Perspectives

BC Journal of Ecosystems and Management

Wildlife and habitat inventory for a results-based Forest Practices Code

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Abstract

Two significant changes are occurring within the forest industry in British Columbia, both of which will necessitate a greater reliance on species and habitat monitoring and inventories. First, as British Columbia moves towards adopting the "New Era" principles of the provincial government, the Forest Practices Code will change from regulatory-based to "results-based." This means that forest companies will have to be monitored to ensure they meet the desired results outlined by the provincial government. Second, market pressures increasingly demand that forest companies be certified as "sustainable" under one of several certification schemes. All certification regimes require that companies be monitored to ensure biodiversity objectives within their sustainable forest management (SFM) plans are achieved. To meet these monitoring requirements, forest companies and the provincial government will need representative, feasible, reliable, and applicable indicators of wildlife and habitat values. Fortunately, British Columbia has several species and habitat inventories that can be used to develop indicators for both certification regimes and the results-based code implementation.

This paper reviews the available inventories in British Columbia and provides an overview of the usefulness of these inventories for monitoring within SFM planning and the results-based code. In general, criteria and indicators developed from the province's habitat inventories can be used immediately to monitor forest management practices; however, these habitat inventories need refined species–habitat models to be most useful. Although direct monitoring of wildlife is important for rare and endangered species and to determine the effects of forest management practices, species inventories are generally less useful for this purpose. Recommendations are provided to ensure the usefulness of inventories in monitoring compliance with the results-based code and meeting the needs of SFM planning.

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Introduction

The current British Columbia provincial government's "New Era" approach to resource management includes a shift from a regulatory-based regime for forest management towards a results-based Forest Practices Code. Although this approach has caused great concern among environmentalists, the government has the stated goal of maintaining an industry that is globally recognized for environmental stewardship (Province of British Columbia 2002). These changes will move much of the responsibility for wildlife habitat protection and stewardship from government agencies to the private sector (B.C. Ministry of Sustainable Resource Management 2002). Under the new British Columbia Ministry of Sustainable Resource Management's (MSRM) service plan, government roles will change from approving forest management plans beforehand to monitoring forest management plans as they are implemented to determine whether these plans are meeting desired results around habitat and wildlife conservation. Government roles will thus emphasize monitoring for compliance and levying penalties or rewards (e.g., approval of Forest Investment Account applications), as opposed to habitat stewardship and the prevention of impacts on wildlife habitat and species.

Even this role for government monitoring will be hindered by staff cuts resulting in only limited spot checks. As a result, Sustainable Forest Management plans (SFMP Working Group 2002), which forest companies are encouraged (but not required) to develop, will likely be implemented mainly through forest certification agencies (e.g., Sustainable Forestry Initiative [SFI], Canadian Standards Association [CSA], Forest Stewardship Council [FSC], and the International Organization for Standardization's Environmental Management System certification [ISO 14001]). These agencies will, by default, apply most of the pressure if forest management plans do not protect wildlife species and habitats. In addition, the recent transfer of MSRM wildlife, land, and air experts to B.C. Ministry of Forests staff will result in a further reduction of government wildlife stewardship (see B.C. Ministry of Forests 2002).

The diversity of living organisms in all their forms and levels of organization including ecosystems is a required component of SFM planning for both certification schemes and the results-based code. To meet the requirements of both SFM planning and the results-based code, forest companies will be obligated to show how their management plans meet the desired objectives around biodiversity conservation, and develop indicators that can demonstrate how well they are achieving these goals.

British Columbia has several species and habitat inventories that can be used to develop indicators for both certification regimes and the results-based code implementation.

For certification schemes to be successful, indicators must be:

- representative (cover the most important parts of the element concerned; show trends over time and differences between places);
- reliable (directly reflect how far the objective concerned is met; be well founded, accurate, and measured in a standardized way with sound and consistent sampling procedures); and
- feasible (depend on data that are readily available or obtainable at reasonable cost) (Prescott-Allen 2001).

Furthermore, to allow the successful implementation of the results-based code, indicators must be applicable for "results-based" monitoring.

Finding indicators for biodiversity conservation that meet these four requirements will call for a comprehensive understanding of the habitat needs of each wildlife species, combined with a spatial picture of the distribution of resources across the landscape. This goal can only be achieved if the legacy of existing wildlife and habitat inventories, combined with existing information around the life history needs of wildlife species, is drawn on to the fullest possible extent.

Fortunately, although British Columbia is exceedingly complex ecologically, it has an unusually productive history of classifying and mapping its ecosystems for wildlife conservation and management purposes. These inventories can be applied in varying degrees to monitoring. In recent years, standardized approaches to species and habitat inventory have been developed. Frameworks for classifying and mapping ecosystems at a variety of scales are also in place.

Most ecosystem classification in British Columbia allows the determination of both present (suitability) and maximum potential (capability) resource values. The difference, or gap, between these values provides a guide to the potential for management of habitat. This mapping can be interpreted to provide values for species abundance through the use of habitat models. It can also be used to identify appropriate areas for introductions of species where they did not historically exist, such as for rare or endangered populations. These ecosystem and wildlife inventories thus provide a basis on which to plan for biological sustainability through integrated resource management.

In this paper, I provide an overview of the history of inventories in this province, a guide to the government agencies currently managing inventories, and a critical analysis of available species and habitat inventories that will be most useful for developing indicators for certification schemes and the results-based code. To ensure that adequate information is available to assess the biological sustainability of forest management practices in the province, I also recommend strategies for improving inventories in British Columbia.

Co-ordinating Standards for Inventory in British Columbia

Historical Perspective

The first national inventory of wildlife habitat was part of the federal Canada Land Inventory (CLI) initiative that acted on recommendations from the 1961 Resources for Tomorrow Conference. This inventory focused on high-priority harvested species, including ungulates and waterfowl, and mapped habitat for these species in about 70% of the province. A stable rating system was desired and, because vegetative succession continually changes the value of habitat for wildlife species, wildlife habitat ratings were expressed using the value for the most desirable successional stage (or land capability). This assessment required consideration of the physical aspects of the habitat, such as climate, terrain, soils, and vegetative cover at all stages of succession, as well as the presence of the relevant wildlife species. Although groundbreaking in concept, the CLI was of limited application because it was strategic in scale (1:250 000) and field work was completed mainly by biologists who lacked background in non-biological disciplines. While *all* habitats were mapped, the habitat ratings were based on biomass productivity units (e.g., white-tailed-deer units). As a result, the habitat of high-elevation or northern-latitude species (e.g., mountain goat and caribou) never achieved top ratings.

In the 1970s, the Resource Analysis Unit of the Environment and Land Use Secretariat (later the Resource Analysis Branch in the B.C. Ministry of Environment) was set up to provide multidisciplinary (biophysical) methods for identifying resource values based on soil, surficial geology (terrain), vegetation, and wildlife biology. A wildlife habitat mapping program was initiated using this approach (Demarchi and Lea 1987). Biophysical mapping was mostly done at a scale of 1:50 000, considerably more detailed than the CLI. Other improvements over the CLI included a comparable rating for species (with the best habitat in the province for the species rated as class 1), and a requirement for input from experts in several disciplines. In addition to the habitat capability concept of the CLI, a habitat suitability rating was added based on the current carrying capacity for a particular species at the present stage of succession. By the early 1980s it became apparent that the multidisciplinary approach to inventory worked best if the field data collection teams were integrated at the field level. This approach became standard for terrestrial ecosystem mapping (TEM) and was conducted in several regions in the 1980s and 1990s, culminating in the production of wildlife habitat maps for over 50 species as part of the South Okanagan Project.

An important step forward in integrating resource inventories came in the late 1970s, with the joint ministries of Environment and Forests' publication of common field data collection standards, *Describing Ecosystems in the Field* (Luttmerding *et al.* 1980). However, further integration did not proceed; this was partly because the ministries of Environment and Forests remained separate entities and no high-level committee championed an integrated approach between ministries.

In 1984, a section with two multidisciplinary teams was transferred to the Ministry of Environment thus forming a Habitat Inventory Section in the Wildlife Branch. By 1990, approximately 6% of the province was mapped at scales of 1:250 000, 10% at 1:50 000, and less than 1% at 1:20 000. The lack of inventory data at the finest scale (1:20 000) was problematic because this scale had proven the most valuable in identifying and managing habitat for rare and endangered species.

At this point, species inventories had been collected primarily in regions for hunted species, with co-ordination and data system development occurring at the Wildlife Branch in Victoria. Data regarding hunting statistics have been collected continuously since the mid-1970s and an ungulate inventory database was set up in the early 1980s.

In the mid-1980s, the Conservation Data Centre (CDC) was set up to collect and manage data for rare and endangered species and ecosystems. Initially modelled on existing organizations in the United States, the methods have now been largely integrated with inventory systems developed in British Columbia.

The Resource Inventory Committee

In 1989, the B.C. Task Force on the Environment (1989) made recommendations that led to a much greater emphasis on inventory. The task force essentially recommended that developing a strategy for sustainable development requires a knowledge of the land's capability for production—maintaining the stock of ecological capital requires some baseline inventory. Planning initiatives at that time revealed a shortage of both inventory information as well as methods and standards needed to facilitate quality assurance. In addition, much of the inventory information was difficult to obtain and incorporate into computer-based tools such as GIS (Geographic Information Systems). As a result, the interministerial Resource Inventory Committee (RIC) was set up to co-ordinate the development of standards for the integrated inventories needed to manage the land's resources in the most efficient way. Standards are now in place for forty-five species and groups of species, as well as for five habitat inventory groups. This committee was instrumental in obtaining moderate increases in funding for inventories through the Corporate Resource Inventory Initiative (CRII). Forest Renewal BC (FRBC), initiated in 1994, provided large amounts of funding for inventory and for the RIC–co-ordinated standards and data system development.

While RIC was very successful at developing inventories, a number of problems arose from inventories being carried out before inventory standards were finalized. As a result, much of the data that was collected now requires updating to the current standards to be fully useful.

Although FRBC inventory funding in the 1990s was initially allocated through regional government staff, in subsequent years the bulk of the inventory funds were allocated directly to timber harvesting licensees, complicating the co-ordination of standards and quality assurance. Furthermore, no provincial-level prioritization of species or habitat inventories existed, nor any prioritization of the required scale or resolution for habitat inventories. The tracking of projects provincially was only possible by laboriously canvassing regions and companies. In 1996, inventory specialists were placed in forest regions to facilitate quality assurance of RIC standards for species inventory, but quality assurance for habitat mapping based on TEM continued to be done in Victoria, as regions lacked expertise in bioterrain classification and vegetation ecology.

In practice, therefore, the wildlife and habitat inventory program has met RIC objectives in many ways, such as providing standards and data systems, but has not played a proactive role in inventory planning and implementation. The result is a haphazard coverage and, in some cases, inconsistent or unknown standards application.

Current Management Framework for Inventory Data in British Columbia

Under the changes implemented by the current provincial government in British Columbia, wildlife-oriented inventory is now the task of the newly created Ministry of Sustainable Resource Management. This ministry is responsible for maintaining most wildlife inventory standards in the province, but is no longer involved in quality assurance. The interministerial Resource Inventory Standards Committee (RISC), which replaced the Resources Inventory Committee, recognizes specific wildlife inventory responsibilities for MSRM, such as being "custodian" (responsible for standards and audit) for certain inventories, including:

- Ecoregion Classification (although the database is no longer supported)
- Broad Ecosystem Inventory
- Terrestrial Ecosystem Mapping
- Predictive Ecosystem Mapping
- Sensitive Ecosystem Inventory
- Wildlife Habitat Ratings and Mapping
- Species Inventory
- Procedures for Habitat Monitoring

The CDC, also part of MSRM, is still responsible for inventory of endangered species and habitat elements, but has reduced staff.

Types of Wildlife Inventory

Habitat Inventories

Habitat inventories are based on ecosystem classifications also used for forest management, usually at scales of 1:20 000–1:50 000. In British Columbia, these inventories are most commonly based on terrestrial ecosystem mapping, although efforts are being made to simulate TEM using data gathered for other purposes such as vegetation inventory. These approximations are termed "predictive ecosystem mapping" (PEM) and include government-sponsored methods of transforming available data from the provincial vegetation resources inventories. At smaller map scales of 1:250 000 to 1:2 000 000, broad ecosystem inventory is the spatial basis for modelling wildlife values. Products available from these base maps include capability and suitability for selected species, or groups of species, which can be interpreted to map spatial habitat features, such as habitat continuity, migration routes, or habitat networks. Broad ecosystem inventories also provide a frame of reference for more detailed mapping. Terrestrial ecosystem mapping and other large map scale inventories can also be interpreted for habitat capability and suitability, sensitive ecosystems, and in some cases forest ecosystem networks (FENs). An overview of available habitat inventories is presented in Table 1.

Species Inventories

A *Species Inventory Fundamentals* manual (Resource Inventory Committee 1998) and thirty-nine methods for species inventories have been published through RIC. As some of these standards apply to "species groups" (e.g., "forest birds"), methods exist for several hundred species including most rare and endangered species and harvested species, such as ungulates and bears (please see the Resource Inventory Standards Committee Web site [http://srmwww.gov.bc.ca/risc/] for more information about existing standards). Unfortunately, no spatial overview of the species inventories completed to date exists, but the species inventory database can be queried for species information by area. Species inventories are undertaken at three levels of precision, which affects their usefulness as indicators. These levels are: presence/absence, relative numbers, and actual count or census.

The reliability of presence/absence data is highly dependent on species' habits. This approach is very effective for:

- species that vocalize during breeding season or when feeding (e.g., many birds and some bats); or
- species with distinctive signs, such as tracks or feces (e.g., ungulates, bears), dirt push-ups (e.g., moles, pocket gophers, ground squirrels, and marmots), or markings of habitat use (e.g., woodpeckers).

However, secretive and nocturnal species, such as salamanders and most reptiles, may occupy habitat without detection until specialized inventories are carried

TABLE 1. Wildlife/wildlife habitat inventory as a source of indicators of forest ecosystem integrity

Inventory type	Indicator for	Representative	Feasibility	Reliability	Results-based[a]
Species: presence / absence	Detection (yes or no); distribution	High	High	Low: may be present, but not detected	Low: no way to attribute absence to environmental change
Species: relative numbers	Population changes	High	Moderate to high	Low–moderate; many variables affect count	Low: difficult to tie cause and effect
Species: actual count or statistically valid sample	Population size and density	High	Low–moderate for most species and populations; expensive	Moderate–high, depending on species	Low: improved by knowledge about other population impacts
Capability or suitability based on TEM or PEM	Habitat	Moderate–high Low for rare/ endangered species	Depends on expert knowledge, so difficult to verify	High potential	High: if capability and suitability models are validated
Capability or suitability based on broad ecosystems	Habitat	Moderate	Depends on expert knowledge, so difficult to verify	High, but only at small scales	Low–high; small scale masks small impacts; useful for strategic-level monitoring

[a] Includes usefulness for developing indicators for sustainable forest management.

TABLE 2. Relative permanence of wildlife/habitat inventory data

Most Permanent			→		Most Ephemeral
Geology	Capability	Suitability	Species Presence or Absence	Species Relative Abundance	Animal Species Census

out. Also, rare plants and some mammal species (e.g., shrews and most bats) are often overlooked by all but specialists on the species.

Relative numbers surveys are widely used to monitor population changes, especially for species requiring hunting regulation. For example, mule deer and black-tailed deer are counted in clearcuts at night using spotlights or from aircraft flown on similar flight paths on an annual basis. Many techniques for presence/absence determinations can also be used for relative abundance estimates by repeated sampling on regular dates and conditions. Problems with these methods are largely attributable to variations in weather affecting animal behaviour and visibility, as well as vegetative succession affecting visibility and suitability of the habitat for the inventoried species over time.

Attempts to obtain accurate census data of most animal species is difficult and usually not necessary. Species that are highly visible for part of the year (e.g., mountain goats) are censused with reasonable accuracy from helicopters. On the other hand, accurate census is exceedingly difficult for species such as grizzly bear. These bears are for the most part invisible from the air (with minor exceptions such as on slides and salt marshes, irregularly for short periods of the year). Until recently, capture and tagging was the only way to obtain accurate population estimates and such studies are too expensive to apply except for limited areas in research studies. New census approaches are being developed using DNA analysis of hair from baited animals (Resources Inventory Committee 1998), but costs are likely to remain prohibitive to conduct censuses over large geographic areas.

Using Wildlife Inventories for Indicators and Monitoring

While the means to maintain these inventory standards is uncertain, the available inventories will be useful to develop indicators for monitoring the sustainability of many aspects of the province's wildlife resources. This is necessary to meet the requirements of SFM plans and the certification agency responsibilities that depend on them. As a general rule, ecosystem monitoring requires repeated measurement of appropriate indicators of broad categories of conditions or processes, which cannot be measured directly. Fortunately, many useful indicators can be derived from existing inventory data collected for other purposes. However, monitoring indicators must be repeatable within predetermined confidence limits. Two factors must be considered in choosing relevant indicators:

- How replicable is the method of field data collection—will the technique provide the same results from two independent survey teams at the same time?
- Will the surveys pick up real changes in the resource being measured?

The importance of the latter depends on the changeability of the indicators being measured. For example, the capability of a landscape is normally stable except in a geological time frame (with the exception of extreme disturbances such as urbanization or intensive agriculture). Conversely, species numbers at a specific site may change from hour to hour. The relative permanence of inventory types is expressed in Table 2.

Indicators from existing inventories for the results-based code will be ineffective unless they can be monitored soon after activities such as timber harvesting occur. Species inventories do not lend themselves to monitoring impacts directly following harvesting, as populations may move or not respond for some time to habitat changes. On the other hand, indicators derived from habitat inventories can be used to report a habitat change immediately. For example, habitat suitability for different species will change with logging and (over time) with

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successional stage. However, to relate these changes to species populations, habitat models that accurately reflect the needs of different wildlife species must be developed and tested. Existing species–habitat models are listed on the wildlife inventory Web site (http://srmwww.gov.bc.ca/rib/wis).

Indicators for a wildlife monitoring program under the results-based code will therefore be more easily derived from habitat inventories than from species inventories. This approach will only work where habitat capability and suitability mapping exists. Also this approach requires models to link species population to habitat capability and suitability (e.g., fish). Species–habitat models are well developed for hunted species, especially grizzly bear and most ungulates, but are very sketchy for many bird and small mammal species. Furthermore, the appropriate use of inventories to monitor implementation of the results-based code will require some redefinition of "impacts." For example, what is the damage indicator for a bulldozer disturbing a stream habitat? Would the evaluated "result" be physical damage to the stream bank or would it be the loss (or population reduction) of stream-dependent species (e.g., giant salamander). Clearly, stream bank damage is a result that could be measured and acted on immediately. However, loss of stream-dependent species would likely never be attributed habitat loss, except in extreme instances of human-induced disasters such as landslides which destroy whole stream systems.

Attributing population responses of large mammals to habitat changes is also difficult, but we have a much closer connection between results measured on habitat capability and suitability, and these effects can be quantified immediately. Similarly, it will be difficult to protect rare and endangered populations through a results-based approach, but the approach could work well for general values of biodiversity through the maintenance of diverse habitats.

Existing inventories developed for wildlife and wildlife habitat management purposes, but considered to have potential for monitoring purposes, are ranked according to a number of criteria in Table 1. For further information on these inventories and assistance in accessing inventory data see the wildlife inventory Web site at http://srmwww.gov.bc.ca/rib/wis. For some inventory types, further assistance in obtaining data is available from the contacts listed at the Web site.

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Recommendations for Application of Wildlife Inventories to Results-based Land Management

1. As broad ecosystem inventory is the only wildlife inventory with full provincial coverage, it should be updated and maintained for bears and ungulates and adapted for future needs such as planning habitat networks.
2. As part of standards setting, further integration of vegetation resources inventory, terrestrial ecosystem inventory, and predictive ecosystem inventory should be pursued as an economical way of obtaining large-scale ecological information over widespread areas.
3. Existing wildlife habitat inventory initiatives need to be carefully evaluated to find sources of indicators for results-based forest practice monitoring. This can potentially provide huge savings, as existing data have a replacement value of tens of millions of dollars. Much of it should serve well as the "before" data in environmental change monitoring.
4. New data collected for monitoring purposes must be evaluated for reliability, as much of it is subject to unpredictable natural fluctuations. To ensure reliability, data types for use in monitoring should be evaluated for several years at representative permanent sites.
5. Results-based monitoring data should be founded on criteria that can be measured soon after environmental disturbances. Physical habitats are more useful for this purpose than are species population inventories which tend to be subject to wide natural fluctuations and where cause-and-effect relationships cannot be easily demonstrated.
6. The physical habitat requirements of species must be well defined so that the effects of habitat alteration can be quickly related to wildlife populations.
7. A quality assurance or audit function for habitat and wildlife inventory must be re-established and maintained through a central agency. Such an agency can only function effectively if staffed with adequate breadth of expertise in ecological knowledge, including surficial geology, soils, plant ecology, and wildlife biology, as well as geographic information systems and data systems.

Conclusion

Under a results-based Forest Practices Code, certification agencies in conjunction with timber licensees will likely assume much of the responsibility for habitat protection and management. Enforcement through government agencies has become inadequate because of staff cuts in habitat protection and the weakening of the forest practice regulations. If a certification agency–led approach is to be credible and applied evenhandedly across the province, government must establish, maintain, and enforce inventory and monitoring standards. This would best be coordinated through a central multidisciplinary agency closely associated with the remaining inventory and habitat protection staff in the regions. A comprehensive audit and quality assurance function involving systematic monitoring should also be established. All inventories should be integrated by an overarching provincial plan that is based on ecoregion and biogeoclimatic zone maps.

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