B.C. Ministry of Agriculture. Portions of the age class 9 stands (> 250 years old) in Albert River valley were set aside as conservation areas on a long-term basis (20 years +), but non-permanently. Within its sustainable forest management plan, Canfor’s old-growth management strategy retains OGMAs rated “excellent and good.” This strategy focusses on old forests and rare ecosystems. Stands with a significant component (> 20%) of western redcedar are retained. Currently, Canfor determines ecosystem rarity in the East Kootenay area using representation analysis conducted on 35 ecosystem types, or groupings of site series, as described by Wells *et al.* (2004).

The Red- and Blue-listed vascular plant species found in the Albert River valley were located mostly in riparian habitat. In the Albert River Pass, Canfor will retain contiguous mature and early mature forest cover over a rotational basis, tying together riparian features to maintain and enhance connectivity. Without pre-harvest field surveys and post-harvest monitoring, it is unknown if these rare plant species and their habitat will be maintained throughout stand rotations. The company’s riparian management strategy also establishes streamside reserves. These reserves could help retain the rare and listed species of vascular plants if their location is strategically planned and supported by field data.

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Test Your Knowledge . . .

Old forest remnants contribute to sustaining biodiversity: The case of the Albert River valley

How well can you recall some of the main messages in the preceding Extension Note?

Test your knowledge by answering the following questions. Answers are at the bottom of the page.

1. Which of the following conservation areas are permanent?
 - A) Parks
 - B) Old-growth management areas
 - C) Ecological reserves
 - D) A and C
 - E) All of the above

2. Ecosystem representation analysis:
 - A) Is used to select harvestable areas in under-represented ecosystems
 - B) Sustains only ecological functions and species whose specific habitat requirements are known
 - C) Is a coarse-filter approach and may fail to reveal the biodiversity value of small remnant stands
 - D) Always relies on field data

3. Three general conditions could lead to the omission of small, but conservation-worthy, sites such as the Albert River valley. Which of the following could be avoided by integrating a fine-filter approach to the management process?
 - A) Larger forested areas of well-represented ecosystem types favoured over highly fragmented but poorly represented ecosystems
 - B) Fine-filter criteria of selection either not included or minimal in the assessment process
 - C) Small remnant forests not overlapping with known habitat boundaries of species of management concern
 - D) All of the above
 - E) None of the above

ANSWERS

1. D 2. C 3. D