

Criteria and Indicators for Monitoring Biodiversity in Alberta's Forests

Part I: Review of Legislation, Policies, External Agreements, and Programs

A Progress Completion Report

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Executive Summary

This report initiates the process of identifying indicators for biodiversity monitoring by reviewing the legislation, policies/guidelines, and external agreement/agencies that provide a basis for management on Alberta's forested landscape. These documents outlined a framework for monitoring at the regional and provincial scale within Alberta. Furthermore, the report reviews a large number of ongoing monitoring programs in Alberta. This produced a profile of mandates, monitoring frameworks, monitored taxa (indicators), geographical coverage, and identified organizations currently involved in monitoring. A following report will identify specific indicators for monitoring biodiversity in Alberta's forested landscapes.

In reviewing all documents, it became apparent that biodiversity indicators serve two general functions. Traditionally, indicators represented species "valued" by stakeholders and hence monitored to ensure their sustained supply. Examples include game species, furbearing species, commercial species, and endangered species. Single species approaches to management, also called fine-filter approaches, tend to utilize this type of monitoring and indicators. A second function of biodiversity indicators are to represent ecological processes and patterns, i.e. ecological integrity. These are not necessarily of direct "value" to stakeholders but ensure the ability of ecosystems to produce a balance of all goods. Ecosystem approaches also called coarse-filtered approaches to management tend to utilize this type of monitoring and indicators. These two functions are not necessarily exclusive. Indicators can be of value to stakeholders and also relate to an important ecosystem function.

National level indicators like the Canadian Council of Forest Ministers, Criteria and Indicators and some of the indicators from the Canadian Biodiversity Strategy mandate the monitoring of indicators of stakeholder values. Similarly, provincial documents like the Fish and Wildlife Division Strategic Plan, the Alberta Forest Conservation Strategy, and the Interim Forest Management Planning Manual also identify indicators for the sustained or enhanced output of desired forest species. However, provincial and regional governments and industry have the primary responsibility of protecting and maintaining the forested ecosystems that produce these and other non-timber values. Thus, they have the added responsibility of identifying and measuring indicators of ecosystem integrity.

The burden of ecosystem monitoring is of special concern. Alberta's forested lands maintain ~460 species of vertebrates, ~1300 species of vascular plants, ~600 species of non-vascular plants, and ~10,000 species of invertebrates. The selection of ecosystem indicators from this enormous and diverse array of species would seem a daunting task. Our knowledge on the impact of industrial development on these elements is improving but still far from complete. In part, our selection of indicators must assemble and condense our understanding of ecosystem integrity into the abundances of relatively few species. Also given our lack of knowledge, resource managers must place the monitoring in a management framework explicitly designed

to handle unpredictability of a management outcome, i.e., risk. National and provincial documents such as the Canadian Biodiversity Strategy, Alberta Forest Conservation Strategy, and Alberta Forest Legacy have proposed two related management philosophies to abate the risk of species loss; coarse-filter approaches and adaptive management. A coarse-filter approach is the management of broad ecosystem functions and patterns in order to maintain broad species diversity. Adaptive management is a formal process of problem assessment/hypothesis, implementation design/execution, monitoring, evaluation, and feedback. Managers craft the cycle of management activities as “experiments” to fill gaps in knowledge and provide a stepwise process to managing risk. These approaches complement the current suite of focal species, i.e. fine filter, policies, management practices, and indicators. To date, coarse filter and adaptive management policies and management practices has been accepted through the Alberta Forest Legacy. However, biodiversity indicators for coarse filter representation of ecosystems and adaptive management scenarios have not been widely developed nor implemented.

Currently, the legislation, policies, strategic planning, and performance measures of the Natural Resources Service favors a stakeholder-indicator approach. Often single species objectives form the basis of management initiatives and practices. This system originated from a traditional mandate of game, fur-bearing, and more recently endangered vertebrates. A fine-filter approach will probably be hard pressed to handle the addition of non-game fish, vascular plants, nonvascular plants, and invertebrates. Also, the requirement by Canadian Biodiversity Strategy, the National Forest Strategy, and the Interim Forest Management Planning Manual to identify biodiversity, habitat, and landscape indicators within a natural land classification framework will require Natural Resources Service to adopt a greater degree of coarse-filter management. A coarse-filter approach would “roll-up” species habitat and landscape measures at a natural land classification level (e.g., natural regions, subregions, ecodistricts) as an indication of the relative status of the whole community. This approach would compliment the current fine-filter approach.

Despite all of the reviewed national, provincial, and regional documents recognizing the need for biodiversity indicators that go beyond stakeholder values, none of these documents identify concrete biodiversity indicators of ecological functions and patterns potentially affected by the industrial development of forested lands. In part, the problem is identifying a framework to accommodate both stakeholder value indicators and ecosystem impact indicators.

The intent of the Alberta Forest Conservation Strategy (Alberta Forest Conservation Strategy Steering Committee, 1997) and the Interim Forest Management Planning Manual is to have companies develop their own indicators. However, there would be great administrative, economic, and scientific merit for end users of indicators to cooperatively develop and utilize the same indicators, sampling protocols, data management, analysis, and reporting methodologies when monitoring similar vegetation communities. The Alberta Forest Biodiversity Monitoring Program is

working towards unifying these activities for forest companies, Foothills Model Forest, and the provincial government. We will integrate this project with the Alberta Forestry Biodiversity Monitoring Working Group to develop and propose a framework and indicators for a monitoring program in the second phase of this project.

The development of management and monitoring initiatives for aquatic indicators lags behind terrestrial indicators. Currently, aquatic indicators focus primarily on game fish and clean water. To develop a coarse filter management approach to monitoring aquatic ecosystems, the impact of natural and man-made disturbances (e.g. wildfires and forestry on the successional dynamics of aquatic ecosystems) needs to be incorporated into management and appropriate indicators of performance developed.

Monitoring for biodiversity in Alberta has greatly intensified over the last fifty years. The current value of programs to monitoring ecosystems is difficult to ascertain until indicators are identified. There are over 100 monitoring programs involving thousands of Albertans and managed by over 30 government and non-government agencies. Avifauna, ungulates, and large carnivores are the most intensively monitored of all taxa. In general, herbaceous, non-vascular, non-game fish species, and invertebrates are underrepresented by sampling programs. Geographical coverage of programs is generally good around urban areas, and in the southern portion of the province but relatively poor in the Boreal Forest and Canadian Shield Natural Regions. Despite the large number of programs, sampling and reporting remains uncoordinated amongst agencies, hence, the comprehensive status of many taxa is very difficult to ascertain. Lastly, the longer monitoring data has been collected the more valuable it becomes. In this regard, funding and support for monitoring programs must be stable and long-term.

Based on the review of documents and programs in this report we generate the following key conclusions:

Conclusion 1: Recent documentation identifies many species-specific indicators of stakeholder values, e.g. woodland caribou, moose. Further effort is required to develop indicators representative of broader ecosystem functions and patterns, i.e. coarse filter indicators. The criteria for these latter indicators should include known potential impacts of industrial development, e.g. loss of deadwood resources.

Conclusion 2: To facilitate long-term data usability and comparability between different geographic locations, common indicators, sampling techniques, data management and analysis procedures, and reporting protocols should be employed.

Conclusion 3: In Alberta, the development of aquatic biodiversity indicators in forested areas lags behind that for terrestrial ecosystems. Aquatic indicators should receive special emphasis. Furthermore, integrated aquatic and terrestrial indicators need to be developed which represent the transfer of properties between ecosystems.

Conclusion 4: Current monitoring efforts poorly represent the following taxa: terrestrial and aquatic invertebrates, herbaceous and non-vascular plants, reclusive amphibian species, reptiles, small mammals, and non-harvested fish species.

Conclusion 5: Coverages of current monitoring programs are uneven both geographically and through time. Full geographic and temporal coverage of the forested landscape of Alberta should be a goal of future initiatives.

Conclusion 6: The utility of monitoring programs is dependent upon the standardization, duration and continuity of monitoring through time. Several small, independent and uncoordinated monitoring programs on biodiversity are unlikely to provide useful results on a cost effective basis over time. Also, there are often overlaps in the administration and sampling scope of monitoring programs. There is likely potential for greater cooperation in sampling, data management, data analysis, and reporting among non-government organizations, government agencies and industry.

Scope

This is the first of two reports prepared for Alberta Environmental Protection's (AEP) Research Users Group. This report reviews the documents and programs currently in place for monitoring of biodiversity in Alberta's forested landscape. This report follows the request of AEP "To identify and test practical indicators for monitoring biodiversity, forest condition, productivity, and multiple benefits to society in forested landscapes at regional and provincial scales." A second report will develop indicators for Alberta's forested boreal landscape.

This and the following report are limited to:

1. Flora and fauna of the forested landscapes including aquatic species.
2. Habitat and landscape features closely related to abundances of flora and fauna of forested landscapes and aquatic zones.

Purposefully, the report has a narrow focus. A number of Services and Branches in Alberta Environmental Protection deal with other aspects of forest health and sustainability such as production of air and water pollutants, and socio-economic factors. These were not considered in this project. Although these factors have effects on biodiversity, they are not direct indices of plant or animal populations. As an example, no one would doubt the importance of clean air to plant and animal populations, however, measures of air quality does not substitute as a measure of plant or animal abundance. That is, with the exception of extreme cases, one could not determine the density of moose in an area from knowledge of air quality. Hence, this and the following report deal specifically with monitoring biodiversity and related elements of "forest sustainability" and "forest health". No doubt biodiversity criteria and indicators should be integrated with other criteria dealing with other elements, however, manpower, budget, expertise, and time considerations makes this integration beyond the scope of this project.

The project also reports on current ongoing biodiversity monitoring programs and databases in Alberta. We summarize major features of each program. However, a comprehensive review of the history and administration of each program are not presented; in depth information on programs is available through the administering personnel and organizations (contacts list in Appendix 20). Exhaustive scientific evaluation of each program is also beyond the scope of this project. To do this would require an evaluation of sampling techniques and analysis of data, as well as comparison with control datasets and analysis. Lastly, we have selected a broad crosssection of programs. No doubt we have not reported on some meritorious programs and we apologize in advance for any oversights.

Lastly, we realize this report is long. It is meant as part analysis, part review, and part reference document. The "gist" of the document can be ascertained from the Executive Summary. The Introduction, Scope, Discussion and General Conclusions provides more in-depth analysis. The report also presents summaries of all legislation, policies, external agreements and monitoring programs. We also include extensive

appendices and contact lists for the various pieces of legislation, policies, external agreements, and programs. Many of these documents are difficult to obtain and these appendices may be of particular value to resource managers in regional offices. The Appendices also allow the reader to evaluate our analysis and reporting and perhaps to form alternative views.

Introduction

In recent years, the scope of “sustainability” has shifted from being defined by economic assessments to include a broader sustainability of ecological functions and patterns, i.e. ecological integrity. This evolution in thinking has largely come about from a greater understanding of the linkages between living organisms and an increasing realization that changes made to a single part of an ecosystem can potentially reverberate throughout the whole ecosystem. The expanded definition of sustainability has led to a large number of new initiatives at the regional, provincial, federal, and international levels. National/International initiatives include; the Canadian Biodiversity Strategy (Canadian Biodiversity Strategy Working Group, 1995), Criteria and Indicators (Canadian Council of Forest Ministers, 1997), and non-governmental certification systems for forest companies (e.g. Forest Stewardship Council, 1997). Provincial initiatives include; Fish and Wildlife Division Strategic Plan (Alberta Forests, Lands, and Wildlife (Fish and Wildlife Division), 1991), Wildlife Act, Water Act, Alberta Forest Legacy Document (Alberta Environmental Protection, 1997), Alberta Forest Conservation Strategy (Alberta Forest Conservation Strategy Steering Committee, 1997), and the new Interim Forest Management Planning Manual (Alberta Environmental Protection (Land and Forest Service), 1997). Regional initiatives include; the Alberta Forest Biodiversity Monitoring Program (Alberta Forest Biodiversity Monitoring Program, 1998) and the Foothills Model Forest Phase II (Model Forest Network, 1997). These new initiatives will change the management of forested landscapes in Alberta.

One of the most perplexing issues in advancing and applying sustainable land use policies is the identification of suitable indicators of performance particularly biodiversity. There are a number of reasons for this difficulty:

1. There are many potential indicators and different levels of organization. In Alberta’s forested regions, there are approximately 460 species of vertebrates, 1300 species of vascular plants, 600 species of nonvascular plants, and tens of thousands of invertebrate species. Furthermore, species assemblages from hierarchical levels such as guilds and communities are also potential indicators. Lastly, habitat and landscape parameters closely related to species can also serve as indicators.
2. Species dependencies on habitat and landscape parameters are often unclear. Industrial development of forested landscapes often affect a number of habitat and landscape parameters simultaneously. Cause and effect is often not a one-to-one relationship, rather effects are due to cumulative effects.
3. Many populations are naturally variable over time and space. In the absence of changes in habitats or landscapes caused by industrial development, many populations naturally cycle with time and vary with geographic location, e.g. small- and medium-mammals.

4. Some species utilize non-forested and/or non-resident habitats over their lifespan. Migratory birds and fish are examples of species whose population densities may be affected by activities not associated with Alberta's forested landbase.

There are two broad views on the selection of indicators for monitoring. Indicators may be valued by stakeholders, and hence monitored to ensure their sustained supply. In many cases, economic, ethical, or aesthetic value determines value e.g. moose, woodland caribou, and thrushes, respectively. Alternatively, indicators may not be of direct value to stakeholders but may form an otherwise important component or output of ecosystem function, e.g. nitrifying bacteria, snags, or small mammals. In this case, monitoring forms the basis for understanding changes to ecosystems. The two types of indicators are not necessarily exclusive. There can be indicators of value to stakeholders which also perform an important ecosystem function, e.g. large predators.

Stakeholder and ecosystem indicators have also been associated with fine- and coarse-filter management approaches, respectively. Fine-filter approaches target specific values for management and indicators are developed for these values. In contrast, coarse filter approaches focus on broad ecosystem functions and patterns, and attempt to sustain these without emphasis on any single value. Coarse-filter indicators depend on the areas impacted by management actions or critical bottlenecks in ecosystem function and pattern. Unlike fine-filter indicators, coarse-filter indicators are not of value themselves, rather their primary value is in the ecosystem process they represent. Although the concepts of fine- and coarse-filter management are presented as alternatives, in the real world, we don't exclusively manage with either. Management should be a mix of the two philosophies.

The mix of fine- and coarse-filter management approaches and, hence, the types of indicators utilized for biodiversity will depend, in part, on the underlying legislation, policies, guidelines, and external agreements governing the management of a landscape. Alberta has a number of documents calling for monitoring of biodiversity. Some like the Canadian approach to Criteria and Indicators (Canadian Council of Forest Ministers, 1995 and 1997) describe criteria and some specific indicators and prescribe reporting by the year 2000. Other documents like the Interim Forest Management Planning Manual (Alberta Environmental Protection (Land and Forest Service), 1997) set a specific management framework, i.e. adaptive management, but only suggest areas of concern as guidelines for indicator selection.

Monitoring for biodiversity is not new in Alberta, on the contrary, it has had a long history with many ongoing programs. For example, the National Audubon Society's Christmas Bird Count was first organized in 1906 with regular sampling since the 1950's. Alberta furbearer database recording the catch of furbearing species has been entered into a national database since 1920/21 (Alberta Environmental Protection,

Natural Resources Service). More recent databases include the jointly organized Breeding Bird Atlas of Alberta (Federation of Alberta Naturalists, Canadian Wildlife Service, Alberta Environmental Protection, Natural Resources Service, and Provincial Museum of Alberta) released in 1992 and the Alberta Amphibian Monitoring Program initiated in 1991 (Alberta Environmental Protection, Natural Resources Service). Monitoring programs have different parent organizations, goals, species of concern, geographical coverage, and degrees of scientific soundness to data collection, management, and analysis. **In developing a biodiversity monitoring strategy for the forested landscapes of Alberta, these existing programs can potentially provide initial species lists, historical and geographical benchmark data, methodologies, and in some cases may substitute or supplement sampling of indicators.**

The objectives of this document are to review the legislation, policies/guidelines, and external agreement/agencies that provide a basis for management on the forested landscape. An understanding of the legislative and policy framework is key to identifying indicators. Furthermore, we review a number of the major federal, provincial, and non-government biodiversity monitoring programs in Alberta and assess the degree these programs fulfill the mandate objectives of the above documents.

Definitions

Adaptive Management is a formal process of problem assessment, hypothesis development, implementation, execution, monitoring, evaluation, and feedback. This approach is commonly used in areas where one or more of the consequences of management are unknown. The cycle of management activities are crafted as “experiments” to fill gaps in knowledge and provide a stepwise process to managing risk.

Biodiversity is the variability among living organisms from all sources including, interalia, terrestrial, marine, other aquatic ecosystems, and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Canadian Biodiversity Strategy Working Group, 1995).

Biomonitoring is the intermittent (regular or irregular) or continuous surveillance carried out to determine one or more of the following purposes (Hellawell, 1991).

1. Detecting ecosystem change.
2. Assessing the effectiveness of policy or legislation.
3. Regulatory (performance or audit functions), e.g. performance monitoring of objectives of forest management plans.

A number of traits characterize effective biodiversity monitoring. These include:

1. Clear linkage between mandate and indicator.
2. Repeated periodic sampling.
3. Standardized sampling techniques.
4. Clear, unambiguous, units for flora, fauna, habitat, or landscape features.
5. Geographically referenced sampling to an administrative or ecological zone.
6. Maintenance of long-term databases.
7. Analysis of long-term trends in data.
8. Public access to data, and analysis.
9. Widespread geographical coverage.

Criterion: A value by which sustainable forest management may be assessed (Canadian Council of Forest Ministers, 1995).

Indicator: A measure, which quantifies an aspect of a criterion (Canadian Council of Forest Ministers, 1995).

Criteria are broad categories that reflect a process or condition of value to stakeholders within a sustainable forest management program. Criteria are evaluated by the measured state of a number of different indicators.

The choice of criterion and indicator framework for organizing monitoring is not without controversy. One criticism is that the word “criterion” is not entirely appropriate. The Oxford definition of criterion is *a principle or standard by which a thing is judged*. For the Canadian Council of Forest Ministers, criteria forms a *principle* for judging sustainability not a standard, i.e., threshold value. Hence, the argument follows that these indicators cannot be used to measure sustainability since the sustainability is a threshold value.

Similarly, the term indicator has a number of definitions that may lead to some confusion. It can be defined as the thing that is measured (e.g. barred owl (noun)), the measure of the thing (e.g. number of barred owls, (prepositional noun)), or a trend in a measure of a thing (e.g. no decline in the number of barred owls, (prepositional verb)). It would seem insufficient to simply know the identity of an indicator, and not the degree of change that would signal unsustainable use.

The organization of monitoring indicators should reflect that sustainable forestry is a concept defined by the summation of many factors, though some would argue an almost inexhaustible number of factors. For that reason, sustainability itself cannot be measured, rather only elements of that sustainability. One suggestion to revise criteria and indicator organization is to use:

Elements of Sustainable Forest Management: categories of forest attributes which in combination determine forest sustainability.

Indicators of Sustainable Forest Management: measures of forest attributes which determine whether the forest is being managed sustainability.

The use of the term *elements*, implies that no one category of measures will establish forest sustainability. Instead, there are suites of measures, all of which must be assessed separately and synthesized into an overall judgement about forest sustainability. The first technical report on Criteria and Indicators by the Canadian Council of Forest Ministers revised their definitions to include *elements* as subclasses of criteria (Canadian Council of Forest Ministers, 1997). For example, the criterion, conservation of biological diversity includes the elements; ecosystem diversity, species diversity, and genetic diversity.

No doubt the discussion on terminology could and should continue. However, it should not block further work on developing a monitoring framework and indicators. Our suggestion is to adopt a tentative terminology and continue with development of a monitoring framework and identification of indicators. In part, the monitoring framework and indicators developed will serve to modify our definitions.

Provincial Legislation

There are seven primary acts affecting biodiversity in Alberta's forested landscape. These are:

1. Wildlife Act
2. Forests Act
3. Water Act
4. Wilderness Areas, Ecological Reserves, and Natural Areas Act
5. Provincial Parks Act
6. Forest Development Research Trust Fund Act
7. Public Lands Act

None of the seven Acts contain specific references to monitoring. Rather, monitoring is an activity which needs to be performed in the context of fulfilling legislated mandates. Listed below are the Acts utilizing monitoring of biodiversity to fulfill their mandates. Also, we list the potential areas affected by monitoring.

Wildlife Act

The Wildlife Act primarily sets forth the obligations of the Government in terms of conserving and protecting wildlife species (excerpts in Appendix 1). Much of the Act deals with extractive uses of wildlife such as fishing, hunting, and trapping with smaller sections on protection of non-game species, habitat protection, and restoration. All these activities implicitly require monitoring as part of the decision-making process for establishment and allocation of resources. Below are the general areas of the Wildlife Act that could be directly tied to monitoring for biodiversity.

1. Activities, programs or services relating to fish and wildlife.
2. Maintenance of wildlife records.
3. Registration of wildlife.
4. Development of wildlife sanctuaries, habitat development areas, migratory bird sites or all wildlife control areas.
5. Protection and restoration of wildlife habitat.
6. Reporting over wildlife killed.

New sections of the Wildlife Act addresses the identification and management of endangered species. Clearly, monitoring would have an impact on the early identification of the species at risk and the subsequent recovery species (excerpts in Appendix 1). Below are listed the areas of endangered species management that would be directly affected by monitoring.

1. Expansion of endangered species to cover plants, fish, invertebrates, and fungi.
2. Early identification of species at risk, adjournment of Endangered Species Committee and Subcommittees.

3. Identification of critical habitat.
4. Development of recovery plans.

Forests Act

The Forests Act mandates the monitoring of forested landscapes and canopy tree species primarily for fire protection and commercial utilization. In terms of commercial harvest, the primary management of forest landscapes is spelled out in Forest Management Agreements (discussed in the Provincial Policies/Strategies/Guidelines section). Biodiversity monitoring potentially affects the following areas (excerpts in Appendix 2).

1. Establishment of annual allowable cut.
2. Ratifying Forest Management Agreements.
3. Charges for damage to timber stands in cutting roads, lines, rights of way, or another disturbance of forest.
4. Reforestation on public land.
5. Management and use of forest land.
6. Logging methods and wood utilization.
7. Zoning and regulation of forest land use.
8. Declaring forest lands for recreation and controlling entry into forested areas.
9. Controlling and prohibiting activities within forested areas.

Water Act

The Water Act clearly outlines a process for incorporating biodiversity within water management plans. The Act requires the development of conservation objectives involving biodiversity, guidelines to implement the management plan, and integration of aquatic and terrestrial ecosystems. The general areas dealing with biodiversity monitoring are outlined below (excerpts in Appendix 3).

1. Planning, assessment, and establishing geographical limits or boundaries on water systems.
2. A framework for developing, implementing, reviewing, and revising management plans.
3. Integration of water management with land and other resources.
4. Development of conservation objectives.
5. Development and implementation of an Aquatic Environment Protection Strategy including the protection of biodiversity.

Provincial Parks Act and Wilderness Areas, Ecological Reserves, and Natural Areas Act

According to the Parks Act, protected areas have two primary functions; first is the conservation and management of flora and fauna, and second is the preservation of geological, cultural, ecological, and values of scientific interest (excerpts in Appendix

4). Monitoring will undoubtedly assist in assessing the level of conservation and preservation in and around protected areas of Alberta. Furthermore, some protected areas may serve as ecological benchmarks for monitoring programs. In particular, monitoring will aid managers with the following issues (excerpts in Appendices 4 and 5):

1. Identifying potential gaps in the conservation of flora and fauna.
2. Identifying potential gaps in the conservation of representative, unique, endangered, or rare ecological areas.
3. Designation of public lands for ecological reserves or controlled buffer zones adjacent to ecological reserves.
4. Increase or decrease of land area designated as a protected area.
5. Setting geographical boundaries for new protected areas.
6. Regulation of activities within protected areas including commercial and scientific activities, the use of all motorized vehicles, issues relating to the feeding of wildlife, and park use zoning.

Forest Development Research Trust Fund Act

The Alberta Forest Research Advisory Council deals with the establishment of forest research priorities, co-ordination of forest research, and recommendations to the Minister regarding the allocation of research funds (excerpts in Appendix 6). Proposals for research are submitted by industry and evaluated by a committee composed of government and industry members. Decisions on the allocation of the fund are the joint responsibility of industry and the provincial government. The fund mandates a wide range of research and development but cannot be used for legislated responsibilities. In the past, funding was primarily granted to forest improvement projects centered on regeneration of trees and more efficient utilization of wood. Lately, projects have included biodiversity areas. In the future, monitoring concerns and activities may affect the allocation of funds.

Public Lands Act

As with the Forests Act, monitoring for biodiversity may alter the management of public lands in Alberta. Like most of the other Acts, the Public Lands Act does not explicitly outline biodiversity monitoring; however, monitoring may have some input into the management and decision processes (excerpts in Appendix 7). Specific areas which may be affected include:

1. Classification of land.
2. Alteration of ground cover.
 1. Protection of soil resources.
 2. Protection of beds and shorelines of watercourses and water bodies.
 3. Protection of watershed capacity.
 4. Maintenance of shelterbelts.

5. Withdrawals from leases.
6. Use of timber resources on the land.
7. Development of permanent access on land.

AEP Departmental Measures of Performance

The three year business plan (1997 – 2000 year) develops goals, strategies, and measures of performance for Alberta Environmental Protection (Alberta Environmental Protection, 1997b). The plan calls for some measurements of performance whose indicators are both direct and indirect measures of biodiversity (excerpts in Appendix 8). Three performance measures evaluate biodiversity.

1. Timber sustainability.
2. Species at risk.
3. Area in parks and natural reserves.

Timber sustainability is dealt with through the Forest Management Branch of Land and Forest Service. Due to the economic importance of the timber industry, no other wild species receives as much administrative support and funding for monitoring. Though primarily concerned with sustainable flows of commercial trees species, the tools used to measure and allocate these sustainable flows have some practical value in serving as indicators for biodiversity. Data sources fall into two categories; landscape data and stand-level (polygons, primarily through PSPs) data. Remotely sensed data, in particular Phase III data (Alberta Energy and Natural Resources, 1985) and Alberta Vegetation Inventory (Alberta Forestry, Lands and Wildlife 1991) serve as potentially important data sources for landscape diversity. Currently, resource managers use these data primarily for timber inventory and land classification. However, repeated mapping and archive of older maps could provide long-term trends in landscape dynamics. Aside from these landscape datasets, permanent sample plots (PSPs) are a potentially valuable source of local monitoring data. The primary focus of this monitoring is the estimation of standing volumes and growth and yield of commercial tree species. However, the plot and tree measurements could provide important correlates for biodiversity (e.g. snags). A later section on Biodiversity Monitoring Programs in Alberta will discuss PSPs in greater detail. Landscape parameters and traditional growth and yield measurements need to demonstrate clear linkages to biodiversity to be useful as indicators of biodiversity.

The Wildlife Act provides for province-wide protection of species at risk. To fulfill the performance measure, potential species at risk are assessed, prioritized, and publicly released every five years in the Status of Alberta Wildlife document. (Alberta Environmental Protection (Natural Resources Service), 1996). A later section on Policy for the Management of Threatened Wildlife in Alberta and Status of Alberta Wildlife Reports provides further discussion.

The third performance indicator is the area in parks and reserves. In terms of monitoring for biodiversity, protected areas have potential value in providing relatively undisturbed benchmarks. These areas also serve as reservoirs of diversity at the

genetic, species, and community levels. In addition to the existing system of protected areas, the Special Places 2000 program hopes to complete the representation of the province's six Natural Regions (20 sub-regions). The program was initiated in 1992 and is to be completed before the year 2000 (Alberta Environmental Protection, 1995). Private citizens, industry, municipalities, land authorities, or conservation groups nominate Special Places sites. Local and provincial coordinating committees accept and review nominations. Review and subsequent submissions to the Minister and the Cabinet are based on Special Places Policies and Principles and scientific criteria. Nominated sites filling existing gaps in the natural regions framework take priority over other nominations. Currently, the program has nominated all sites and achieved representation of the natural regions and 20 sub-regions. These sites are being reviewed by local and provincial coordinating committees.

Fish and Wildlife Policy for Alberta/Fish and Wildlife Division Strategic Plan

The 1982 Fish and Wildlife Policy for Alberta firmly establish the concepts of sustainable use and biodiversity monitoring (Alberta Public Lands and Wildlife, 1982; excerpts in Appendix 9). It argues that the primary considerations of the government are to **ensure protection of wildlife populations from severe decline and maintenance of viable populations**. Furthermore, it argues that the Fish and Wildlife Division (now called Natural Resources Service) functions as an advocate within the government to pursue this goal. The policy recognizes biodiversity monitoring as playing a major role in achieving goals and as such demands that the Minister responsible make periodic declarations of present and projected resource demands.

The Fish and Wildlife Division Strategic Plan is a restatement of the policy with specific objectives and activities (Alberta Forests, Lands, and Wildlife (Fish and Wildlife Division), 1991; excerpts in Appendix 10). The strategy has a number of goals; conservation, allocation, recreational fishing, and recreational hunting, which require long-term programs for inventory and assessment. It states that "all goals are important elements...although the resource conservation goal is paramount" (p 15). As an example, one of the objectives of the conservation goal is " To commence monitoring the health and soundness of all significant fish and wildlife ecosystems". The 1991 strategy also expands the mandate of the 1982 policy to include recognition of invertebrate species and ecosystems.

Policy for the Management of Threatened Wildlife in Alberta and Status of Alberta Wildlife Reports

In 1985, Alberta Energy and Natural Resources released a Policy for the Management of Threatened Wildlife in Alberta (Alberta Energy and Natural Resources (Fish and Wildlife Division), 1985; excerpts in Appendix 11). This policy recognizes and provides management strategies for "endangered species". In terms of monitoring, it establishes a strategy of provincially coordinated inventory programs to be designed

and conducted at regular intervals. These regular surveys will assess and prioritize the status of species.

In response to this monitoring goal and the recent departmental performance measures, Natural Resources Service periodically publishes the Status of Wildlife in Alberta Report (Alberta Energy and Natural Resources (Fish and Wildlife Division), 1984; Alberta Forestry, Lands, and Wildlife. (Fish and Wildlife Division), 1991; Alberta Environmental Protection (Natural Resource Service), 1996). The intent is to reassess and report the status of Alberta's wildlife every five years. Expert opinion is solicited to assess the qualitative status of a species. Past and current reports, which do not include fish, plant, or invertebrate species, likely underestimate the total number of species at risk.

Currently, species are classified as extirpated, red, blue, yellow, green, or undetermined status (See Appendix 12 for definitions and lists). The current 1996 edition surveyed over 483 bird, mammal, reptile, and amphibian species. Twenty-nine species were listed as either blue or red status, 93 yellow listed species, 340 green listed species, and 18 species were of undetermined status. Species found in forested landscapes account for a significant percentage of red, blue, and yellow listed species (Appendix 12). Approximately, 33% (2/6) amphibian, 37.5% (3/8) reptile, 67% (55/82) bird, and 53% (14/26) mammal species inhabit forested riparian or upland forest landscapes. Yellow B listed species potentially serve as important indicators of changes in forested landscapes. The population dynamics of some species are particularly sensitive to habitat changes or inhabit rarer habitats, e.g. old growth.

A Fish Conservation Strategy for Alberta

Alberta Environmental Protection developed the Fish Conservation Strategy for Alberta (Alberta Environmental Protection, 1997a; excerpts in Appendix 13) to guide the management of fish resources in a manner consistent with the Fisheries Act of Canada, the Fish and Wildlife Policy for Alberta, and the business plans of Alberta Environmental Protection and Natural Resources Service. The mission statement for the Fisheries Management Division is, "Sustain the abundance, distribution and diversity of fish populations at the carrying capacity of their habitats." Three primary goals flow from this mission statement:

- Habitat Maintenance—sustain, or achieve a net gain in, the quality and quantity of fish habitat;
- Fish Conservation—regulate fish harvest in line with, and not exceeding, the productive capacity of fish populations; and
- Fish-use Allocation—manage fish populations in a manner that meets the present expectations of Albertans without compromising the ability of future generations to meet their expectation.

The guiding principles for management highlight monitoring of aquatic habitats and fish populations. Four guiding principles call for monitoring:

1. No net loss of the productive capacity of habitats.
2. Fish populations are to be maintained by natural reproduction wherever possible.
3. The biological diversity of the fish fauna is to be maintained and the depletion or extirpation of species, populations, sub-populations, or unique strains must be avoided.
4. The management of the fisheries will be conducted on the basis of fundamental ecological principles and factual information.

Though, the guiding principles mandate management efforts across all biodiversity, in practice, game species are the focus of both aquatic habitat and fish population monitoring. Studies of benthic invertebrates are often done in conjunction with pollution studies. Other aspects of aquatic biodiversity are relatively poorly monitored (See Biodiversity Monitoring Programs in Alberta section).

Alberta Forest Conservation Strategy

The Alberta Forest Conservation Strategy is a comprehensive strategy document dealing with the management of the forested landscape (Alberta Forest Conservation Strategy Steering Committee, 1997; excerpts in Appendix 14). Six principles guide the strategy: ecological sustainability, economic sustainability, precautionary principle, adaptive management, accountability, and decision-making.

Through the precautionary principle, the strategy acknowledges the consequences of management actions are often uncertain. To deal with uncertainty, adaptive management using scientific information, ongoing research, and monitoring should be applied (Recommendation 4). Recommendation 6 further fleshes out the adaptive management plan, setting forth the broad objectives for forest planning (see next section on Interim Forest Management Agreement Planning Manual-Guidelines). These broad objectives are similar to criteria set forth by the Canadian Council of Forest Ministers (Table 2; Canadian Council of Forest Ministers, 1997). The Alberta Forest Conservation Strategy. Recommendation 12 (Alberta Forest Conservation Society Steering Committee, 1997) supports the monitoring framework of the Canadian Council of Forest Ministers Criteria and Indicators (Canadian Council of Forest Ministers, 1995).

The strategy also recommends that the government provide opportunities not only for extensive management of the forested land base but also intensive management. These areas would focus on maximizing a primary product such as timber production, wildlife habitat, or tourism opportunities. Since this is a new management direction, resource managers require biodiversity monitoring to evaluate the impacts of this shift in policy (Recommendation 15).

Lastly, the strategy calls for the identification and protection of Special and Representative Protected areas (Recommendation 13) through the current network of

protected areas and completion of the Special Places Program. Two types of protected areas are important to the strategy. Special Protected areas would include unique or exceptional biological, geological or cultural features offering unique opportunities to study natural processes. Representative Protected areas would include areas typical of natural regions and subregions of Alberta. They would be selected on scientific basis to provide: baseline or natural history data, opportunities to observe natural processes, and preservation of biodiversity.

The Alberta Forest Legacy

The Alberta Forest Legacy (Alberta Environmental Protection 1998) is an implementation framework built on recommendations provided to the provincial government by public consultation since 1990. The legacy document is Alberta Environmental Protection's attempt to provide an integrated response to the recommendations to expert and public consultation processes including: Report of the Alberta Round Table on Environment and Economy (Alberta Round Table on Environment and Economy, 1993), Forest Management in Alberta: Report of the Expert Review Panel (Alberta Forestry, Lands, and Wildlife, 1990), and the Alberta Forest Conservation Strategy (Alberta Forest Conservation Strategy Steering Committee, 1997).

Throughout the Alberta Forest Legacy, there is an explicit support for monitoring with adaptive management providing a management context for monitoring. The Legacy document adopts the landbase allocation philosophy found in the Alberta Forest Conservation Strategy. The landbase is divided into facility, heritage, extensive and intensive management landbases. The heritage landbase includes historical sites of significance as well as natural landbase programs such as Alberta's Special Places program. The extensive landbase supports a sustained multiple use to both timber and non-timber use. Interspersed within the extensive landbase are intensive management zones. These zones support an increased output of a single or small group of values. Potential outputs include timber, grazing, land, wildlife, and recreational opportunities. On all landbases, the resource managers will monitor planning and management activities. Scientific research and monitoring forms the basis for revising management plans on the extensive and intensive management landbases.

Like many of the other documents, the Legacy document divides the sustainability of forests into ecological integrity and societal options. This organizational division results in different frameworks for monitoring and potentially different indicators. The Legacy document affirms the role of monitoring for ensuring the ecological integrity of the forest. In particular, ecological management, research, reference areas, and Special Places 2000 are important components of integrity. These areas also require the development of monitoring and indicators. Under the section on Society's options, the Provincial Government retains its mandate on stewardship enforcement and monitoring, and assessments of performance. Stewardship enforcement and monitoring refers to the maintenance of traditional regulatory functions for AEP.

Lastly, the Legacy document support the reporting of indicators from the 1995 Canadian Council of Forest Ministers document, “Defining Sustainable Forest Management: A Canadian Approach to Criteria and Indicators.”

Interim Forest Management Planning Manual

The Interim Forest Management Planning Manual is a departure from the status quo. Appendix 15 lists excerpts from sections on biodiversity and monitoring. The manual provides guidelines rather than a “formula cookbook” for development and submission of forest management plans. Companies have the ability to develop and rationalize many aspects including:

- Resource management philosophy;
- Resource management goals (biological, economic and social);
- Forest management objectives, evaluation of resource management strategies and selection of the preferred forest management strategy;
- The implementation strategy (How the plan will be delivered operationally);
- Performance Monitoring (What is monitored and tracked annually or periodically and what is reported in the stewardship report).

More than any other document, the Interim Forest Management Planning Guidelines lay out how monitoring will be incorporated into management. Companies develop a resource management philosophy from which management goals, plans, implementation, and monitoring flow. The philosophy takes into account the current legislation, policies, and plans that provide direction in forest management. The philosophy and goals should also assess the whole landscape including both commercial timber and non-timber values. Indeed, one of the major differences between the previous method for development of FMAs and interim planning guidelines is the importance placed on non-timber values. This emphasis is present from the development of the philosophy to performance monitoring stages.

Adaptive management and monitoring enter the development of the FMA in the Objectives and Strategy Evaluation phase. Projection of the “future forest state” determines selection of objectives and strategies. That is, companies set both short- and long-term objectives and strategies that produce the “desired” landscape in the future. The objectives must be measurable, and should be linked to criteria/ indicators. Some of the biodiversity related areas suggested for consideration in defining objectives and, hence, monitoring include: ecological, timber, silviculture, watershed, and wildlife habitat (Appendix 15). Through the Public Involvement Plan, stakeholders and members of the public may also be involved in determining objectives, strategies, and indicators.

Companies will report the outcomes of monitoring in two forms. Annual reports will track the cumulative trends in indicators from the time the forest management plan is implemented. Annual reports require no formal submission to the province but are reviewed as outlined by the Public Involvement Plan. Every five years the company

would prepare and submit a formal stewardship report to the province. The report focuses on performance successes and problems. The government then works with the forest industry on monitoring and reporting external factors that may affect the performance.

The implementation of these forest planning guidelines will have a significant impact on the monitoring for biodiversity in forested regions in Alberta. The annual and five year performance reports could potentially become one of the most important sources of biodiversity monitoring data in Alberta. Cooperative efforts should be made by forestry companies operating in similar natural regions or subregions to utilize similar indicators and monitoring techniques. This would make the data more geographically relevant and allow for broad spatial comparisons.

External Agencies/Agreements

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

COSEWIC is a process for compiling, evaluating, and maintaining a national database of endangered, threatened, and vulnerable species. It provides non-binding status reports on Canadian species and is administered by the Canadian Wildlife Service. Listing decisions are made by a body of government, academic and non-government experts which categorizes species at risk as extinct, extirpated, endangered, threatened, or vulnerable. In 1997, COSEWIC listed 276 species in risk categories (COSEWIC, 1997). In comparison to Alberta's 1996 Status of Wildlife reports (Alberta Environmental Protection (Natural Resources Service), 1996), COSEWIC has some obvious differences. Most importantly, the status reports do not designate endangered species. Rather, the report makes a first cut at prioritization for subsequent detailed studies of status. AEP Natural Resources Service, consider red and blue listed species as at risk or may be at risk, respectively. These species then move forward for detailed status reporting. In contrast, COSEWIC fully lists species in categories of endangerment. COSEWIC has formal coverage of fish, insects, plants, and mollusks. These are not currently considered in Alberta's 1996 Status of Wildlife Report though plans to include fish, insects, and vascular plants are underway for the 2001 reports. Since species do not recognize political boundaries, both provincial and federal governments have moved to unify the assessment and designation of endangered species. The proposed Canadian Endangered Species Protection Act requires provinces to have an assessment system.

The impact of the COSEWIC lists to the already enumerated forest species in the 1996 Status of Alberta Wildlife lists is likely to be minimal. All terrestrial mammals, birds, amphibians, or reptiles accounted from COSEWIC lists (Endangered or Threatened or Vulnerable) were already accounted in The Status of Alberta Wildlife Report (all categories). Even the broadening of status reports to consider fish, invertebrates, and plants, would potentially add only two species (short-jawed cisco and Banff Springs mollusk) to the yellow, blue, or red lists.

Canadian Biodiversity Strategy

In 1992, the federal government with the support of provincial and territorial governments ratified the United Nations Convention on Biological Diversity. To fulfill the requirements of the agreement, the federal/provincial/territorial governments began work on the Canadian Biodiversity Strategy (Canadian Biodiversity Strategy Working Group, 1995). The strategy contained five primary goals:

1. Conservation of biodiversity and sustainable use of biological resources.
2. Improving understanding of ecosystems and increasing resource management capability.

3. Promote understanding of the need for biodiversity and use of biological resources in a sustainable manner.
4. Maintain or develop incentives and legislation that support biodiversity and sustainable use of biological resources.
5. Promote conservation and sustainable resource use in other countries.

Alberta, along with the governments of other provinces, territories, and Canada, is committed to using the Canadian Biodiversity Strategy as a guide for conserving biodiversity and ensuring sustainable use of biological resources. Alberta Environmental Protection released a draft response in October, 1997 (Alberta Environmental Protection (Natural Resources Service), 1997).

Throughout the Canadian Biodiversity Strategy, monitoring plays a key role. Twenty-nine of the strategic directions within the strategy relate to monitoring of biodiversity with most of these in the sections on Conservation, Sustainable Use and Ecological Management (excerpts in Appendix 16). The monitoring mandate is for both fine- and coarse-filter indicators. Despite the heavy emphasis on biomonitoring, the document provides no specific indicators. The only direction given is that ecosystems, landscapes, species, and genetic diversity should be all monitored.

Certification Systems for Sustainable Forest Management

There are underway a number of certification systems for sustainable forest management. Several different organizations such as non-profit NGOs (e.g. Rainforest alliance), for profit private sector companies (e.g. SGS forestry), and the forest industry itself are developing certification systems or standards. Three of the largest associations formulating standards are; Canadian Standards Association (CSA), International Organization for Standardization (ISO 124001-96), and Forest Stewardship Council (Canadian Standards Association 1996a; Canadian Standards Association 1996b; Forest Stewardship Council 1997; Huseini et al. 1996ab).

As of the writing of this report, no companies in Alberta have implemented these certification standards, though a number are evaluating their positions with respect to applying. In part, there is concern from industry for implementing such standards because this will add to the cost of production and the current marketplace does not demand certification. Governments are also reluctant to have such standards in place because of differences in approaches to forest policy by federal, provincial, territorial governments, and the potential for market exclusions (Committee of Assistant Deputy Ministers on International Forest Issues, 1996).

National Forest Strategy and Canadian Forest Accord

In 1991, the Canadian Council of Forest Ministers began development on a new National Forestry Strategy to replace the 1987 strategy (Canadian Council of Forest Ministers, 1987). The groundwork for a new strategy developed through a series of

public forums. In 1992, a new National Forest Strategy document was released. It contained nine strategic directions with 96 commitments, covering the full range of activities within the forestry sector of Canada. Commitment to the new strategy was sought through the Canadian Forest Accord (National Forest Sector Strategy Coalition 1997). Signatories to the Accord included provinces, territories, the federal government, Aboriginal interests, non-governmental organizations, industry agencies, private woodlot owners, labor, education, and professional associations. The strategic directions included; forest stewardship, forest management practices, public participation, economic opportunities, forestry research and technology, workforce changes, Aboriginal people, private forests, and global views. Table 1 lists the commitments dealing with monitoring for biodiversity.

In 1997, The National Forest Sector Strategy Coalition released a final report with the general conclusion that "substantial progress had been made in these strategic directions and commitments" (National Forest Sector Strategy Coalition, 1997). Of the 14 commitments that dealt with some aspect of monitoring and standards, four commitments were "fulfilled" or "achieved substantial progress" (Table 1). Most of these commitments were in the strategic directions of Public Participation and Economic Opportunities dealing with the acceptance of indicators/standards by the public or industry. Most biodiversity monitoring commitments in the strategic directions of Forest Stewardship (Forest Environment or Management) achieved only "some progress" or in three cases "little or no progress" ratings.

Table 1: National forest strategies and commitments relating to biodiversity monitoring and their relative status as of the final report in 1997.

<i>Strategic Directions, Objectives, and Commitments</i>		<i>Status of Commitment</i>
Strategic Direction One; Forest Stewardship: The Forest Environment		
Objective: To improve our ability to manage forest ecosystems and to maintain their productive capacity and resilience.		
1.1	Governments will complete an ecological classification of forest lands.	Some progress
1.2	Public and private forest management agencies will include measurable objectives for the state of the forest ecosystem in their forest management plans.	Some progress
1.3	Public and private forest management agencies will evaluate local soil, climate, and wildlife conditions as part of the planning process for forest roads, harvesting systems and silviculture activities.	Some progress

Table 1: continued

Objective: To ensure forest management activities maintain the	
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diversity of our forests.		
1.6	By 1995, governments, in consultation with the forest community and the public, will develop working definitions of biodiversity applicable to Canada's forests.	Some progress
1.7	By 1995, the CCFM will establish a system for reporting nationally on the state of forest biodiversity.	Little or no progress
1.8	All members of the forest community will work towards completing, by the year 2000, a network of protected areas representative of Canada's forests, to provide ecological benchmarks, protect areas of unique biological value and ensure wilderness experience.	Some progress
1.9	Governments, in consultation with the forest community and the public, will develop working definitions of old-growth forests and formulate forest management strategies to ensure the continuation of old growth as a natural heritage.	Some progress
1.11	Public and private forest management agencies will include specific measures to maintain biodiversity in their forest management plans.	Little or no progress
Strategic Direction Two: Forest Stewardship: Management Practices		
Objective: To improve our ability to plan for a full range of forest values.		
2.1	Public and private forest management agencies will broaden the scope of their inventories to include the additional information needed to manage forests on an ecosystem basis, to provide for a full range of forest values and to forecast the growth and yield of various forest resources.	Little or no progress
Objective: To encourage forest stewardship and the use of the best forestry practices.		
2.17	By 1994, members of the forest community will cooperate to establish working models of sustainable forest management in the major forest regions of Canada.	Fulfilled
Strategic Direction Three: Public Participation: Expanding the Dialogue		
Objective: To improve public access to easy-to-understand information on forests.		
3.4	By 1993, the CCFM will prepare a plan to upgrade the national database on forests to improve information on forest regeneration, and to include data on non-timber values such as wildlife, wilderness and recreation.	Some progress
3.5	By 1993, the federal government will develop a system of national indicators to measure and report regularly on progress in achieving sustainable forest management.	Fulfilled
3.6	Governments will regularly publish reports on the state of our forests.	Some progress

Table 1: continued

Strategic Direction Four: Economic Opportunities: A Changing Framework		
Objective: To increase the use of Canadian goods and services in world markets.		
4.12	Industry and governments will work cooperatively to pursue joint technical discussions aimed at internationalizing product standards, codes and certification procedures.	Fulfilled
4.17	By 1994, forest-based industry associations will adopt self-regulating codes of environmental practice.	Substantial progress

Canadian Council of Forest Ministers Criteria and Indicators

In response to the National Forest Strategy (Action 3.5), the Canadian Council of Forest Ministers (1995) produced criteria and indicators for development of sustainable forestry in the temperate and boreal forests. Biological diversity, ecosystem condition and productivity, and multiple benefits to society featured indicators were three criteria directly related to biodiversity (Table 2). As of the writing of this document, Alberta, along with the other provinces, is working on reporting some indicators by the year 2000. Of the 15 indicators directly affecting biodiversity, Alberta plans to provide reports on 10 by the year 2000 (Canadian Council of Forest Ministers C & I Task Force, 1997). A preliminary technical report provided a synopsis of the current ability to measure and analyze forest values (Table 2; Canadian Council of Forest Ministers, 1997). Pre-existing data was most readily available for indicators related to “traditional” forest measurements. There has been much less development on identifying biodiversity indicators and establishing databases.

Table 2: Canadian Council of Forest Ministers biodiversity criteria and indicators for development of sustainable temperate and boreal forestry. Preliminary indicators are listed in the left hand column (Canadian Council of Forest Ministers, 1997).

Criteria 1: Conservation of Biological Diversity	Data from 1996 Criteria and Indicators Technical Report
1.1 Ecosystem diversity	
1.1.1 Percentage and extent, in area, of forest types relative to historical condition and total forest area.*	All of Canada has 15 ecozones. Alberta is divided into 4 zones; Montane Cordillera; Boreal Plains, Taiga Plains, and Boreal Shield. No mention of the “historical condition and total forest area.”
1.1.2 Percentage and extent of area by forest type and age class (ref. 2.2.1).*	Forest ages range to greater than >160 appropriate for Alberta but unclear to what extent the percentage in Alberta. In appropriate for Pacific Maritime ecozones.

Table 2: continued

<p>1.1.3 Area, percentage and representativeness of forest types in protected areas^a.*</p>	<p>Protected areas; strictly protected and other protected. The latter permits logging and other industrial activity as long as it does not conflict with the overall goal of conserving natural systems. By ecozones in Alberta, protected areas change from 1985 to 1995 () represent strictly protected areas; Montane Cordillera 8.7(8.5)-9.5(9.3)%, Boreal Plains 8.1(6.9)-8.7(7.2)%, Taiga Plains 5.5(3.2)-5.6(3.3)%, and Boreal Shield 7.9(2.5)-8.5(3.0)%.</p>
<p>1.1.4 Level of fragmentation and connectedness of forest ecosystem components.</p>	<p>No summary. Suggest using density of roads for the entire ecozone.</p>
<p>1.2 Species diversity</p>	
<p>1.2.1 Number of known forest-dependent species classified as extinct, threatened, endangered, rare or vulnerable relative to total number of known forest-dependent species.*</p>	<p>Forest dependent species by ecozone listed by COSEWIC (vulnerable, threatened, or endangered, respectively); Montane Cordillera (3, 1, 0), Boreal Plains (2,1,0), Taiga Plains (no reporting), and Boreal Shield (1,0,2). Appendix 17.</p>
<p>1.2.2 Population levels and changes over time of selected species and species guilds.*</p>	<p>No report of changes, however, a listing of potential indicator species by age of stand. Number of potential indicator species in each ecozones of young, mature, and old-growth forests; Montane Cordillera (5, 4, 5), Boreal Plains (6, 11, 6), Taiga Plains (no reporting), and Boreal Shield (4, 7, 5). Appendix 17.</p>
<p>1.2.3 Number of known forest-dependent species that occupy only a small portion of their former range.*</p>	<p>Reports of species with >50% reduction in the historical range excluding COSEWIC species. Number of animal and plant species, respectively in each ecozones; Montane Cordillera (11,0), Boreal Plains (6,1), Taiga Plains (no reporting), and Boreal Shield (7,3). Appendix 17.</p>

^a As defined by the Canadian Biodiversity Strategy Working Group 1995.

* Alberta assessments being made for reporting in the year 2000.

Table 2: continued

1.3 GENETIC DIVERSITY	
1.3.1 Implementation of an <i>in situ/ex situ</i> genetic conservation strategy for commercial and endangered forest vegetation species.	Most provinces and territories do not have Genetic conservation strategy. Alberta reports 226 provenance tests, seed orchards (450 families and 298 clones), 736 clonal archives, and 3,722 seed archives.
Criteria 2: Maintenance and Enhancement of Forest Ecosystem Condition and Productivity	
2.2 ECOSYSTEM RESILIENCE	
2.2.1 Percentage and extent of area by forest type and age class (ref. 1.1.2).	See 1.1.2.
2.2.2. Percentage of area successfully naturally regenerated and artificially regenerated.	Data is available, report only summary for all forested areas of Canada. Successful regeneration of 90% of sites within 10 years of harvesting.
2.3 EXTANT BIOMASS (BIOTA)	
2.3.1. Mean annual increment by forest type and age class.*	Data derived for each ecozone broken down by species from National Forestry Database. No time trend data reported.
2.3.2. Frequency of occurrence within selected indicator species (vegetation, birds, mammals, and fish).	No values reported. Document refers to 1.2.2. (Population levels and changes over time for selected species and guilds).
Criteria 5: Multiple Benefits to Society	
5.1 Productive Capacity	
5.1.1. Annual removal of forest products relative to the volume of removals determined to be sustainable.*	Reports a relatively stable (1970-1994) total AAA for Canada, data not broken down by provinces/territories or ecozones. These are presented with the Stats Canada data on the number and value of pelts by species (1990-1995).
5.1.3. Animal population trends for selected species of economic importance.*	Currently, there is no national systematic method in place to track populations of commercially important wildlife species across Canada.

Table 2: continued

5.1.4. Availability of habitat for selected wildlife species of economic importance.*	A national scientific assessment of habitat status for major forest-dwelling game and fur-bearing species would complement research and information on population status.
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The status of reporting for biodiversity indicators is in relatively poor shape. Specific indicators for industrial impacts on the broad forest types forests are not given except in relation to stand age. Also the land classification, i.e., ecozones, utilized at the national level will not match the Alberta Environmental Protection system of ecoregions and subregions. Lastly, the national framework for evaluation of endangered species differs from Alberta's. This makes the use of the suggested Canadian Council of Forest Ministers biodiversity indicators unclear at best.

In part, the problem is that national indicators of biodiversity "roll-down" very poorly to the regional level. The processes that affect population numbers vary a great deal between ecozones and even within an ecozone. Similarly, ecozones will have a great deal of natural variability in species distributions making species characterization of ecozones impossible or very general at best. An argument can be made for reversing this process. That is, for areas of potential impact, indicators should be recognized at the regional level and "rolled-up" to the national level. In the end, the national indicators may be a broad list of very regional indicators that recognize the diversity of both industrial impact and biodiversity in forest regions of Canada.

Biodiversity Monitoring Programs in Alberta

Introduction

The intention of this section is to review current biodiversity monitoring in Alberta. Program summaries will include:

1. Parent organization.
2. Mandate and purpose.
3. Species or species groups monitored.
4. Geographic coverage.
5. Sampling protocols, data management, and analysis methodology.
6. Reporting.

By summarizing current monitoring programs, gaps may be identified and improvements made. Along with summaries of each monitoring program, a listing of reviewed programs is provided in Appendix 19. A contact list can be found in Appendix 20 which includes telephone numbers for the representatives and agencies/organizations reviewed in this section.

Government of Alberta Monitoring Programs

Avifauna Monitoring Programs

Peregrine Falcon Monitoring Program

Peregrine falcons were nearly extinct by the time the Peregrine Falcon Monitoring Program was established in 1970. These falcons are now expanding their population into their former range, partly due to the enormous effort of this monitoring program. The Natural Resources Service (NRS), Canadian Wildlife Service (CWS), and Canadian Heritage, Parks Canada are the three primary contributors of this program. The NRS fulfills the monitoring objectives of the program, whereas specific studies and reintroduction programs are managed by the CWS. Parks Canada contributes to the monitoring of northern Alberta populations because over half the northern nesting sites currently reside within Wood Buffalo National Park.

Peregrine Falcon monitoring occurs intensively throughout their current range which include the northeast, central and southern areas of the province. The monitoring intensity fluctuates from year to year, however, monitoring does occur annually in a standardized fashion. In northern areas of the province a one week egg count survey occurs in mid June. A combined fledgling count and bird banding program is conducted for one week in mid July. Funding permitted, peregrine falcons in the north are monitored for the entire breeding season. Study sites in central and southern Alberta are monitored for the entire breeding season with greater effort allocated toward research and reintroduction programs. NRS in Edmonton stores and analyzes data from this program. Analysis primarily focuses on population dynamics and growth, survival rates, and reproductive fitness. The data is also used to study the life

history of peregrine falcons, and address management concerns. Reports are actively produced on a periodic basis.

Mammal Monitoring Programs

Alberta Caribou Studies

Woodland Caribou is currently blue listed in Alberta (see Appendix 12 for the definition of blue listed). Caribou is also an umbrella species which reflects some landscape level changes and may be representative of many other species inhabiting late seral stage coniferous forests. For these reasons, intensive studies began in 1991 with the establishment of the West Central, Northwest and Northeast Standing Committees on Woodland Caribou. The three standing committees are a joint effort of the Natural Resources Service (NRS), forestry companies, and Alberta's universities. The primary objectives of the studies are to estimate the impacts of forestry and oil and gas industries on caribou populations, and gather ecological information on this species (i.e. habitat requirements, recruitment, survivorship and mortality factors). Three individual caribou studies have also been conducted in the Northeastern Slopes Region dating back as early as 1981. A synthesis of these three studies into a single document is currently underway, and will be the most significant attempt to date at analyzing long-term trends for caribou populations. Furthermore, the Edson NRS regional office is currently working on collecting all data from the agencies involved with caribou research. This centralization and standardization of the caribou information will likely improve the overall organization of caribou studies in the province.

Caribou are considerably more difficult to systematically survey than other ungulates. Aerial surveys are typically used to achieve ungulate population estimates, however, this method has flaws when applied to caribou. Low population densities, clumped distribution, low visibility from the air, and highly variable distribution based on the time of year, weather, and snow conditions affect sampling accuracy. Radio telemetry, GPS (Geographical Positioning Systems), and track count surveys are more reliable techniques. Currently, surveys do not match the full geographic range of woodland caribou in Alberta. Most studies focus on specific caribou populations from which information is extrapolated to represent caribou populations on a regional basis. Standardized sampling techniques will likely be refined to effectively and practically monitor woodland caribou over greater portions of its range.

Amphibian Monitoring Programs

Alberta Amphibian Monitoring Program

The Alberta Amphibian Monitoring Program was established in 1991 by the Natural Resources Service (NRS). This program is the first of its kind in Alberta to collect province-wide distribution information for amphibian species. Two main reasons exist for the establishment of the Alberta Amphibian Monitoring Program; first, Alberta has limited amount of long-term amphibian information, and second, this program is a

response to the DAPCAN (Declining Amphibian Populations in Canada) conference which concluded that amphibians are experiencing global declines in population numbers. This program is especially useful for its role as a centralized database for all amphibian research and monitoring in the province. The Alberta Amphibian Monitoring Program transfers its data into the NRS Biodiversity/Species Observation Database (B/SOD). Annual summary reports are produced which include: presence and distribution maps for all amphibian species, and a volunteer distribution map to give an indication of the sampling effort for each region in Alberta.

Though this is the largest amphibian monitoring program in Alberta, there are some gaps which should be addressed. The NRS manages the database, but a large proportion of the data comes from a volunteer base of 85 people. Data collection mainly occurs around major urban centers, the Parkland Natural Region and also south-central areas of the Grasslands Natural Region. Even with data input from other amphibian research and monitoring programs, poor coverage exists in the Rocky Mountain, Boreal Forest, Foothills, Canadian Shield, and northern areas of the Grassland Natural Region. Biases also exist in the species sampled. Common species which are highly vocal during the breeding season such as the boreal chorus frog and the wood frog are the most readily recorded. Species most likely to be under represented include reclusive species (e.g., long-toed salamanders), species with eruptive population cycles (e.g., spade foot toad), or species located in unsampled areas of the province. These issues will likely be addressed as amphibian monitoring develops, thereby improving the understanding of a taxa largely overlooked in the past.

Fish Monitoring Programs

Refer to the Fish, Game and Furbearer section within the Provincial Monitoring Program section.

Vegetation Monitoring Programs

Permanent Sample Plots (PSPs)

Permanent Sample Plots (PSPs) are used by the Land and Forest Service, Timber Management Division of Alberta Environmental Protection to study forest stand dynamics. PSPs have three major uses; assessing stand dynamics such as succession, regeneration, ingrowth and mortality; providing data for growth and yield curves; and supplying representative areas to study management techniques (Land and Forest Service, 1997). Overall, the PSP program is likely the most effective vegetation monitoring program in the province.

PSPs are long-term and represent a large geographical area. Since 1960, over 650 PSPs have been established in forested areas (Land and Forest Service, 1997). There are significantly more PSPs when accounting for those within Forest Management Agreements (FMAs). Quantitative measures are made on canopy and understory tree

species while qualitative measures are made on most biophysical and understory vegetation. Sampling techniques have been historically quite consistent and plots are repeatedly sampled over regular time intervals. Depending on the type and age of the stand, measurements are taken at 5 or 10 year intervals. Though PSPs have wide coverage, the Land and Forest Service Report (1997) suggests that there should be over 3000 PSPs in Alberta to obtain more representative information on all of Alberta's forested landscape.

Holistic Monitoring Programs

Alberta Natural Heritage Information Centre (ANHIC)

The Alberta Natural Heritage Information Centre (ANHIC) is a member of the Natural Heritage Network and global Conservation Data Centres. Alberta joined the network in 1996 with the establishment of the ANHIC. Six information centres exist in Canada and nearly 100 within the United States, Central America and South America. All members of the Network are coordinated by the Nature Conservancy U.S. The ANHIC uses globally standardized methodologies. Its database is linked to all other Natural Heritage Network and global Conservation Data Centres.

The focus of the ANHIC is to collect information on elements (subspecies, species, communities etc.), particularly rare or "at-risk" elements. ANHIC activities include species locating, species mapping, ranking species risk, identifying biodiversity 'hotspots', and potential geographic areas for protection. As an example, ANHIC identified a number of potential sites for the Special Places program; a provincial response to the World Wildlife Fund of Canada (WWF) Endangered Spaces Campaign.

The ANHIC actively collects data from the field as well as information from provincial and federal agencies, universities, industry, private consultants and non-profit organizations. Information from the ANHIC is available to other agencies and is managed by the Natural Resources Service of Alberta Environmental Protection. The ANHIC collects information for vascular and non-vascular plants, vertebrates, and invertebrates. The most significant progress in the early stages of the ANHIC has been with non-vascular plants, largely due to its close partnership with the Devonian Botanic Garden and Parks Canada. Invertebrates are the least monitored taxa in the province and also have the poorest representation in the ANHIC database. The database has good coverage of protected areas, areas of conservation concern and areas with high biological diversity. In general, northern regions of the province still require greater levels of monitoring. Information collected by the ANHIC is rapidly growing and is already proving to be very useful for biological conservation in Alberta.

Biodiversity/Species Observation Database (B/SOD)

The Biodiversity/Species Observation Database (B/SOD) was established in 1996 to monitor the status of wildlife species, especially those of special management concern. NRS Wildlife Management Division, Alberta Conservation Association, and

Federation of Alberta Naturalists co-ordinate and operate the database. B/SOD primarily collects information on species known to be sensitive to human activities. This information is used to document the occurrence and abundance of sensitive species numbers in Alberta and help assess their status. This ranking is published every five years by the NRS in the Status of Alberta report (Alberta Environmental Protection, 1996). Flora, fungi, fishes, and invertebrates are not currently included in B/SOD. These groups will be added for status reports in the year 2000.

Data is collected predominantly from casual observations. These are recorded by regional biologists, technicians, and public volunteers. Data from other provincial monitoring programs, such as the Alberta Amphibian Monitoring Program and NGOs, are also recorded. Currently, B/SOD incorporates information from all regions of Alberta, however, significant gaps still exist. Areas of Alberta with insufficient or no representation include federal lands and areas north of 56 degrees latitude.

Fish, Game and Furbearer Monitoring Programs

Traditionally, the Natural Resources Service (NRS) focused much of its monitoring on sport-fish, game species and furbearer species. Currently, NRS still monitors 28 mammal, 36 bird, and 18 fish species that are recreationally or commercially harvested (Appendix 18). The management zones for angling, commercial fishing, hunting, and trapping all differ and are primarily dependent upon the biology of the taxa. The tendency is to discount this type of monitoring activity in favor of programs oriented toward endangered species or species more representative of ecosystems. Though those types of monitoring are important, fish and game records should not be discounted. There are a number of reasons to use these traditional records:

1. These are some of longest recorded databases in existence for Alberta.
2. The methods of administration, reporting, and record keeping are already established.
3. Many of the species are top predators or large bodied herbivores; fluctuations in numbers of these species are potentially indicative of changes in the food web or habitat.
4. Some species are sensitive to cumulative effects because of their large home ranges.

Fish and game species have always been of social and economic importance to humans. Development largely from forestry, oil and gas, and agriculture has already impacted these harvested species and socio-economic concerns have already arisen. As a result, many harvested species are monitored to some extent.

Unfortunately, intensive monitoring is often based on public pressure resulting in a reactive monitoring strategy and/or limited to harvested species with high socio-economic value (e.g. waterfowl). Such surveys are often executed in response to public perceptions of resource decline, potential wildlife problem, and/or allocation dispute. This tends to lead to censuses of populations at times of crisis and provides

little data on the range of natural variation. Furthermore, it leads to sporadic geographic coverage, unstandardized monitoring protocols, and irregular timing for sampling. These problems make it difficult to assemble complete datasets for more than a handful of species.

Currently, data from fish, game and furbearer species monitoring reside in various regional and Edmonton offices of the NRS. Internal and public reports provide summaries, and long-term trend analysis.

Fish Species Monitoring

Aquatic ecosystems of Alberta are inhabited by 60 species of fish, of which 18 are harvested by recreational, commercial, and domestic fisheries (Alberta Environmental Protection, 1997). Fish monitoring is restricted almost exclusively to harvested species, whereas the other 42 fish species have little or no long-term monitoring. Even amongst the angled species of fish, only declining populations are monitored. The overall lack of monitoring is a concern. Fish populations are under pressure from introductions of non-native fish species, habitat loss (Alberta Environmental Protection, 1997), and over harvesting. Some of the primary limitations which have affected fish monitoring include:

1. The biology of fish makes monitoring difficult. Volunteer based monitoring programs are nearly impossible because survey techniques require trained personnel. Intensive surveys are costly and time consuming making province wide and long-term monitoring impractical.
2. Population trends are very difficult to predict. Current monitoring techniques do not estimate recruitment of juvenile cohorts very well.
3. Habitat factors such as variation in annual water levels, turbidity, and temperature affect the catchability of fish. These factors make it difficult to compare results from different years.
4. Sampling techniques are inconsistent over time and among the different fish surveys. Improving sampling techniques, and customized protocols for unique management concerns have all contributed to a historic lack of standardization.
5. Historically, there has been no centralized data management.

The Fisheries Management Division has made progress toward improving fish monitoring in Alberta. One of the most significant improvements has been their attempt to create a centralized database. It is currently being tested, and should be fully operational in the near future. Information from past, present and future programs will be incorporated into a standardized format. Outside sources of information will also be incorporated to supplement the database. This database will facilitate analysis of long-term population trends and mapping distributions on a provincial scale; crucial to any monitoring strategy. The format of the fish database will be based on the existing NRS Biodiversity/Species Observation Database (B/SOD). Currently, there is also a great deal of effort to standardize sampling techniques among different fish surveys. Though gaps within fish monitoring will

continue to exist, the improvements mentioned above will significantly reduce the historical deficiencies in the sampling and analysis of fish species.

Game Species Monitoring

Ungulate and game bird species are the most intensively monitored organisms in Alberta. The socio-economic impacts of game species are substantial leading to strong public pressure for monitoring, especially when numbers are perceived too low or too high. Each region has its own set of management concerns and objectives, however, game species are all relatively well monitored.

Waterfowl are the most intensively monitored game species in Alberta. Joint agency programs are common in waterfowl monitoring. The Natural Resources Service and the Canadian Wildlife Service are joint contributors to waterfowl monitoring programs throughout Alberta, such as the Spring Waterfowl Breeding Pair Survey and the Waterfowl Brood Survey. These programs will be described in more detail in the Federal Monitoring Programs section below. Monitoring occurs for other game birds including sharp-tailed grouse and the pheasants living in the Grassland Natural Region. In particular, sharp-tailed grouse has been monitored since the late 1960's using both ground and aerial surveys.

Ungulate monitoring and studies are generally carried out by the different regional branches of the NRS. There are three primary purposes for monitoring hunted ungulates:

1. Track the health and status of ungulate populations.
2. Address management issues as they relate to industry.
3. Ensure hunting limits are maintained at sustainable levels.

Most ungulate surveying began between the late 1940's and mid 1950's when fixed-wing aircraft were first applied to biological studies. Since the 1960's, ungulate studies throughout Alberta commonly use aerial surveys for estimating population sizes, calf/cow ratios, bull/cow ratios, and habitat use. Unfortunately, the costs associated with aerial surveys limits the geographic coverage, periodicity of sampling, and the overall number of surveys carried out annually. Generally, wildlife management units (WMUs) within the primary range of the ungulate populations, vulnerable herds, and areas with the greatest public pressure are assigned top priority and surveyed. These WMUs are surveyed rotationally, ideally every three to five years. This leaves some WMUs with very little or no monitoring. Generally, remote WMUs with stable ungulate populations and/or low hunting pressures are not surveyed. Monitoring is most intensive for pronghorn, moose and white tale deer, and mule deer.

All species of large carnivores are hunted in Alberta, and thus are also monitored to ensure sustainable population sizes. Intensive monitoring is done on a periodic basis to assess baseline population levels or in response to public concerns over allocation.

Harvest registration provides some ongoing monitoring. The status of the large carnivores within Alberta significantly influences the amount of monitoring effort allocated to the various species. Grizzly bears, being a blue listed species (see Appendix 12 for definition blue listed species) with limited distribution in Alberta, are monitored in the Rocky Mountain and Foothills Natural Regions, however, throughout the rest of their range very little monitoring takes place. Conversely, black bears have a wide geographic range and generally healthy populations. Thus they receive very little monitoring. Surveys of cougar and wolf populations often occur in response to public pressure. Otherwise, population status is inferred from harvest registration. In general, most ongoing efforts to monitor large carnivores occur in the Rocky Mountain and Foothills Natural Regions.

Furbearer Species Monitoring

There is a long history of data collection for furbearer species in Alberta beginning near the turn of the century. Three furbearer databases exist for Alberta. They monitor trapping activity and assess provincial quotas and harvest rates for 19 mammal species. This information also provides potential indices of relative species abundance. For many small and mid-sized mammals, there are no other monitoring programs of comparable geographic scope, sampling intensity, or longevity. Trapping information is the most cost-effective means of collecting wide-scale information on furbearing species. However, biological factors (i.e. population levels, ease of capture, and weather conditions) and socio-economic factors (i.e. fur prices, trapper skills, and trapping effort) all affect trapper effort and catch. Thus, indices of species abundance need to be interpreted cautiously. In Alberta, information is gathered from 1750 registered traplines, most being located in the Boreal Forest, Parkland and Foothills Natural Regions. Below is a summary of the three existing databases used in Alberta.

Alberta inputs the Furbearer data into a national database. The first records date to the 1920/21 harvest. This national database includes the total fur production in Canada. It is designed to create a national perspective on trapping, however, provincial levels for each species can be assessed. Statistics Canada publishes national and provincial harvest summaries as well as socio-economic data. Natural Resources Service regional offices also maintain a regional database and produce regional summaries of data.

Two other Alberta databases are the Fur Affidavit and the Fur Registration Databases. The Fur Affidavit Database began province-wide data collection in the 1971/72 trapping season. Annual totals for all furbearers are collected from each registered trapper in the Alberta. The Fur Registration Database has been ongoing since approximately the mid 1980's. Its focus is to monitor the trapping rates for four species considered to be sensitive to over harvesting; i.e., wolverine, river otter, fisher, and lynx. All pelts from these animals must be registered before sold, thereby allowing for an accurate assessment of annual harvest levels. The primary use of this database is to set trapping quotas for specific WMUs. These two databases effectively determine harvest levels for trapped species within their respective WMUs

Museum and University Collections

These collections form a database of specimens collected over relatively long periods of time. Also, they provide checklists for the potential biodiversity within a region and taxonomic data for species identification. Museum and University data often form the basis for mapping historical and current distributions of species, particularly rare species. Archival voucher specimens are also available for later analysis.

Substantial collections exist at the Provincial Museum of Alberta, University of Alberta, and University of Calgary for invertebrates, vertebrates, and plants. For example, Provincial Museum of Alberta houses over 500 000 specimens, and the University of Alberta has specimens of every plant species in the province. Together these institutions allow for species verifications and distributions in Alberta. The Provincial Museum of Alberta and University collections do not directly constitute monitoring because they lack a systematic method or schedule for collection. The lack of regular, systematic sampling makes it difficult assess populations changes within specific locations over time.

The Devonian Botanic Garden, as part of the University of Alberta, contributes to the understanding of plant diversity and distribution within Alberta. Since its establishment in 1959, the Devonian Botanic Garden has acquired approximately 400 live plant species native to Alberta. They also have a number of plant species with cultural and medicinal value to the Aboriginal peoples of the Alberta. The vast majority of the plants at the Garden represent the Grassland Natural Region of Alberta. There are plans to set up a garden dedicated to rare and endangered plant species of Alberta. Furthermore, the Devonian Botanic Garden may play a more significant role in future plant monitoring. There are plans to expand the seed bank program with the acquisition of a cryofreezer. This will be very important in benchmarking the genetic diversity of native vegetation.

Provincial Parks, Natural Areas and Ecological Reserves

The Recreation and Protected Areas Branch of the Natural Resources Service generally do not conduct biodiversity monitoring. This is not to imply that no monitoring occurs within protected areas. Other provincial, federal and non-government agencies actively incorporate protected areas within their monitoring programs. The value of protected areas as ecological benchmarks will likely increase as the surrounding areas undergo further development. With this trend, monitoring will also likely increase.

Government of Canada Monitoring Programs

Avifauna Monitoring Programs

Prairie Shorebird Survey

The Canadian Wildlife Service has been conducting surveys for shorebirds throughout Alberta since approximately 1985. In 1994, the sampling intensity increased by

monitoring selected lakes for a two year period. Many of the lakes surveyed are within the Parkland and Grassland Natural Regions near the Alberta/Saskatchewan border. They also track population trends for endangered shorebird species. The cumulative datasets are linked to other regional, national, and international shorebird surveys and used to identify candidate sites for shorebird reserves. Selected reserves will be incorporated into the Western Hemisphere Shorebird Reserve Network (WHSRN), an international conservation initiative designed to protect key habitats and resources used by shorebirds during their migrations (Morrison *et al.*, 1995). It is important to note that there is no repeat sampling of surveyed areas after two years. Currently, the mandate of the program is to collect benchmark data, thereby serving as a baseline for future studies.

Spring Waterfowl Breeding Population Survey

The Spring Waterfowl Breeding Population Survey is an international program with the largest dataset of its kind in the world. The survey has been ongoing since 1955 and covers the primary breeding grounds for waterfowl throughout North America (i.e. the Prairie Pothole Region). This survey addresses concerns about the cumulative effects of hunting pressure and wetland habitat loss on waterfowl populations. Survey data is also the basis for setting quotas on waterfowl hunting.

The survey monitors all duck species, as well as geese, grebes and mergansers. Data is collected annually during the spring breeding season. Aerial transect surveys are used to measure population numbers with coordinated ground surveys to provide a correction factor. Sampling areas and protocols have been consistent since 1955 thereby allowing for accurate long-term trend analysis. Population trends are considered to be as accurate as possible within the bounds of financial and physical practicality.

In Alberta, geographic coverage is best within the Parkland Natural Region and southern areas of the Grassland Natural Region. In this area, aerial and ground surveys have been used since the beginning of the program. The Grassland Natural Region surrounding Peace River and Grand Prairie also has good coverage. Aerial surveys began in 1955 but were not coordinated with ground surveys until 1987. Population estimates within the Boreal Forest and Canadian Shield Natural Regions are based only on aerial surveys. Despite the presence of viable waterfowl populations, no surveys are conducted in the Foothills and Rocky Mountain Natural Regions. Recently, there have been improvements to the geographic coverage of the survey. This was achieved primarily through the incorporation of the North American Waterfowl Management Plan (NAWAMP) sites in 1991.

The Spring Waterfowl Breeding Population Survey is largely coordinated by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service, but Alberta Environment Protection and Ducks Unlimited also make contributions. The U.S. Fish and Wildlife Service is responsible for the storage, analysis and publication of all data collected by

the Spring Waterfowl Breeding Population Survey. The data is made accessible to other organizations for further analysis and publication.

Waterfowl Brood Survey

The U.S. Fish and Wildlife Service developed the Waterfowl Brood Survey to complement the Spring Waterfowl Breeding Population Survey. This survey provides a crude index of waterfowl reproduction. Data from programs provide an excellent assessment of total waterfowl production in North America. Unlike the Spring Waterfowl Breeding Population Survey, the Waterfowl Brood Survey uses aerial surveys without complimentary ground surveys, and no differentiation is made between the duck species. Aerial surveys follow the same transect lines as the Spring Waterfowl Breeding Pair Survey making comparisons between the two programs possible. The geographic coverage of Alberta is the same for both programs.

Invertebrate Monitoring Programs

Biological Survey of Canada (Terrestrial Arthropods)

Insects are the most numerous and diverse group of organisms on Earth. Canada has greater than 55 000 species and another 11 000 species of spiders and mites (Biological Survey of Canada, 1997). Yet human understanding of invertebrates is still quite weak. Survey goals are to address some of these concerns by determining species diversity, abundance and also their distribution from a national perspective.

The Survey was set up by the Entomological Society of Canada in 1977 and since 1980 the Canadian Museum of Nature has been a partner. In Alberta the Survey has focused on the Grassland Natural Region. Contributions of researchers working in other Natural Regions actively supplement the database. Because this program is focused on networking research, isolating research priorities, and acquiring preliminary invertebrate information, the Survey does not focus its efforts toward long-term monitoring. The Survey has produced three major books and several shorter publications.

Holistic Monitoring Programs

Canadian Heritage, Parks Canada

National Parks of Canada are the country's most significant attempt at protecting and preserving important attributes of nature. Within the Parks Act, it states that parks are to be maintained and developed for the conservation and management of flora and fauna, as well as for the preservation of areas and objects therein. The importance of this mandate will increase as development continues within and around National Parks. Furthermore, the expanding view that National Parks are ecological benchmarks will stimulate the need for research and monitoring within their boundaries. A large number and variety of monitoring programs exist within these areas. Individual programs for each National Park in Alberta are listed in Appendix 9. The scope of this document does not allow for a detailed description for each monitoring program.

However, specific information can be obtained by calling the National Park Contacts given in Appendix 20.

Most monitoring activities fall into one of three primary categories; biological, physical or cultural. Biological monitoring is the dominant type of monitoring. Biodiversity monitoring within National Parks is customized to meet the specific needs and management objectives of individual parks (Rissling and Welch, 1995). The lack of an overall monitoring strategy has resulted in variation in the degrees and types of monitoring (Rissling and Welch 1995). Traditionally, the majority of research and monitoring focused upon charismatic megafauna such as large carnivore and ungulates species. Currently, 23 of the 62 programs monitor large carnivore or ungulates. Until recently, little or no emphasis was placed on invertebrates, amphibians, reptiles, fish, small mammals, flora, or avifauna. Currently, monitoring has expanded to include; 12 avifauna, 11 flora, and fewer than 5 programs each for amphibian, reptile, fish and invertebrate taxa. Aquatic species receive relatively little attention.

All five National Parks in Alberta are improving the level of monitoring. In particular, there is increased involvement with established NGO programs and the Alberta Natural Heritage Information Centre. Also, National Parks have been formulating or restructuring integrated management policies. These policies are used to identify gaps and either establish new or restructure existing monitoring programs within the last five years. Specific attention is also being focused on the technical aspects of monitoring. Some examples include; updating species lists, standardization of sampling protocols and planning for repeated sampling.

Ecological Monitoring and Assessment Network (EMAN)

The Ecological Monitoring and Assessment Network (EMAN) is developing a national network of ecosystem monitoring across Canada. EMAN intends to monitor a standardized suite of biotic and abiotic factors and processes within designated sites. This will give a holistic view of ecosystems and enable the assessment of cumulative ecological stresses. To do this EMAN has adopted an interdisciplinary approach by coordinating logistics with over 100 organizations. These include international agencies; federal and provincial agencies and departments; regional and municipal governments, universities, hospital and school boards, and industry; and also non-profit NGOs, aboriginal groups, local clubs and organizations, and interested volunteers.

Monitoring activities are focused on representative ecozone sites described in Wiken (1986). Study sites are planned for each of Canada's 15 terrestrial ecozones and 5 marine ecozones. Of the approximately 100 EMAN sites across Canada, seven sites are included in Alberta. In the Boreal Natural Region, EMAN will have sites in the Terrestrial and Riparian Organisms, Lakes and Streams Study area (TROLS), and Meanook Biological Research Station. Elk Island and Waterton Lakes National Parks will represent the Parkland Natural Region and Rocky Mountain Natural Region respectively. Finally, the Grassland Natural Region will be sites in C.F.B. Suffield, the

Alberta Rangeland Reference Area, and Lethbridge Research Centre. By monitoring representative ecozone sites, EMAN intends to identify environmental issues as these emerge and assess the effects of human activity within these sites. To achieve these goals, EMAN will use long-term and multi-disciplinary studies.

Non-Government Monitoring Programs

Avifauna Monitoring Programs

Bird List Survey

Established in 1994, the Bird List Survey is organized by the Federation of Alberta Naturalists (FAN). This survey is designed to collect information on bird distribution and abundance. It will eventually be used to determine long-term trends of bird diversity. All avian species are incorporated into the Bird list Survey. However sampling over-represents species found in more settled regions of the province. Because the bird lists are collected throughout the year, both resident and non-resident bird species are recorded and monitored. To give an indication of the volunteer effort, 120 forms were submitted for Alberta in 1997. Summaries are published in the quarterly FAN newsletter, *Alberta Naturalist*. A database for all the avian monitoring programs is being developed by the FAN. This will facilitate future analysis of this dataset. Information collected by the Bird List Program is stored by the FAN, and is made available for other research projects upon request.

Breeding Bird Atlas

The Breeding Bird Atlas program of Alberta is organized jointly by the Federation of Alberta Naturalists (FAN), Canadian Wildlife Service, Alberta Environmental Protection, Natural Resources Service, and the Provincial Museum of Alberta. The Atlas provides an Alberta perspective on the distribution of breeding birds; an assessment of their relative abundance; and functions as a wonderful educational tool. The 1992 *Atlas of Breeding Birds of Alberta* (Semenchuk, 1992) was the first atlas published by the FAN. Data was collected from 1986 to 1991. The atlas is based on quantitative data and is the most thorough of its kind in Alberta. The Breeding Bird Atlas program is a tremendous accomplishment, having sampled all natural regions in the province. The distribution map of sample sites (Semenchuk, 1992) reveals relatively good coverage throughout south and south-central Alberta. Though there was an effort to sample in remote areas, many of these areas still only have spotty coverage. As an example, the Boreal Forest Natural Region had weak overall coverage, however specific areas with rich avifauna diversity e.g. Peace-Athabasca Delta, do have very good coverage.

A complimentary database was created to organize and aid in data collection during the research phase of the Atlas. This database maintains an inventory of breeding bird distributions throughout the province. The FAN keeps the database open to allow current information to be incorporated as it arises and fill knowledge gaps in remote areas of Alberta. Furthermore, the database aids in establishing the distribution and

abundance of breeding birds for future atlases. FAN is planning a second edition of the Atlas 10 to 15 years from the first publication date. Overall the *Atlas of Breeding Birds of Alberta* has proven to be of great use for research, management, and general interest purposes.

Canadian Lakes Loon Survey

The Canadian Lakes Loon Survey has existed in Alberta since 1990. This national program is based out of the Long Point Bird Observatory in Ontario. It is coordinated by Bird Studies Canada. The program was established in response to the 150 year trend of decreasing abundance and breeding range of common loons in North America. The survey provides baseline information on the distribution and breeding success of common loons within Canada. Parameters measuring shoreline development are also included. Habitat alterations are considered to be a significant factor in the northern movement of loon ranges. The program has potentially wider impacts; loons are a top predator of lake ecosystems, thus, a potential indicator of lake ecosystem health.

The Canadian Lakes Loon Survey is dedicated to long-term monitoring and values consistent methodologies. Some shortcomings include: non-randomized lake sampling and inconsistent sampling effort. Also, little or no sampling exists for lakes without viable populations of loons. This last point limits the ability to explain why potentially habitable lakes do not support viable loon populations.

Since 1990, 122 lakes in Alberta have been sampled at least once. Volunteers record observations at least once a month during the loon breeding season (June to August) over an entire lake or lake section. All data is stored and analysed at the Long Point Bird Observatory. Summaries are provided quarterly in the Bird Studies Canada newsletter, *Birdwatch Canada*, and journal publications are also periodically produced. Data is accessible to researchers and the public.

Canadian Migration Monitoring Network Intensive Surveys

The Canadian Migration Monitoring Network censuses migrating bird populations across Canada. This data is used to produce long-term migration and population trends. The program complements other monitoring datasets on migrating birds by representing remote areas of the province. Though all migrating species travelling through study sites are recorded, songbirds are the target species.

The Canadian Migration Monitoring Network has good geographical coverage of Alberta. Data collection is based out of three banding stations known to have high diversity and abundance of avifauna. These stations include the Beaverhill Bird Observatory which is roughly 65 km east of Edmonton (53 20' latitude, 112 30' longitude), Lesser Slave Lake Bird Observatory (55 30' latitude, 114 50' longitude), and Inglewood Bird Sanctuary located near Calgary (51 00' latitude, 114 00' longitude). Because each station is on a distinct migration route, slightly different bird groups are monitored. Beaverhill Bird Observatory is the most established of the three

stations, and has been running this program since 1992. This station alone collects information on over 100 species of songbirds each year.

Christmas Bird Count (CBC)

The National Audubon Society sponsors the Christmas Bird Count (CBC) which surveys wintering populations of birds throughout North America. The CBC is the oldest biodiversity monitoring program in Alberta, with the first survey occurring in 1906 in Edmonton. CBCs were not conducted regularly in Edmonton until the 1950's, and by the early 1970's only Calgary and Edmonton consistently participated in the CBC. Within the last 25 years, the popularity of the CBC has steadily grown in Alberta, with 25 communities participating in 1996. Coverage of Alberta is highly localized; the Parkland Natural Region has the most coverage; the Boreal Forest and Canadian Shield Natural Regions have poor coverage; and the rest of Alberta generally has moderate levels of coverage.

By monitoring resident bird species living in Alberta, the CBC supplements spring-based surveys, such as the North American Breeding Bird Survey, which tend to focus on migrant bird species. Surveys take place annually for one day, within two weeks of December 25. Volunteers with a wide range of bird identification skills record all birds seen within circular count areas. The circular count areas are visited year after year, and tend to be near or within urban centres. The data from the CBC is stored and published by the National Audubon Society with annual summaries published in *American Birds*. Data collected from the survey is used to assess continent-wide trends of species distributions and abundances. The U.S. National Biological Survey has published long-term trend analysis from data collected from 1959 to 1988.

The merits of the CBC include its large volunteer base and long-term commitment toward resident bird monitoring. The CBC is highly respected for public education and promotion of non-consumptive uses of nature. However, when using the results from the CBC, one must proceed with caution. The survey is a relatively crude measurement of overwintering bird abundance and distribution. The sampling period is short, study sites are not randomly chosen, birding skills vary among participants, and other factors such as weather affect results.

Monitoring Avian Productivity and Survivorship (MAPS)

The Monitoring Avian Productivity and Survivorship (MAPS) is a continent-wide program using the cooperative efforts of public agencies, private organizations and the bird banders of North America. Long-term information, such as changes in habitat, population characteristics and demography, is collected for selected landbird species. MAPS also attempts to assess the impacts of large-scale environmental problems such as global warming and pollution on landbird populations. Special focus is given to bird species experiencing declines or fluctuating population sizes.

MAPS is relatively new to Alberta, starting in 1992. There are currently six MAPS stations in Alberta; three near Lesser Slave Lake, two near Tofield and one near

Calgary. In the future there are plans to add more stations. Throughout the breeding season, data is collected by trained technicians. Survey techniques include; standardized and consistent-effort mist netting, bird banding, and point count call surveys. The database is managed by the Institute for Bird Populations in California, who also publish annual regional estimates for adult population size, adult survivorship and recruitment.

Nest Record Scheme (NRS)

The Nest Records Scheme (NRS), also called the Prairie Nest Record Scheme, is a national program that has been ongoing in Alberta since 1981. The NRS collects data on the breeding success, species distribution, and habitat use of nesting birds. It is unique in its emphasis on habitat. Habitat requirements for breeding birds are often missed by other programs, making the NRS an especially important monitoring tool. Unfortunately, the geographic coverage of the NRS is relatively spotty. This is due to the small volunteer base of 15 to 20 people who collect NRS data annually. However, these volunteers collect nest information on nearly 100 avian species each year. Volunteers fill supplied data sheets relating nest locations to habitat. Data from the prairie provinces is stored at the Manitoba Museum of Man and Nature, and is accessible to other organizations to supplement their research. Summary reports are distributed annually to all volunteers, however, little data from Alberta has been analyzed in recent years.

North American Breeding Bird Survey (BBS)

The North American Breeding Bird Survey (BBS) is one of the most extensive bird studies in North America. Established in Alberta since 1966, this annual survey monitors short- and long-term fluctuations in songbird populations. It also provides continent-wide approximations of songbird ranges. Point count surveys along roadsides is the primary method for data collection. On an annual basis, volunteers monitor between 80 and 100 BBS routes in Alberta. The BBS has a highly standardized protocol, which accounts for such variables as weather, traffic activity, time of data collection and variations among volunteer birding skills. Despite these measures, the method of surveying introduces some biases in the data collection and subsequent analysis. A number of bird groups are under represented including year-round residents, silent species, and groups sensitive to traffic, edges, and habitat fragmentation. Also, areas of Alberta with few roads are poorly represented, including most of the Boreal Forest, Rocky Mountain, and Canadian Shield Natural Regions.

The Canadian Wildlife Service stores and analyzes all BBS data collected in Canada. The U. S. Fish and Wildlife Service in Patuxent, Maryland stores and analyzes all North American data. It is one of the most accessible bird monitoring datasets amongst NGOs. Using BBS data from 1966 to 1983, Collins (1989) published the latest data summaries and analysis.

Project Feederwatch

Project Feederwatch is a North American based program which began in 1987. The goals of Project Feederwatch are to collect long-term data on overwintering bird populations, detect significant population declines or expansions, identify habitat characteristics affecting bird populations, and facilitate public involvement and education. Since overwintering birds are the focus of the project, this complements the Christmas Bird Count data. Volunteers monitor their bird feeders for one to two days every two weeks from November through March. Over 6000 participants participate annually throughout North America, of which 26 to 50 are from Alberta. Most of the data collected by Project Feederwatch are from suburban and suburban/rural areas. This limits geographic coverage. In Canada this program is coordinated by Bird Studies Canada who also publish summaries and results from Project Feederwatch in its quarterly newsletter, *Birdwatch Canada*.

Rocky Mountain Eagle Research Foundation

The Rocky Mountain Eagle Research Foundation is a leading raptor monitoring program in Alberta. It has studied bird migrations through the Rocky Mountain Natural Region since 1992. Aside from educating the public about raptor issues, this program studies the migration dynamics and population trends of raptors with special emphasis on golden eagles. As an example, the program discovered a number of previously unknown eagle migration routes. There are a dozen sampling stations in Alberta scattered throughout the southern and central areas of the Rocky Mountains. Volunteers monitor raptors on a daily basis for the duration of the spring and fall migration. Foundation headquarters stores and analyzes the database for this program. A number of different journals publish summary reports. The Hawk Migration Association of North America journal, *Hawk Migration Studies* publishes rigorous analytical information biannually.

Spring Bird Count

The Spring Bird Count (also called the May Bird Count) is another monitoring program organized by the Federation of Alberta Naturalists (FAN). Participants collect data on both breeding and non-breeding species found in the province. Data collection occurs annually during the last week of May, and has been ongoing since 1976. The FAN has sites within every Natural Region of Alberta. However, south and central Alberta areas particularly those near urban centres have the most monitoring. This program has 25 sites and approximately 400 participants each year. The FAN stores data from this program. Bird count protocols are not scientifically standardized, thereby limiting the scientific analysis of the dataset. The *Alberta Naturalist* publishes yearly summaries. Currently, there has been no analysis of long-term trends, however, the FAN is developing a computer database for the Spring Bird Count. This will facilitate analysis for long-term trends in the future.

Mammal Monitoring Programs

Bat House Program

The Bat House Program is one of many bat conservation programs organized by the Bat Conservation Society of Canada. This Calgary based organization began in 1995. The Bat Conservation Society of Canada intends to develop a long-term monitoring program for bats. Unfortunately, its future in Alberta is uncertain because of the low response rate from bat house owners.

There are 9 species of bats residing in Alberta. Three species are known to use man-made bat houses for roosting. Bat house owners collect information on the species, numbers, habitat characteristics, and bat house characteristics. Protocols for data collection and overall objectives are similar to that of the North American Bat House Research Project described below. The Bat Conservation Society of Canada stores the Canadian data but shares it with Bat Conservation International. The international organization analyzes the data for species distribution and overall population trends.

North American Bat House Research Project

The North American Bat House Research Project is one of many bat conservation programs headed by Bat Conservation International. The mandates of this program are to increase public awareness, and ensure maintenance of sufficient bat habitat, and assess North American bat population and distribution trends. Participants collect weekly information during spring and summer months on bats using a variety of artificial bat roosting structures. Biannual reports of summary information are sent to members of this program.

Central Rockies Wolf Project

The Central Rockies Wolf Project is a Canmore based organization which has been intensively monitoring wolf packs since 1987. This long-term program studies the population dynamics of wolves in the Central Rocky Mountains, and also studies their habitat requirements, movement patterns and the impact of human encroachment. The study area is approximately 40 000 square kilometres incorporating Banff National Park and Kananaskis Provincial Park in Alberta; Joho and Kootenay National Parks, and Elk Lake and Mount Assiniboine Provincial Parks in British Columbia. It also includes areas around these protected areas. The program monitors all five wolf packs living within these areas using track counts and radio telemetry. The Canmore office stores and analyzes all data. Researchers have already applied monitoring results to computer modeling and management recommendations.

Spring Mammal Count

The Federation of Alberta Naturalists (FAN) coordinates the Spring Mammal with the Spring Flower Count. In these surveys, volunteers record all non-domestic mammal sightings while collecting vegetation data. Every year since 1976, volunteers have recorded mammal observations during the last week of May. Most of the study sites are near urban centers, thereby leaving more remote areas of the province under represented. Like all other FAN programs, the FAN stores data and makes data available for other research and management initiatives upon request. Though there is

a long history of data collection, no analysis for long-term trends has been done. In 1998, a database for the Spring Mammal Count will be complete allowing for the pursuit of data analysis in the future. Currently, the FAN newsletter, *Alberta Naturalist*, publishes only annual summaries.

Amphibian Monitoring Programs

Amphibian Monitoring Program

The primary intention of the Amphibian Monitoring Program is to develop presence/absence information for all amphibian species in Alberta. This program is a response to the Declining Amphibian Populations in Canada (DAPCAN). DAPCAN is a national initiative to evaluate the status of Canada's amphibians and explain declining trends. Participants have collected data annually since 1992. This data will be ultimately used to develop an amphibian atlas for the province. The atlas will serve as an important document to establish and compare the distribution and diversity of amphibians in Alberta. This provides a crucial first step in quantifying the status of amphibians. Upon completion of the atlas, the Amphibian Monitoring Program intends to continue amphibian surveys and ensure distribution information is kept up to date. The Biodiversity/Species Observation Database (see Provincial Government Monitoring Programs) also uses the data from this program to publish The Status of Alberta Wildlife report (Alberta Environmental Protection, 1996).

The first report published by the Amphibian Monitoring Program summarized data spanning from 1992 to 1994. During this time period, participants collected data almost exclusively from the Grassland and Parkland Natural Regions south of Edmonton. To date, southern Alberta continues to have the most extensive amphibian sampling in Alberta. In recent years, northern areas are experiencing an increase in the volunteer base. As with the Alberta Amphibian Monitoring Program (see Provincial Government Monitoring Programs), the sampling protocol uses call surveys. As a result, researchers can derive presence/absence data, but cannot accurately determine relative abundances. Similar species are under represented by both programs. These include species such as the long-toed and tiger salamanders, great plains toad, and the spade-foot toad. Information collected for these species are generally opportunistic.

Researching Amphibian Numbers in Alberta (RANA)

The newest amphibian monitoring program in Alberta is the Researching Amphibian Numbers in Alberta program, otherwise known as RANA. Established in 1997, RANA is unique amongst amphibian monitoring programs in western Canada. This program uses trained technicians who capture, identify and record amphibians from selected waterbodies. Technicians use drift fences encircling small bodies of water to intercept dispersing amphibians. Technicians sample larger waterbodies by using a combination of drift fence arrays and pitfall traps. This method effectively captures more reclusive species, such as tiger salamanders, which are normally missed by other extensive monitoring techniques. Researchers derive accurate breeding population estimates, amphibian community composition, and also study general amphibian

ecology. RANA stores its data at the University of Alberta, and also contributes information to Natural Resources Service of Alberta, Biodiversity/Species Observation Database (see Provincial Government Monitoring Programs). This program also embraces its role as a public educator of amphibian ecology. Future plans include testing the accuracy of call surveys to estimate relative species abundance. This question is of great importance to all amphibian monitoring programs relying on call surveys.

Currently, the geographic coverage of the program is limited. All sites are within Central Alberta's Lesser Slave Lake Provincial Park, Beaverhill Lake, and Meanook Biological Research Station in the Athabasca District. Future plans include study site expansion into the Grassland and Rocky Mountain Natural Regions.

Invertebrate Monitoring Programs

Coast-to-coast Moth and Butterfly Survey

The Canadian Wildlife Federation (CWF) has organized the Coast-to-coast Moth and Butterfly Survey since 1996. The primary objective of the Survey is to increase public awareness about Lepidoptera and conservation issues. This Survey occurs nationwide during the spring and summer months. Seven butterfly species and two moth species have been selected for monitoring based on three criteria: they must be common, easily identified, and sensitive to environmental health and habitat loss. Data is stored by the CWF, and is available to the public. In the future, CWF will analyze the data for general trends such as national distributions and presence/absence information. It is important to note that much of the data is not valid for other analytical applications; there are no restrictions for where data is to be collected, and rarely is there any repeated sampling.

July Fourth Butterfly Count

The Fourth of July Butterfly Count is a North American monitoring program initiated in 1992. Along with educating the public about the nonconsumptive and recreational attributes of butterfly watching, this program gathers information on butterfly species diversity, abundance and population fluctuations. Volunteer participants select and survey a 24 kilometer diameter study site for one day. The sampling day falls within a few weeks before or after July 4, depending on the latitude of the sampling area. Currently, there are five study sites in Alberta; Sir Winston Churchill Provincial Park, Beaverhill Bird Observatory, Edmonton, Darwell, and Opal. These sites currently only represent the central area of the Province. The North American Butterfly Association (NABA) coordinates the July Fourth Butterfly Count, as well as stores the data and publishes annual summaries in their newsletter, *NABA July Fourth Counts*.

Ladybug Survey

The effects of introduced organisms on native species can be quite profound. Habitat loss, food chain disruption, species displacement, and hybridization are just a few potential effects resulting from non-native species. Of the 13 species of ladybugs

native to Canada, preliminary results suggest that some have already been negatively affected by the introduction of 3 European ladybug species. This survey is quantifying how introduced ladybug species affect the distribution of native species throughout Canada. More specifically in Alberta, 2 non-native species are potentially affecting 10 native species.

The Canadian Nature Federation (CNF) established the Ladybug Survey as part of the Endangered Plants and Invertebrates of Canada (EPIC) initiative. EPIC is a CNF program designed to obtain measurable data on these species and increase public awareness about the values of non-charismatic species. Nationwide, the EPIC program attracts 40 000 volunteers. Alberta is well represented by volunteers though actual numbers are not available. As with many other NGOs, data is generally collected in and around urban areas, making it difficult to assess ladybug abundance and distribution in more natural areas. Participants collect information in the spring, summer and early fall. Besides establishing the Ladybug Survey, the CNF is also responsible for the coordination, data analysis and annual reporting of the program. Data will be collected over 10 years with a final report in 2005.

Vegetation Monitoring Programs

Plantwatch

Plantwatch is designed to monitor flowering times for plant species considered to be indicators of climate change and weather variability. Plantwatch was established in 1987, and has an average of 200 volunteers. The objective is not directed toward biodiversity, rather to follow the impact of climate change on biota. Reports of flowering dates are produced annually. Data collected from Plantwatch is useful for analyzing variations in spring development times from year to year and between different areas of the province. Plantwatch gathers information on roughly 15 species of native plants. Their selection was based on phenology criteria including lack of subspecies, ease of recognition, brief flowering period, and wide geographic distribution.

Spring Flower Count

The Spring Flower Count, otherwise known as the May Species Count, is a joint monitoring program between the Alberta Native Plant Council and the Federation of Alberta Naturalists (FAN). The program monitors both native and non-native flowering plants found in Alberta. Surveys have been done during the last week of every May since 1976, yet long-term trends have not been analyzed. Along with the other FAN programs, the upgrading of existing databases will allow for more in-depth analysis of the data that has been collected. Yearly summaries are published in the newsletter, *Alberta Naturalist*. The count has representation from all Natural Regions in Alberta, but is largely centred from urban centers. As one of the longest running plant monitoring programs in Alberta, the Spring Flower Count is a valuable resource.

Discussion and General Conclusions

Legislation, Policies, and External Agreements

The review of current provincial legislation, provincial policies, and external agreements supports the need for monitoring of biodiversity in Alberta. Provincial legislation provides no specific language for monitoring of biodiversity rather monitoring is an implicit part of decision making in resource management. Biodiversity monitoring provides potentially important data in managing the different responsibilities covered by each Act.

Policies, performance measures, and guidelines as well in external agreements outline specific provincial monitoring requirements. Of the areas of responsibility, assessment and management of biodiversity flows most directly from the policies of Natural Resources Services (NRS), particularly through the Wildlife and Fisheries Management Branch. The Fish and Wildlife Policy for Alberta (Alberta Public Lands and Wildlife. 1982.), Fish and Wildlife Division Strategic Plan (Alberta Forests, Lands, and Wildlife (Fish and Wildlife Division). 1991.), A Fish Conservation Strategy for Alberta (Alberta Environmental Protection (Natural Resources Services 1997), and Policy for the Management of Threatened Wildlife in Alberta (Alberta Energy and Natural Resources (Fish and Wildlife Division) 1985) all focus on the requirement for monitoring of biodiversity.

Along with the policies of NRS, Alberta Environmental Protection, Land and Forest Service (LFS) plays an important role in biodiversity protection and monitoring. The primary mandate of LFS is the management of the forested landscape. Rather than the direct management of biodiversity, LFS deals with management of the habitat. Arguably, this is of more direct impact to biodiversity since most industrial activity in forested alters habitats and landscapes. Recognizing the complex and often unpredictable nature of interactions between forest development and biodiversity, forest management policies identify the importance monitoring in an adaptive management framework. The concept of monitoring figures prominently in a number of recent strategy and policy documents such as the Alberta Conservation Strategy (Alberta Forest Conservation Strategy Steering Committee 1997), Alberta Forest Legacy (Alberta Environmental Protection 1998) and new Interim Forest Management Agreement Guidelines (version 4.2, Alberta Environmental Protection (Land and Forest Service) 1997).

Two external agreements, the Canadian Biodiversity Strategy (Canadian Biodiversity Strategy Working Group 1995) and Canadian Council of Forest Ministers (Canadian Council of Forest Ministers 1995) call directly for biodiversity indicators. The Canadian Biodiversity Strategy provides no firm examples of species, habitats, or landscapes to be monitored. The framework for indicator selection includes both stakeholder species and species used to track ecosystem function and pattern. Alberta has developed a plan to implement the Canadian Biodiversity Strategy (Alberta

Environmental Protection (Natural Resources Service 1997). Currently, the plan is reviewing provincial biodiversity programs to ascertain the degree to which these programs meet the Canadian Biodiversity Strategy Goals and Elements. However, the response does not suggest specific indicators for monitoring of ecosystem function and pattern.

In contrast, the Canadian Council of Forest Ministers identified a number of firm and potential indicators for reporting by the year 2000 (Canadian Council of Forest Ministers 1996). Alberta has committed to reporting on 10 of the 15 biodiversity indicators by 2000 (Table 2). In general, these represent general forest measures, e.g. total forested area species of economic importance. Of the 15 indicators, eight are likely to produce problems in assessment and reporting:

1. landscape fragmentation (indicator 1.1.4)
2. genetic strategy (indicator 1.3.1)
3. endangered forest dependent species (indicator 1.2.1)
4. range decrease in forest dependent species (indicator 1.2.3)
5. indicator population changes over time (indicator 1.2.2)
6. frequency of occurrence for selected species (indicator 2.3.2)
7. animal population trends for economic species (indicator 5.1.3)
8. availability of habitat for economic species (indicator 5.1.4).

These indicators are either lacking datasets for analysis or the specific parameters for analysis have not been identified.

Some difficulty may exist in reconciling provincial and federal indicators. In part, this is caused by the problems in using the Canadian Council of Forest Ministers suggested land classification and species (Appendix 17).

1. The federal land classification system of four ecozones within Alberta do not match boundaries of the four forested natural regions and 14 subregions used by Alberta Environmental Protection (Alberta Environmental Protection 1994). Thus the summation and “roll up” of indicators from regional to national scales is difficult.
2. The Canadian Council of Forest Ministers indicators rely heavily on COSEWIC lists for both endangered species and forest species with reduced ranges. Currently, Alberta’s endangered species system differs from the other provinces sharing similar ecozones.
3. The Canadian Council of Forest Ministers focus on vertebrate indicators of stand age. Undoubtedly, changes to stand age are an important impact, however, other indicators are required to assess other impacts such as riparian, access, forest fragmentation, and changes in understory communities.

The problem in reconciling provincial and federal indicators underscores larger issues dealing with the meaning and practicality of indicators measured at local, regional, and national levels.

In part, the differences in approach between national and provincial/regional levels of “roll-up” and reporting reflect their overall objectives. The Canadian Council of Forest Ministers (Canadian Council of Forest Ministers 1997) objective is:

“...to provide a common understanding and scientific definition of sustainable forest management in Canada.”

This broad objective primarily concerned with providing measures for reporting on the “state of Canada’s forests” and have indirect linkage to regional forest management. In contrast, the objectives of provincial and regional monitoring are tied to pre-established management actions based on the changes in monitoring, i.e. adaptive management.

*“...provide feedback so that improvement to management can be made...
...provides a measure of (forest company) accountability to the public on management effectiveness. It also contributes to information on provincial, national and international sustainability reporting systems.”*

The Alberta Conservation Strategy (Alberta Forest Conservation Strategy Steering Committee 1997) and the new Interim Forest Management Agreement Guidelines (version 4.2, Alberta Environmental Protection (Land and Forest Service), 1997) provide a different approach to the selection of species for performance measures. The Forest Management Agreement link performance monitoring and indicators for adaptive management as part of the approval and renewal process. Potential indicators include species valued by stakeholders, e.g. moose, similar to Canadian Council of Forest Ministers and species that represent ecological function or pattern, e.g. cavity dwelling birds. Alternatively, indicators may not be species at all rather they may be habitat or landscape elements. **Despite differences in use, both provincial and national reporting systems require that stakeholder indicators need to be supplemented with indicators of ecosystem pattern and function that are linked to areas of concern in forestry development.**

Recent Natural Resources Services (NRS) policies recognize the extension of monitoring to other forms of biodiversity. It is unclear to what extent NRS will have the resources to monitor the expanded definition of biodiversity. Traditionally, NRS has limited monitoring angled, game, or fur species. The Wildlife Amendment Act expands biodiversity to include fish, invertebrates, vascular plants, nonvascular plants, and fungi. Even with the inclusion of these additional species, NRS policy still primarily manages species using a fine filter approach. That is, species are enumerated and analyzed independent of each other and their origin-ecosystems. Subsequent management actions on these species are often practiced independently of ramifications on other species. As the charge of greater and greater numbers of species grows, the effectiveness of these fine filter policies and practices will become more

cumbersome to the point of being untenable. No doubt species of economic, aesthetic, and ethical importance will continue to be monitored in a fine-filter manner but other species may require broader, coarse filter strategies.

Conclusion 1: Recent documentation identifies many species-specific indicators of stakeholder values, e.g. woodland caribou, moose. Further effort is required to develop indicators representative of broader ecosystem functions and patterns, i.e. coarse filter indicators. The criteria for these latter indicators should include known potential impacts of industrial development, e.g. loss of deadwood resources.

Though the provincial guidelines permit companies to develop their own indicators, there would be great merit for companies operating in similar vegetation communities to monitor the same indicators. This facilitates sharing of sampling techniques and resources, data management, and results. The latter allows for geographical comparisons of data to determine whether changes in populations are local or more widespread. The Alberta Forest Biodiversity Monitoring Program is working towards standardizing methodologies and indicators (Alberta Forest Biodiversity Monitoring Program, 1998).

Conclusion 2: To facilitate long-term data usability and comparability between different geographic locations, common indicators, sampling techniques, data management and analysis procedures, and reporting protocols should be employed.

The review of all documents including monitoring programs indicates that development of aquatic indicators has lagged behind terrestrial indicators. Aquatic indicators focus primarily on game fish or clean water. Although these conditions need to be considered, what remains unclear is the type of management and indicators that would be developed for aquatic ecosystems under a coarse filter management scenario. As an example, the impact of natural and man-made disturbances on the successional dynamics of aquatic ecosystems needs to be incorporated into management and appropriate biodiversity indicators developed.

Conclusion 3: In Alberta, the development of aquatic biodiversity indicators in forested areas lags behind that for terrestrial ecosystems. Aquatic indicators should receive special emphasis. Furthermore, integrated aquatic and terrestrial indicators need to be developed which represent the transfer of properties between ecosystems.

Monitoring Programs by Taxa

Monitoring for biodiversity in Alberta has greatly intensified over the last fifty years. Provincial, federal and non-government agencies have all made significant contributions during this time. In total, there are over 100 biomonitoring programs managed by over 30 agencies and organizations (Appendices 19 and 20) involving thousands of Albertans. This underscores three main points. First, monitoring is

important to Albertans. Second, Alberta has a need to monitor organisms. Lastly, Albertans place great interest and value on nature.

There are ten monitoring programs or organizations assessing a range of species groups or taxa. The primary examples of holistic oriented programs includes museum and university collections, Biodiversity/Species Observation Database (B/SOD), Alberta Natural Heritage Information Centre (ANHIC), National Park Warden Wildlife Observation Databases and the Ecological Monitoring and Assessment Network (EMAN). The information from these programs is substantial, and generally serves to complement other programs. Some of these programs collect information in geographically isolated areas and focus on otherwise poorly monitored species. As well, some of these programs are an important sources of taxonomic and geographical distribution information. For example, museums and university collections produce atlases of species distributions in Alberta, and the Status of Alberta Report (Alberta Environmental Protection, 1996) B/SOD. In part, the Special Places 2000 program used ANHIC datasets to identify potential sites (Alberta Environmental Protection 1995).

Most monitoring programs in Alberta are based upon individual species or species groups. Avian species are the most effectively monitored taxa in Alberta. Federal and non-government agencies constitute 25 out of the 26 avifauna monitoring programs. Though more than half of all avian programs are greater than 10 years old, new programs are being continually added. This demonstrates the continued interest and expansion of avifauna monitoring. A wide diversity of programs incorporate both intensive and extensive monitoring techniques. The large quantities of research and monitoring have documented avifauna species diversity, ranges, biology, abundances, annual summaries and long-term trends. In particular, waterfowl, songbirds, shorebirds, and sensitive species have very good records and geographic coverage. Despite better overall geographic coverage than other taxa, records north of Lac La Biche and Lesser Slave Lake are limited to localized sampling in areas with access, near population centres, and/or locations with high abundance and species diversity.

There are over 30 monitoring programs for mammals, but unlike avifauna monitoring, mammals have a poorer coverage of species diversity. Natural Resources Service and National Parks account for most of the large mammal monitoring programs. For mammals this group are actively monitored, substantial amounts of data and analysis have been published on population trends at local, regional and provincial levels. There are virtually no monitoring programs for small mammals other than furbearer species. Ongoing field research, museum and university collections provide some uncoordinated “monitoring” of small mammals.

Amphibian and reptile monitoring is relatively recent in Alberta. There are no long-term datasets for these species, but a number of programs have established within the last ten years. There are a mix of intensive local and extensive geographical programs. The goal of most programs is to determine whether their status in Alberta is if local

following a worldwide trend of decline. Unfortunately, there is very little data on the long-term population trends of reptiles or reclusive amphibians.

The level of monitoring for non-game fish species is quite weak. There are no non-government organizations with fish monitoring programs. Federal agencies also do not have a substantial role in fish monitoring in Alberta. Provincial programs, which focus on sport fish, are the most significant attempt monitoring fish of any kind in Alberta. The geographic coverage of fish monitoring programs is generally limited to waterbodies with high harvesting rates or special management concerns. Reporting does occur for the existing programs, but reporting of provincial trends may be more common in the future with the establishment of a centralized database by the Natural Resources Service.

Invertebrates have the highest species diversity of any taxa in Alberta, however, they are the least monitored. There are eight monitoring programs in Alberta, primarily focused on areas near urban centres and within national parks. Coverage outside these areas is very poor. Currently, invertebrates tend not to be used as indicators. The primary focus of invertebrate monitoring in Alberta is on species identification, distribution, biology, and applied areas such as pest control. Use of invertebrates as indicators is likely to expand once linkages between invertebrates and industrial impacts are better established and subsequently incorporated into management practice. Public interest has already grown in invertebrate species with the recent establishment of three new non-government organization programs.

Flora of Alberta is also generally underrepresented among the monitoring programs. 15 flora programs currently exist, the majority being within national parks. Vegetation monitoring is reasonably comprehensive in some national parks, however, much of the effort tends to focus on range land assessments and inventories of plant species. Non-government organizations largely focus on species groups with limited geographic scope. Provincial information for forested areas of the province relies largely upon the Permanent Sample Plot program and remote land classification maps. These programs focus on canopy species. There is very little or no monitoring for the vast majority of non vascular and vascular plant species, and there are many areas of the province with no regular systematic sampling.

Conclusion 4: Current monitoring efforts poorly represent the following taxa: terrestrial and aquatic invertebrates, herbaceous and non-vascular plants, reclusive amphibian species, reptiles, small mammals, and non-harvested fish species.

Conclusion 5: Coverages of current monitoring programs are uneven both geographically and through time. Full geographic and temporal coverage of the forested landscape of Alberta should be a goal of future initiatives.

Monitoring Programs by Agency

Provincial monitoring programs largely focus on species of special management concern. Many of these organisms have significant socio-economic value, and thus are some of the most well monitored organisms in the province. The longevity and wide geographic coverage of game, furbearer, and permanent sample plot programs demonstrates their significance. More recently, species or species groups of less socio-economic value have been the focus of recent provincial monitoring. This is demonstrated by the establishment of the Biodiversity/Species Observation Database and the Alberta Natural Heritage Information Centre and other programs.

Federal biodiversity monitoring is primarily conducted by Parks Canada and the Canadian Wildlife Service. Monitoring for the species covered by the federal programs are generally quite good with maintenance of long-term datasets, good geographical coverage within designated study areas, and consistent reporting. As with provincial monitoring programs, the primary objective of federal programs are to monitor species of important management concerns. The Canadian Wildlife Service mainly focuses its attention on waterfowl monitoring, likely the model of excellence for all monitoring programs. For Alberta national parks, monitoring mainly focuses on large carnivores, ungulates, and rare or sensitive species. Monitoring outside this scope is quite poor. Overall, the number of national park programs is substantial (see Appendix 19), however, this may be somewhat deceiving. On a provincial scale, the geographic coverage is less than ten percent of Alberta's land base.

Both provincial and federal agencies offer some advantages in monitoring. Currently, federal and provincial programs have some of the longest running databases in Alberta. Despite departmental reorganizations and changes in mandates, government agencies are still able to safely archive data for long periods of time. Their mandate covers the province, hence agencies have better access to remote areas of the province. Lastly, government agencies are generally better able to train and equip individuals for collecting data than volunteer non-government organizations (NGOs) who mostly rely upon volunteers with varying degrees of skill.

Non Government Organizations (NGOs) are an effective means of monitoring biodiversity. For any agency, effective monitoring over a large expanse of area requires a considerable amount of secure financial and human effort. NGOs offer a unique avenue of monitoring which fulfill the roles of data acquisition, public awareness/involvement, and education. In many cases, non-profit NGOs have taken the initiative to fill knowledge gaps, increasing public awareness about conservation issues, lobbying for research and environmental protection, and satisfying important biodiversity monitoring objectives. As an example, many new NGO programs have recently focused on plants, invertebrates, and amphibians; species with little previous monitoring.

There are, however, some limitations to volunteer-based biomonitoring:

1. The geographic coverage is often limited to highly accessible areas, especially near urban centres. An exception are the biological research stations located in remote areas which manage programs despite relatively low volunteer effort. Areas of the province least covered by NGO monitoring programs include the Boreal Forest and Canadian Shield Natural Regions, largely because of the limited accessibility and a small volunteer base.
2. The types of species monitored by NGOs are based on public interest, ease of species identification, and conduciveness to extensive monitoring techniques. It is for these reasons that avifauna are the most intensively monitored taxa by NGOs. The volunteer base, diversity of species monitored, and geographic coverage is relatively poor for the other taxa.
3. Lack of randomized sample sites, lack of repeated sampling within the sample sites, and variability in effort and skill levels of volunteers collecting the data all limits the statistical analysis of some NGO monitoring programs. These shortcomings are more characteristic in the smaller NGO programs, or programs primarily intended for public education and recreation. For larger NGO programs, many of these issues have been resolved.

Conclusion 6: The utility of monitoring programs is dependent upon the standardization, duration and continuity of monitoring through time. Several small, independent and uncoordinated monitoring programs on biodiversity are unlikely to provide useful results on a cost effective basis over time. Also, there are often overlaps in the administration and sampling scope of monitoring programs. There is likely potential for greater cooperation in sampling, data management, data analysis, and reporting among non-government organizations, government agencies and industry.

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Appendices

Appendix 1: Wildlife Act: Chapter W-9.1

Excerpts containing only sections affected by biomonitoring.

Lieutenant Governor in Council regulations

- (a) respecting the operation and administration of the Fish and Wildlife Trust Fund;
- (b) prescribing fees or assessments in respect of licenses and permits and any government activity, program or services relating to fish or wildlife;
- (c) classifying wildlife sanctuaries into those for the benefit of all wildlife or those for prescribed kinds of wildlife;
- (d) respecting hunting and related activities.

Ministerial regulations

The Minister may make regulations:

- (a) respecting the records to be kept and the returns or reports to be made for the purposes of this Act;
- (b) respecting the registration of wildlife for the purposes prescribed by the Minister;
- (c) establishing migratory bird lure sites and wildlife control areas, and specifying their purposes;
- (d) providing that areas are to be wildlife sanctuaries, habitat development areas, migratory bird lure sites or wildlife control areas only for prescribed parts of the year;
- (e) respecting the use, control and management of wildlife sanctuaries, habitat development areas, migratory bird lure sites and wildlife control areas or any part of any of them;
- (f) respecting the access or exclusion of any persons to or from a wildlife sanctuary, habitat development area, migratory bird lure sites and wildlife control areas or any part of any of them;
- (g) respecting the protection of wildlife habitat and the restoration of habitat that has been altered, and enabling the Minister to order the person responsible for the alteration to restore the habitat and to charge that person with the cost of it if he has failed to effect the restoration;
- (h) respecting the reporting of wildlife animals killed and the submission to the Minister of prescribed parts of prescribed wildlife animals killed.

Endangered Species Conservation Committee

9.1(1) The Minister shall establish and maintain a committee to be known as the "Endangered Species Conservation Committee", whose functions are to advise the Minister about endangered species and to make recommendations to the Minister with respect to:

- (a) the preparation and the adoption by the Minister of recovery plans for endangered species;
- (b) organisms that should be established as endangered species;
- (c) endangered species and biodiversity conservation; and

- (d) any other matters respecting endangered species on which the Minister requests its advice, in accordance with this section.
- (2) The committee shall establish, appoint and maintain an independent scientific subcommittee of the committee to study and assess endangered species and to recommend organisms to the committee that in the subcommittee's opinion should be established as endangered species, and the committee shall give the subcommittee such directions on matters falling within that mandate as it considers appropriate.
- (3) Endangered species recovery plans may include population goals and identification of critical habitats and of strategies to enable populations to recover.
- (4) The recovery plans, after being made by the Minister are:
 - (a) to be reviewed by the committee; and
 - (b) to undergo a process of review by the public.

Appendix 2: Forests Act: Chapter F-16

Excerpts containing only sections affected by biomonitoring.

Part I (Administration) Sections 4 and 5

Lieutenant Governor in Council regulations:

- (d) prescribing the charges to be made for damage to timber stands in the cutting of roads, lines, rights of way, or other disturbance of the forest;
- (f) governing all aspects of reforestation and afforestation on public land;
- (k) governing the management and use of forest land.

Also, for Part I Section 4 which defines the

Minister's regulations:

- (a) governing logging methods and wood utilization standards.

Administration of public land

- 6. If the member of the Executive Council charged with the administration of the Public Lands Act is a person other than the Minister:
 - (a) the Minister has the administration of all public land that is contained in or subject to timber dispositions, forest land use zones, forest recreation areas or forest recreation trails for the purposes of this Act; and
 - (b) the member of the Executive Council charged with the administration of the Public Lands Act has the administration of the public land referred to in clause (a) for the purposes of the Public Lands Act.
- 1977 c22 s7

Public land

- 7. The Minister shall administer and manage timber on public land under his administration and standing and cut timber on all road allowances.
- 1971 c37 s6

Forest growth

- 10. Except as may be authorized by the Minister, no person shall:
 - (a) cut, damage or destroy; or
 - (b) cause to be cut, damaged or destroyed any forest growth on forest land.
- RSA 1980 cF-16 s10; 1996 c28 s20

Forest recreation areas and trails

- 11. The Minister may construct and maintain forest recreation areas and forest recreation trails.
- 1975(2) c17 s26; 1977 c22 s8

Part 2

Forest management units

- 14(1) For the purposes of administration of this Part, the Minister may divide forest land into forest management units.
- (2) The Minister may determine the annual allowable cut of timber with respect to each forest management unit.

Forest management agreements

- 16(1) The Minister, with the approval of the Lieutenant Governor in Council, may enter into a forest management agreement with any person to enable that person to enter on forest land for the purpose of establishing, growing and harvesting timber in a manner designed to provide a perpetual sustained yield.
- (2) Except as against the Crown and subject to any agreement to the contrary, ownership of all Crown timber on land subject to a forest management agreement or forest management lease is, during the term of the agreement or lease, vested in the holder of the agreement or lease, who is entitled to reasonable compensation from any person who causes loss of or damage to any of the timber or any improvements created by the holder.
- (3) No person shall assign a forest management agreement without the prior consent in writing of the Minister and an assignment without the consent of the Minister is void.
- (4) An assignment of a forest management agreement must be an unconditional assignment of the entire interest of the assignor in the forest management agreement.

1971 c37 s14; 1977 c22 s9

Part 3 (Forest Land Uses)

Lieutenant Governor in Council regulations (section 46):

- (a) declaring any area of forest land to a forest land use zone;
- (b) permitting, prohibiting, regulating or controlling uses of land in forest land use zones;
- (c) declaring any area of forest land to be a forest recreation area or forest recreation trail;
- (d) governing the use of forest recreation areas or forest recreation trails and prohibiting, regulating or controlling activities in them.

Minister's responsibilities

- (a) prohibit or restrict entry to all or any part of a forest recreation area or forest recreation trail; or
- (b) prohibit any use or activity in all or any part of a forest recreation area or forest recreation trail.

Appendix 3: [unproc] Water Act, Chapter W-3.5

(Assented to September 3, 1996)

Excerpts containing only sections affected by biomonitoring.

Part 2: Planning and Environmental Assessment

Division 1 Planning

Provincial planning framework

- 7(2) The framework for water management planning must include a strategy for the protection of the aquatic environment, as described in section 8, and may include:
- (b) the geographical limits or boundaries within which water management planning is to be carried out in the Province, including limits or boundaries for the development of strategic and operational plans;
 - (d) an outline of the processes for developing, implementing, reviewing and revising water management plans, including opportunities for local and regional involvement;
 - (e) matters relating to integration of water management planning with land and other resources; and
 - (f) matters relating to the development of water conservation objectives.

Aquatic environment protection strategy

- 8(1) In this section, "biological diversity" means the variability among living organisms and the ecological complexes of which they are a part, and includes diversity within and between species and ecosystems.
- (2) The Minister must establish a strategy for the protection of the aquatic environment as part of the framework for water management planning for the Province.
- (3) The strategy referred to in subsection (2) may include:
- (a) identification of criteria to determine the order in which water bodies or classes of water bodies are to be dealt with;
 - (b) guidelines for establishing water conservation objectives;
 - (c) matters relating to the protection of biological diversity; and
 - (d) guidelines and mechanisms for implementing the strategy.

Appendix 4: Provincial Parks Act: Chapter P-22

Excerpts containing only sections affected by biomonitoring.

Purpose of parks

- 3 Parks shall be developed and maintained:
- (a) for the conservation and management of flora and fauna;
 - (b) for the preservation of specified areas and objects therein that are of geological, cultural, ecological or other scientific interest.

Acquisition of property

- 6(1) The Lieutenant Governor in Council may by order authorize the purchase, expropriation or other acquisition of land or buildings or other fixtures on land by the Minister for the purpose of a park or recreation area.
- (2) Land purchased, expropriated or otherwise acquired for the purposes of this Act or designated as a park or recreation area pursuant to section 7 is under the administration of the Minister.

Establishment of parks and recreation areas

- 7(1) The Lieutenant Governor in Council may by order:
- (a) designate land that is owned by or leased to the Crown as a provincial park or provincial recreation area and declare the name by which it is to be known, and
 - (b) increase or decrease the area of land designated as a park or recreation area.
- (2) Provincial parks designated pursuant to any predecessor of this Act continue as designated parks under this Act.

Land not designated as a park or recreation area

- 7.1 Where land under the Minister's administration is not designated as a park or recreation area, the Minister may by regulation:
- (a) declare any provision of this Act or the regulations to be applicable to that land as if it were a park or recreation area;
 - (b) declare that land to be included in any reference made to a park or recreation area that is contained in a provision of any other Act or its regulations;
 - (c) prescribe conditions under which any provision referred to in clause (a) or (b) applies to that land;
 - (d) prescribe periods of time during which any provision referred to in clause (a) or (b) applies to that land.

Powers and duties of Minister

- 9 The Minister:
- (a) may establish, develop and maintain a system and classification of parks and recreation areas;
 - (b) is responsible for the administration, planning, development and maintenance of parks and recreation areas.

Regulations

- 11 The Minister may, in respect of parks and recreation areas, make regulations:
- (d) governing uses of and activities on that land;
 - (e) governing commercial, scientific and research activities that may be carried on;
 - (f) governing the use of motor vehicles, off-highway vehicles, boats, trailers and equipment;
 - (j) governing the treatment and feeding of wildlife.

Powers of the Minister

- 13(1) The Minister may by order:
- (a) close all or any part of a park or recreation area for any periods he considers necessary;
 - (d) zone any portion of a park or recreation area so as to regulate or confine the various uses of land resources and water within the park or recreation area.

Appendix 5: Wilderness Areas, Ecological Reserves, and Natural Areas Act:
Chapter W-8

Excerpts containing only sections affected by biomonitoring.

Designation of wilderness areas. Section 2(7):

- (7) The Advisory Committee shall receive and consider requests from the public regarding wilderness areas and ecological reserves and may make recommendations to the Minister regarding:
- (a) the establishment of new wilderness areas or ecological reserves;
 - (b) the addition of land to wilderness areas or ecological reserves;
 - (c) the withdrawal of land from wilderness areas or ecological reserves;
 - (d) the making of regulations for the administration, management, operation and utilization of wilderness areas, ecological reserves and controlled buffer zones.

Designation of ecological reserves. Section 2(3):

- 3.1(1) The Lieutenant Governor in Council, in order to preserve public lands for ecological purposes, may by regulation designate as an ecological reserve any area of public land that, in his opinion:
- (a) is suitable for scientific research associated with the studies of natural ecosystems;
 - (b) is a representative example of a natural ecosystem in Alberta;
 - (c) serves as an example of an ecosystem that has been modified by man and that offers an opportunity to study the recovery of the ecosystem from that modification;
 - (d) contains rare or endangered native plants or animals that should be preserved; or
 - (e) contains unique or rare examples of natural biological or physical features.

Programs

- 5 The Minister may carry out or cause to be carried out measures or programs in a wilderness area or ecological reserve, or approve the carrying out by other persons of measures or programs in a wilderness area or ecological reserve,
- (a) for the management and preservation of the animal and plant life and the environment of the wilderness area or ecological reserve,
 - (b) for environmental research that does not involve any physical disturbance of the wilderness area or ecological reserve,
 - (c) generally, for the preservation and protection of the wilderness area or ecological reserve.

Travel restrictions

- 11(1) The Minister may by order prohibit or restrict travel in a wilderness area or ecological reserve during any period either absolutely or except under the authority of a permit issued by or on behalf of the Minister.

Controlled buffer zones

12(1) The Lieutenant Governor in Council may, by regulation, designate any area of public land adjoining a wilderness area or ecological reserve as a controlled buffer zone.

Appendix 6: Forest Development Research Trust Fund Act: Chapter F-13

Excerpts containing only sections potentially affected by biomonitoring.

Duties of the Alberta Forest Research Advisory Council (section 6):

- (a) establish forest research priorities;
- (b) co-ordinate forest research; and
- (c) make recommendations to the Minister concerning the allocation of research funds.

Appendix 7: Public Lands Act

Excerpts containing only sections affected by monitoring.

Powers of Lieutenant Governor in Council

7 The Lieutenant Governor in Council may

- (c) set aside public land:
 - (i) for use as a provincial park, historical site, natural area, ecological reserve, wilderness area, forest reserve, forest recreation area, wildlife sanctuary, habitat development area, public shooting ground or public resort or for the development of any natural resource

Powers of the Minister

Classification of land

10 The Minister may by order classify public land and declare the use for which he considers different classes to be adaptable.

RSA 1980 cP-30 s10

Unauthorized seeding of crops

48 If a person without authority seeds a crop on public land, the Minister may:

- (a) authorize an officer to seize the crop either before or after it is harvested; and
- (b) order the crop to be disposed of as he decides.

RSA 1980 cP-30 s48

Seizure of clay, marl, sand or gravel

49(1) When an officer believes on reasonable grounds that any clay, marl, sand, gravel, silica sand, topsoil or peat has been removed unlawfully from public land, he may seize it and any vehicle, tools or equipment used to remove or transport it.

Destruction of or injury to surface

50 The holder of a disposition shall not do any act or thing which injures or destroys, or which is likely to injure or destroy, the surface of the public land described in the disposition unless:

- (a) he has obtained the authorization of the Minister; or
- (b) he is authorized by the disposition to injure or destroy the surface.

Prohibitions

51(1) No person shall cause, permit or suffer:

- (a) the accumulation of waste material, debris, refuse or garbage on public land;
- (b) the existence on public land of any structure or excavation of any kind that is undesirable in the Minister's opinion;
- (c) the existence on public land of any condition which, in the opinion of the Minister, may cause danger by fire to life, property or forest growth;
- (d) the doing of any act on public land that may injuriously affect watershed capacity;

- (e) the disturbance of any public land in any manner that results or, in the opinion of the Minister, is likely to result in injury to the bed or shore of any river, stream, watercourse, lake or other body of water or land in the vicinity of that public land; or
 - (f) the creation of any condition on public land which, in the Minister's opinion, is likely to result in soil erosion.
- (1.1) A person lawfully carrying out any industrial activity on public land in accordance with:
- (a) the terms and conditions of a disposition or authorization issued under this Act, and
 - (b) any other applicable Acts and regulations shall not, by reason of that fact alone, be considered to have contravened this section.

Shelter belts, etc.

61(1) In wooded, parkland or brush-covered areas the holder of a disposition shall preserve and maintain for shelter belts, windbreaks and woodlots such areas of brush and forest cover as may from time to time be prescribed by the Assistant Deputy Minister.

Use of land

74 A lessee shall not make use of the land for any purpose other than that for which the lease was granted without the consent of the Minister, and then only on the terms and conditions the Minister may prescribe.
RSA 1980 cP-30 s74

Use of cordwood and timber

75(1) Every lessee who prepares land contained in his lease for cultivation may use wood for fuel and for the construction of buildings and improvements on the leased land without a permit.
except as permitted by subsection (1), no lessee shall cut timber on land contained in his lease for any purpose without the authority of a permit issued pursuant to the regulations under the Forests Acts.
RSA 1980 cP-30 s75

Withdrawal from lease

79(1) Sixty days after the date on which the Minister mails a notice in writing to the last known address of the lessee, he may cancel a lease or withdraw any part of the land contained in a lease:

- (b) when the land contained in the lease or to be withdrawn from it is to be subdivided or made the subject of a disposition that will authorize its use for industrial or commercial purposes;
- (c) when the land contained in the lease or to be withdrawn from it is to be designated as a park pursuant to the Provincial Parks Act or added to a park designated under that Act or its predecessors, or is to be set aside as a public resort or recreation area;

- (e) when the land contained in the lease or to be withdrawn from it is required to provide public access to a public resort or recreation area or to a river, stream, watercourse, lake or other body of water; or
- (f) when, in the opinion of the Minister, the land contained in the lease or to be withdrawn from it is required for a purpose that he considers to be in the public interest.

Use of land

104 No purchaser shall build or make any improvements of a permanent nature, other than fencing or cultivation, on any part of the land contained in a homestead sale that lies within one rod of a statutory road allowance.

RSA 1980 cP-30 s104

Use of timber

105 Section 75 applies, with the necessary changes, to homestead sales and the purchasers holding them.

RSA 1980 cp-30 s105

Appendix 8: Alberta Environmental Protection Business Plan 1997-1998 to 1999-2000

Excerpts containing only sections with biodiversity indicators.

Goal 2: To manage Alberta's renewable resources for the continued prosperity and benefit of Albertans.

- Strategies**
- 2.1 Provide clear, effective direction and guidance for the use, management and development of Alberta's renewable natural resources. Includes developing resource use conditions, guidelines and plans; park visitation, guiding and outfitting, commercial fishing and trapping, timber harvesting
 - 2.2 Streamline regulatory processes and legislative requirements. Includes continued streamlining of review and approval processes
 - 2.3 Reduce impact of natural hazards (fire, drought, flood, pests) on people, property and resources.

Ministry Performance Measures

- Timber sustainability

Goal 3: To protect and manage Alberta's natural heritage for present and future generations.

- Strategies**
- 3.1 Establish acceptable levels of protection for natural resources and ecosystems. Includes evaluating major projects, regulating activities and ensuring compliance in the context of protection

Ministry Performance Measures

- Species at risk
- Areas of parks and natural reserves in Alberta

Appendix 9: Fish and Wildlife Policy for Alberta

Excerpts containing only sections pertaining to biomonitoring for biodiversity.

Subject: Wildlife Policy

Intent: To establish policy goals for the administration of wildlife resources in Alberta.

Policy: 1) Wildlife is a replenishable Crown resource; it is incumbent upon the Government, as the resource steward, to ensure that appropriate use is made of the wildlife resource and that it is passed on to succeeding generations as it was received.

The primary consideration of the Government is to ensure that wildlife populations are protected from severe decline and that viable populations are maintained. By virtue of the fact that all fish and wildlife resources and the relevant legislation are the responsibility of the Fish and Wildlife Division, it is to function as the advocate within government in the pursuit of this goal.

- 3) The Minister responsible for wildlife will periodically make a declaration of:
- (a) the present resource status, allocation and use;
 - (b) future issues and projected resource demands; and
 - (c) how the government plans to deal with these demands and issues.

Appendix 10: Fish and Wildlife Division Strategic Plan

Excerpts containing only sections pertaining to biomonitoring for biodiversity.

1. Conservation Goal:

To ensure the well-being and perpetuation of Alberta's fish and wildlife resources.

Objectives:

- To commence monitoring the health and soundness of all significant fish and wildlife ecosystems.

Activities:

- b) Develop and implement a comprehensive ecosystem monitoring, assessment, protection, and management system.
- c) Identify all endangered species/ecosystems through the completion of a comprehensive reconnaissance inventory, while a comprehensive approach for ecosystems management is being developed and established. The management approach will ensure that ecosystems and non-vertebrate species at high risk of extinction are prevented from further decline by the implementation of management/restoration activities, on the basis of existing knowledge.

2. Allocation Goal:

To allocate Alberta's fish and wildlife resources in a manner which is fair to all Albertans, and reflective of an sensitive to public interests.

Objective (by the year 1995):

- To allocate fish and wildlife resources, through a formalized process which recognizes legal constraints and reflects broad public interests.

Activities:

- a) Establish parameters for resource allocation and broad public objectives. Develop and implement an allocation system, obtain government support for system.

3. Recreational Fishing Goal:

To maximize the recreational fishing benefits and enjoyment to Albertans from Alberta's fisheries resources.

Objectives (by the year 2000):

- To provide anglers with the greatest possible variety and amount of recreational fishing opportunity.
- To provide publics with opportunities for input to fisheries management.

- To ensure all participants in recreational fishing are well informed, responsible, and ethical in their fishing activities.

Activities:

- e) Develop and implement a comprehensive, long-term program for inventory and assessment of recreational fisheries and fisheries habitat.
- f) Develop and implement a comprehensive, long-term program for inventory and assessment of recreational fisheries use and demand.

4. Recreational Hunting Goal:

To maximize the recreational hunting benefits and enjoyment to Albertans from Alberta's wildlife resources.

Objectives (by the year 2010):

- To ensure that the majority of Albertans approve of hunting as a valid recreational pursuit.
- To ensure the majority of Alberta's hunters are able to participate in the hunting activities of their choices annually.
- To ensure at least 75% of participants in each form of recreational hunting activity are satisfied with their experience.

Activities:

- Implement hunting regimes which produce the desired effects in game population levels, structures, and harvest opportunities.

Appendix 11: A Policy for the Management of Threatened Wildlife in Alberta

Excerpts containing only sections pertaining to monitoring for biodiversity.

Goal: The chief management goal for Threatened Wildlife is to restore populations in Alberta to viable levels.

Management Strategies:

In order to facilitate the rehabilitation of Threatened Wildlife, the Division will endeavor to achieve the following management objectives:

- to monitor and update the status of designated species as new information is collected.
- i) Monitor and Update Status
Particular attention will be given to monitoring the status of those nine species categorized as Threatened Wildlife. Provincially coordinated inventory programs will be designed and conducted at regular intervals. The status of species will be adjusted as population information indicates.

Appendix 12: The Status of Alberta Wildlife

Alberta Environmental Protection, Natural Resources Service classifies bird, mammal, amphibian and reptile species into five groups: Red list, blue list, yellow list, green list, and status undetermined list. These groups are defined below according to the Status of Alberta Wildlife Report (Alberta Environmental Protection, (Natural Resources Service), 1996) . By assessing species status, appropriate management and conservation efforts can be allocated.

Red List: Current knowledge suggests that these species *are* at risk. Populations of these species have declined, or are believed to have declined, to nonviable levels, or show a rate of decrease indicating that they are at immediate risk of declining to nonviable levels in Alberta.

Blue List: Current knowledge suggests that these species *may be* at risk. This list includes species which are particularly vulnerable because of non-cyclical declines in population or habitat, or reductions in provincial distribution.

Yellow List: These are sensitive species that are not currently believed to be at risk, but may require special management to address concerns related to naturally low populations, limited provincial distributions, or demographic/life history features that make them vulnerable to *human-related* changes to the environment. Yellow listed species are further divided into A and B categories. Category A species have demonstrated long-term declines in numbers and maybe incipient for blue listing . B category species may want management attention and or to ensure they do not end up in trouble. B category species include those species that are:

1. naturally rare but not are not on the decline;
2. naturally rare and have clumped breeding distributions; and
3. associate with habitats or habitat elements that are, or maybe, deteriorating.

Green List: These species are not considered at risk. Their populations are stable and their key habitats are generally secure at present.

Status Undetermined List: This category includes those species not known to be at risk but for which insufficient information is available at present to determine status using this process.

Lists are contain only those species likely to be affected by commercial development of forested landscapes.

Amphibians – Red List

Canadian Toad

Northern Leopard Frog

Reptiles – Yellow A List

Red-sided Garter Snake
Wandering Garter Snake

Reptiles – Yellow B List

Western Painted Turtle

Birds – Red List

Whooping Crane

Birds – Blue List

Bay-breasted Warbler	Ferruginous Hawk
Black-throated Green Warbler	Sage Grouse
Cape May Warbler	Short-eared Owl
	Trumpeter Swan

Birds – Yellow A List

American Bittern	Harlequin Duck
Brown Thrasher	Lesser Yellowlegs
Clay-colored Sparrow	Northern Harrier
	Swainson's Hawk

Birds – Yellow B List

American Dipper	Chestnut-sided Warbler	Marsh Wren
American White Pelican	Clark's Nutcracker	Mourning Warbler
Bald Eagle	Turkey Vulture	Northern Goshawk
Barred Owl	Cooper's Hawk	Osprey
Black Swift	Western (or Cordilleran) Flycatcher	Pileated
Woodpecker		
Black-and-white Warbler	Double-crested Cormorant	Ring-necked Pheasant
Black-backed Woodpecker	Golden-crowned Sparrow	Rock Wren
Black-crowned Night Heron	White-faced Ibis	Sandhill Crane
Boreal Owl	Grasshopper Sparrow	Sedge Wren
Brewer's Sparrow	Yellow-breasted Chat	Steller's Jay
Broad-winged Hawk	Great Blue Heron	Townsend's Warbler
Brown Creeper	Great Gray Owl	Western Grebe
Canada Warbler	Great-crested Flycatcher	Golden Eagle
		Western Tanager

Mammals – Red List

Wood Bison – currently found in protected forests only.

Mammals – Blue List

Grizzly Bear	Northern Long-eared Bat
Red-tailed Chipmunk	Wolverine
Woodland Caribou	

Mammals – Yellow A List

Badger

Long-tailed Weasel

Mammals – Yellow B List

Bobcat

Canada Lynx

Cougar

Fisher

Northern Flying Squirrel

Nuttall's cottontail

Olive-backed Pocket Mouse

Wandering Shrew

Appendix 13: A Fish Conservation Strategy for Alberta 1997 – 2005

Excerpts containing only sections pertaining to monitoring for biodiversity.

MISSION STATEMENT OF FISHERIES MANAGEMENT DIVISION

“Sustain the abundance, distribution and diversity of fish populations at the carrying capacity of their habitats.”

The following are three primary components of the above mission statement for fisheries management:

- **HABITAT MAINTENANCE**—sustain, or achieve a net gain in, the quality and quantity of fish habitat;
- **FISH CONSERVATION**—regulate fish harvest in line with, and not exceeding, the productive capacity of fish populations; and
- **FISH-USE ALLOCATION**—manage fish populations in a manner that meets the present expectations of Albertans without compromising the ability of future generations to meet their expectation.

3.0 BENEFITS FROM FISH RESOURCES

The benefits Albertans expect from their fish resources are diverse and include both consumptive and non-consumptive values. These include:

- An indicator of the quality of the aquatic environment.

Fish populations are sensitive. Healthy, uncontaminated fish populations are indicators of a healthy aquatic environment. The quality of the water and aquatic habitat are important to anglers and non-anglers.

7.0 GUIDING PRINCIPLES IN FISHERIES MANAGEMENT

There are several guiding principles that can assist in the implementation of the overall fish conservation strategy. They are:

1. No net loss of the productive capacity of habitats.

Every effort should be made to avoid habitat losses. If habitat losses are unavoidable, they should be balanced with habitat replacement.

As part of the fish conservation strategy, the role of proponents of development involves:

- Determining the extent and type of fish use and habitat base at sites of proposed development; and
- Incorporating appropriate habitat protection, mitigation and compensation measures, monitoring results of these measures and maintaining habitat mitigation and compensation features.

2. Fish populations are to be maintained by natural reproduction wherever possible.

Natural reproduction is the most biologically sound and cost-effective way of maintaining fish populations and fish production.

Maintenance of natural reproduction involves:

- Maintaining and improving spawning and rearing habitat, and fish access to this habitat;
- Maintaining sufficient numbers of mature adults in each fish population;
- Ensuring genetic integrity of fish populations, sub-populations and unique strains;
- Ensuring all fish introductions follow the document *A Decision-Making Process for the Evaluation of Fish Introductions in Alberta* (Berry and Stenton, 1993) and are consistent with *Alberta's Fish Stocking Policy* (Natural Resources Service, 1995);
- Continuing to regulate the impact of aquaculture activities to ensure the safety of wild fish populations and fish habitat; and
- Developing a risk-analysis process to be used with the decision-making process for the evaluation of fish introductions, particularly where a proposal involves an exotic species.

3. The biological diversity of the fish fauna is to be maintained, and the depletion or extirpation of species, populations, sub-populations or unique strains must be avoided.

Any maintenance and protection strategy should include all fish species in order to maintain the biological diversity of the fish fauna.

Maintenance of natural biodiversity involves:

- Monitoring fish populations to determine their status, productive capabilities and potential problems.

4. The management of the fisheries will be conducted on the basis of fundamental ecological principles and factual information.

Good and timely information on fish stocks is fundamental to achieving habitat maintenance, fish conservation and fish-use allocation goals.

Achievement of this principle involves:

- Developing and maintaining adequate programs for gathering relevant information fish stocks (including their number, growth, production rate, harvest rate and habitat conditions);
- Developing an information management system to handle the information and to provide pertinent and quick analysis in order to make appropriate and timely decisions;

- Allowing for years of low production in the calculation of the harvestable supply of a fish population to prevent over harvest;
- Giving fish conservation precedence over fish use, where adequate information on the harvestable supply is unavailable; and
- Monitoring fish populations for status and fish health, and reporting these results to the public.

Appendix 14: Alberta Forest Conservation Strategy

Excerpts containing sections mandating monitoring of biodiversity.

Recommendation 4: That the Government of Alberta and all forest users adopt adaptive management in the allocation of forest resources and management in the forest.

Recommendation 6: That the Government of Alberta landuse planning focus on setting broad objectives. Industries, in cooperation with one another and with other users, should plan how these objectives can best be achieved. Forest planning conducted by either government should:

- Be based on the best applicable sciences and inventories of ecological and other forest values;
- Plan over ecologically meaningful landscapes and time frames;
- Integrate all forest values and uses;
- Involve all forest users cooperatively.

Recommendation 12: That the Government of Alberta, in partnership with forest users, set the establishment of sustainability indicators and targets as high priority. The National criteria and indicators developed by the Canadian Council of Forest Ministers will provide an appropriate starting point for an Alberta system. The government of Alberta should gather, analyze, process, and publicly report the economic, ecological, and social information necessary to assess performance in terms of sustainability indicators and targets, in order to evaluate the sustainability of forest and forest-based economy of Alberta.

Recommendation 13: That the Government of Alberta under the Special Places program, complete its system of protected areas to represent the full diversity of all the forested natural regions of Alberta, in a manner that is compatible with the need for protected areas as identified in the Alberta Forest Conservation Strategy.

Recommendation 15: That the Government of Alberta will provide opportunities for intensive management on forested lands in an effort to maximize a particular use or production of a primary product (such as timber, forage production, wildlife habitat, and tourism development) if the practice is proposed and implemented as part of a comprehensive process such as a forest management plan. The total area that may be allocated as a part of an intensive management regime will respect ecological limitations, as defined by sound science, and a need for positive economic return. Public involvement, ongoing monitoring and feedback mechanisms will be necessary components of both site selection and implementation phases of intensive management. Activities proposed as part of an intensive management regime must be identified and their effects on forest productivity and processes be defined to better understand the costs/benefits of intensive forest management. The type of study will also help identify potential impacts of intensive management on other forest values.

Excerpts containing those sections pertaining to monitoring for biodiversity.

1.1 FOREST MANAGEMENT PLANNING: GUIDING PRINCIPLES

Several key guiding principles apply to forest management plans prepared in Alberta at this time and have been kept in mind while preparing this planning manual. These principles are:

Current sustained yield timber management planning is required under existing legislation but planning should move toward sustainable forest management;

The Current forest management administrative units (Forest Management Unit and Forest Management Agreement boundaries) are respected but allow future forest management plans to recognize larger, ecologically relevant *landscape* units as the basis for sustainable forest management;

The forest management plan is developed in a series of components that are progressively reviewed and approved by the Department;

Forest management planning is a dynamic process in that:

- * knowledge obtained through research and operational trials is incorporated;
- * forest management enhancements resulting from new national or provincial policy, or as a result of legislation changes, is captured;
- * performance monitoring mechanisms provide corrective feedback to the Forest Management Plan (FMP), thereby improving performance.

Forest management recognizes timber and other forest resource values and integrates the management of these values within the defined forest management area.

Management of other forest resources is currently the responsibility of the Crown. These resource values, however, must be considered by both the forest industry and the public.

Forest management planning will recognize all current resource commitments as the basis for future planning and decision making.

1.2 MANUAL PURPOSE

The purpose of this manual is to provide and update to existing forest management policy and provide guidance for future changes to forest management in Alberta. Changes will come into effect pursuant to:

implementation of the *Alberta Forest Conservation Strategy*;
further development of national forest management initiatives (such as the Forest Accord, CCFM, Canadian Biodiversity Strategy, etc.).

4. PUBLIC INVOLVEMENT PLAN

4.1 EXPLANATION

Meaningful public involvement in the development and implementation of forest management plans is important. The forest manager must be committed to follow through on issues and concerns that arise from the public participation process. This is particularly important given that approved plans are considered public documents. In addition, ongoing public involvement and participation will increase public understanding of forest management activities.

The public come from a variety of backgrounds and occupations. They can provide opinions, ideas and information for development of the plan by:

- (a) identifying non-timber forest values; and
- (b) helping with monitoring of the plan.

There is usually a public involvement component for most of the plan stages, specifically:

- (a) resource management goals;
- (b) forest management objectives;
- (c) selection of the preferred forest management strategy;
- (d) performance monitoring.

4.2 CONTENTS AND DOCUMENTATION

Outline a public involvement performance monitoring strategy.

5.0 FOREST MANAGEMENT PLAN

INTRODUCTION

The forest management plan submission consists of :

- (a) resource management philosophy;
- (b) resource management goals (biological, economic and social);
- (c) forest management objectives, evaluation of resource management strategies and selection of the preferred forest management strategy;
- (d) the implementation strategy (How the plan will be delivered operationally);
- (e) performance Monitoring (What is monitored and tracked annually or periodically and what is reported in the stewardship report).

Agreement and progressive approval of plan components ensures that subsequent steps in plan development can proceed with confidence. The approval stages of concern at the resource analysis stage are:

- (a) resource management philosophy;
- (b) resource management goals;
- (c) forest management objectives and strategies;
- (d) forest inventory verification;
- (e) final plan (includes resource management strategies tested and the preferred forest management strategy).

5.1 RESOURCE MANAGEMENT PHILOSOPHY AND GOALS

5.1.1 EXPLANATION

The purpose of this portion of the plan is to explain the resource management philosophy and goals that will guide management of those resources under the control of the forest manager over the next five to ten year period. It is this information that forms the basis for discussions concerning the current condition of the forest and the desired future forest state. There is also a need for the resource management philosophy to reflect the direction contained in national and provincial agreements, policies and plans.

In particular, the resource management philosophy and goals should address the biological, economic and social aspects of the area. This information is obtained through a landscape assessment. The *Integrated Resource Management (IRM)* framework currently being developed by the Alberta government, is to provide a system of plans that will utilize a landscape assessment approach to resource management and decision making. Until such time as these plans are in place, however, forest managers are faced with the task of conducting their own assessments of the biological, economic and social influences on their planning areas. These assessments should be adequate to ensure that forest management activities will not unduly impact the opportunity to utilize or access other resource values. It is not intended that these assessments be used to plan for the management of other resource values.

Goals related to biological aspects of the area consider those attributes contributing to ecosystem integrity. Biodiversity conservation is one of the more important attributes to consider in this regard. One approach to conservation of biodiversity focuses on the management of landscape pattern and structure. This “Coarse Filter” approach, as it is commonly known, is fundamental to ecological management. Other forest values may require special management and/or protection (e.g. endangered, threatened and rare species) via “Fine Filter” techniques. A combination of Coarse and Fine filter strategies is recognized as a sound approach to sustainable forest management.

An evaluation of current forest land uses and values would contribute to the determination of the biological, economic and social aspects influencing the area. This information would also serve as the basis for defining management objectives which contribute to the achievement of the desired future forest state.

Forest management planners should evaluate ecological units on a broad scale to obtain an appropriate ecological management unit strategy between adjacent management areas.

Such units are more conducive to a sustainable forest management approach. The existing hierarchy of ecological units follows:

Natural Subregion:	Expression of regional climate differences
Ecodistrict:	Defined by broad physiographic features
Ecosections:	Patterns of topography and vegetation types
Ecosites:	Combination of moisture and nutrient regimes resulting in characteristic vegetation composition and site capability
Ecosite Phase:	Dominant tree species variation within an ecosite, usually reflecting a successional stage

5.1.2 CONTENTS

State the sustainable forest management philosophy.

Identify important social, economic and environmental issues.

Identify resource management goals.

Describe the approach to landscape assessment. Suggested topic areas include:

Description of landscape pattern and structure including:

- (a) forest age class distribution;
- (b) amount and distribution of seral stages;
- (c) patch characteristics; and
- (d) forest connectivity.

Description of landscape disturbance and succession including:

- (a) natural disturbance interval;
- (b) timber harvesting and access;
- (c) successional trajectory; and
- (d) fire history characteristics.

Description of landscape use and function including:

- (a) land use and allocation (including current use levels);
- (b) forest productivity (productive vs. non productive land);
- (c) timber resource;
- (d) fish and wildlife resources;
- (e) water resources; and
- (f) other forest values.

Description of landscape resource dynamics including:

- (a) fish and wildlife; and
- (b) timber.

5.1.3 DOCUMENTATION

Reference government legislation, policies and plans that provide current direction.

Provide a map of landscape planning units and sustained yield units.

Provide analysis information, including assumptions and constraints, associated with the identification of resource management goals.

Indicate models used, if any.

Provide electronic data sets.

Rationalize resource management goals in terms of risks and opportunities.

The documentation must include the methods, *models*, assumptions, and analysis results used in goal setting. Any discrepancies in scale will need to be addressed in the discussion of results. Conclusions drawn from this process will feed into the identification of forest management objectives and the development of resource management strategies.

5.2 FOREST MANAGEMENT OBJECTIVES AND STRATEGIES

5.2.1 EXPLANATION

The desired future forest state is defined primarily on the basis of the results of a landscape assessment. Forest management objectives, that will lead to this condition, are developed. The objectives must be as specific as possible regarding the desired future forest state.

Objective and Strategy Development

Objectives must be measurable. Short and long-term objectives should be outlined. Objectives are short term if associated resource management strategies can be achieved or completed within five or 10 years. Objectives become long-term if they take in excess of 10 years to achieve. A staged approach to achievement is usually involved in the case of long-term objectives.

The following questions should be considered when developing plan objectives and strategies:

- (a) Can the objective be achieved in the short term or the long-term?
- (b) What strategies, tactics and actions are required to achieve the objective?
- (c) Is the sequence of objectives critical to achievement?
- (d) If the data shows that an objective cannot be achieved, and must be revised, how does this change the preferred forest management strategy?
- (e) What performance monitoring criteria would be associated with the objective?
- (f) What data is needed to determine that these objectives are being met?

- (g) Is the data available or does it have to be gathered?
- (h) How will the data be collected? How long will it take to collect?
- (i) Does the data need to be updated? How often? How will it be updated?

Subject areas that should be considered for the purpose of defining objectives include:

Ecological

- biodiversity/genetic diversity
- forest connectivity
- ecological integrity

Forest Inventory

Timber

- coniferous/deciduous/mixedwood management
- sustainability
- fibre priorities
- harvest priorities/utilization standards

Forest Protection

- forest health
- fire and fuels
- insects and diseases

Silviculture

growing stock, establishment period, green up period, free to grow, and growth rates

- reforestation lag period
- treatment and retreatment
- reforestation potential, site productivity and yields
- tree quality and genetics
- understorey

Watershed

- water quality and quantity
- erosion, siltation and flooding
- riparian zones

Fish and Wildlife

- habitat
- riparian zones
- endangered, threatened and rare species
- hiding cover, shelter, corridors and critical areas
- access

5.2.2 CONTENTS

List current and past management objectives to establish the basis for change projected in a new analysis.

Summarize recommendations from monitoring programs, performance reviews, audits and stewardship reports that identify both successful and unsuccessful resource management strategies used for the previous planning period.

Describe the desired future forest state.

List and justify the forest management objectives leading to the desired future forest state.

Describe resource integration initiatives.

Identify linkages between resource activities and strategic, tactical, and operational planning.

5.2.3 DOCUMENTATION

Supporting ecosystem assessment results.

Linkages to resource management strategies and modeling assumptions.

7.0 PERFORMANCE MONITORING AND STEWARDSHIP REPORTING

7.1 EXPLANATION

Adaptive management is an integral component of forest management in Alberta. Management activities are modified based on the experience gained from previous activities. Performance monitoring and the analysis of the monitor data provide feedback so that improvements in management can be made. Feedback results in changes to operational plans and activities as well as the forest management plan. Reporting on the results of performance monitoring provides a measure of accountability to the public on management effectiveness. It also contributes information to provincial, national and international sustainability reporting systems.

An annual performance report is used to record results in the preceding year. In addition, it tracks cumulative performance from the time the forest management plan is implemented. This report is reviewed annually with no formal submission required, but will be reviewed as identified in the Public Involvement Plan.

The stewardship report is a more formal compilation of performance prepared and submitted every five years. Forest managers will report on performance problems associated with the Forest Management Plan (FMP), even if those problems are beyond their control or mandated responsibilities. The government will work with the forest industry in monitoring and reporting on external factors affecting DFMP performance. Performance successes should also be noted in this report.

Criteria and indicators are established as part of the process of setting goals and objectives. These variables should be monitored so that progress towards the set of objectives can be measured. In addition, as part of the timber supply analysis, sensitivity analysis may be used to identify variables which have a substantial effect on the results of the analysis. Consideration should be given to monitoring these variables

as well. Tolerance limits may be established for the variables being monitored. Results which exceed the tolerances will trigger specific actions. Cumulative effects of management practices should also be addressed.

The forest manager must establish an adaptive management process that:

- (a) tracks actual activities in comparison to forecast activities;
- (b) tracks actual responses to management activities and compares to forecasted responses;
- (c) has the ability to detect and assess impacts arising from change;
- (d) triggers appropriate actions to correct or mitigate any negative impacts of the change.

Compliance to legislation, agreements and ground rules is not intended to be part of the forest management plan performance monitoring. Company performance in these areas is reported separately. In fact, the Cabinet approved document, “Recommendations Regarding Alberta’s Forest Management Agreements”, references the importance of performance criteria in the negotiation of FMA renewals.

7.2 CONTENTS AND DOCUMENTATION

Performance information compares actual results to plan expectations including the achievement of objectives, land base additions versus deletions, planned activities versus actual, etc. The following provides a framework for reporting that would be linked to criteria documented in the forest management plan. The actual criteria are presented in the approved plan as commitments and assumptions. Regulatory performance or compliance is reported through existing, separate reporting systems (e.g. Silviculture Records Management System, scaling and production, etc.).

3. Performance Indicators and Objectives

Assess the current performance indicators as they relate to management objectives.

5. Inventory

Provide information on inventory initiatives that were planned in the forest management plan, including aerial photography, Permanent Sample Plots (PSPs), ecological inventories and non timber resource inventories, etc.

6. Research

Provide a summary of research activities identified in the FMP including emerging trends or issues, inventories and non timber resource inventories.

8.2 NATURAL DISTURBANCE CHANGES

Provide information on significant events relative to AAC assumptions (e.g. fire, insects, disease, wind throw, etc.). Reclamation, reforestation and/or afforestation activities associated with disturbed areas and/or non productive lands (burns, deciduous scrub, drainage projects, etc.

Appendix 16: Canadian Biodiversity Strategy

Excerpts contain only sections dealing with biomonitoring of biodiversity.

Conservation and Sustainable Use

Goal 1: To conserve biodiversity and use biological resources in a sustainable manner.

Ecological Planning and management

A. Wild Flora and Fauna and other Wild Organisms

Strategic Directions:

- 1.9 Develop indicators to monitor trends and support the management of wild populations, species, habitats and ecosystems.

D. Sustainable Use of Biological Resources

Strategic Directions:

- 1.35 Develop and improve methods of monitoring ecosystems and biological resources to support the sustainable use of these resources.

Aquatic Areas

Strategic Directions:

- 1.53 Implement biological and ecological inventory, monitoring programs and classification systems to determine appropriate biodiversity conservation measures and provide a framework for managing aquatic resources on a sustainable basis.
- 1.55 Enhance efforts to conserve aquatic biodiversity by protecting: species and ecosystems at risk, endemic species, vulnerable spawning areas and unique and representative ecosystems.
- 1.56 Establish reserves to conserve aquatic biodiversity and contribute to networks of national and international protected areas in accordance with the strategic directions provided in the section on protected areas of this Strategy.

Forested Areas

Strategic Directions:

- 1.66 Increase our understanding of forest biodiversity by enhancing ecological site classification systems and the inventory and monitoring of commercial and non-commercial species, soil, soil biota, climate and other biophysical characteristics.

- 1.78 Establish protected areas to conserve representative and critical forest ecosystems as part of an overall network of protected areas in accordance with the strategic directions provided in the section on protected areas in this Strategy.

E. Biosafety: Harmful Alien Organisms and Living Modified Organisms

Harmful Alien Organisms

Strategic Directions:

- 1.81 a) developing and implementing effective means to identify and monitor alien organisms.

Ecological Management

Goal 2: To improve our understanding of ecosystems and increase our resource management capability.

A. Improving our Ecological Management Capability

Research

Strategic Directions:

- 2.1 Focus research to improve policy development and to integrate multiple land and resource-use objectives, with emphasis on:
- d) developing and implementing issue identification measures and adaptive management techniques to enhance management performance.
- 2.2 Focus research to increase our understanding of ecosystems and our ability to manage human use of ecosystems and resources by:
- b) developing cost-effective biodiversity inventory and monitoring methods and programs, including rapid assessment procedures and biodiversity indicators, to detect and monitor changes to ecosystems, species and genetic diversity;
 - c) evaluating and improving methodologies to determine sustainable resource use levels;

Inventories: Landscape, Species and Genetic Levels

Strategic Directions:

- 2.4 Improve biophysical inventories at ecosystem, species and genetic levels by:
- a) developing and applying regionally integrated landscape-level classification systems for terrestrial, freshwater and marine areas to provide a framework for the collection of information and the management of resources;
 - b) linking biological inventories and soil, climate and other surveys;
 - c) conducting biological inventories, based upon jurisdictional priorities, that take into consideration vulnerable, threatened and endangered species and

- ecosystems, critical habitats, little-studied taxonomic groups, taxonomic groups of economic importance, areas of high diversity and areas where human development and disturbance are the most significant; and
- d) encouraging the use of innovative and traditional methods to increase knowledge about the diversity of micro-organisms, their functional roles in ecosystems, and their potential economic uses.
- 2.5 Enable agencies and individuals to conduct biological and biophysical inventories by:
- a) developing ways to collectively identify funding sources and determine priorities for inventories; and
- b) ensuring that there is sufficient expertise available to conduct inventory work, including taxonomists, biosystematists, parataxonomists, museum professionals, ecologists, geneticists and other experts.
- 2.6 Support efforts to improve the reliability and cost-effectiveness of biological inventory methodologies and technologies.
- 2.7 Maintain the capacity of museums and other institutions to scientifically describe, classify and store collected specimens, as well as maintain their ability to effectively disseminate data and information.
- 2.8 Continue to establish networks of Conservation Data Centres or Natural Heritage Centres to develop and harmonize databases for the conservation of vulnerable, threatened and endangered species and ecosystems.
- 2.9 Improve inventories to determine the genetic diversity of domesticated and non-domesticated biological resources to maximize the conservation and economic use of genetic resources.
- 2.10 Collaborate with other countries to inventory populations and habitats of transboundary species, particularly those that are at risk.

B. Increasing Resource Management Capability

Data and Information Management Strategic Directions:

- 2.11 Investigate and implement means to enhance the collection, sharing, analysis, scope and distribution of data and information required to conserve biodiversity and sustainably use biological resources.

C. Monitoring

Strategic Directions:

2.27 Develop and implement monitoring programs to:

- a) better understand the functional linkages in ecosystems;
- b) evaluate the success or failure of conservation and sustainable use policies and programs; and
- c) better integrate the monitoring of biological and non-biological parameters.

2.28 Develop and use biodiversity indicators that are meaningful, scientifically defensible, practical and compatible with regional, provincial, territorial, national and international programs.

2.29 Identify appropriate locations to establish base monitoring sites.

2.30 Target monitoring programs on ecosystems, species and populations that are currently under the most stress.

2.31 Develop and implement measures to monitor the ex situ collection of biological resources.

Appendix 17: Canadian Council of Forest Ministers Biodiversity Indicators of Sustainable Forest Management

Tables contain only forest dependent species for ecozones found in Alberta. Ecozones are a national land classification system (Wiken, 1996).

1.2A FOREST-DEPENDENT SPECIES BY ECOZONE THAT ARE LISTED BY COSEWIC AS VULNERABLE OR ENDANGERED^b						
<u>ECOZONE</u>	<u>ANIMALS</u>			<u>PLANTS</u>		
	Vulnerable	Threatened	Endangered	Vulnerable	Threatened	Endangered
Montane Cordillera	grizzly bear, wolverine, Nuttall's cottontail	yellow-breasted chat	—	—	—	—
Boreal Shield	woodland caribou	—	cougar	—	—	—
Boreal Plains	woodland caribou, wolverine	^a wood bison	—	—	—	—

^aonly found in protected areas

^bstatus designations may not follow Alberta's designations

1.2B ANIMAL INDICATOR SPECIES IN FOREST ECOZONES BY AGE OF STAND			
<u>ECOZONE</u>	<i>Young</i>	<u>FOREST STAGE</u> <i>Mature</i>	<i>Old growth^a</i>
Montane Cordillera (subalpine)	moose, lynx, mule deer, black bear, golden-crowned sparrow	caribou, grizzly bear, mountain chickadee, red crossbill	caribou, marten, black-backed woodpecker, three-toed woodpecker, Hammond's flycatcher
Boreal Plains (includes Alberta Montane and aspen parkland)	moose, wapiti, lynx, ruffed grouse, hairy woodpecker, snowshoe hare	caribou, elk, grizzly bear, flying squirrel, varied thrush, barred owl, boreal chickadee, red crossbill, Cooper's hawk, wolverine, long-eared bat	marten, wood bison, black-backed woodpecker, boreal owl, three-toed woodpecker, silver-haired bat
Boreal Shield (north)	moose, lynx, snowshoe hare, ruffed grouse, hairy woodpecker	caribou, northern flying squirrel, barred owl, boreal chickadee, red crossbill, wolverine, long-eared bat	marten, black-backed woodpecker, three-toed woodpecker, boreal owl, silver-haired bat

^a"old growth" is defined as stands in which there is a net annual loss of the standing biomass of mature trees; many old-growth species are also found in older mature forests

1.2C FOREST-DEPENDENT SPECIES BY ECOZONE THAT OCCUPY ONLY A SMALL PORTION OF THEIR FORMER RANGE (EXCLUDING SPECIES LISTED BY COSEWIC)

<u>ECOZONES</u>	<i>ANIMALS</i>	<i>PLANTS</i>
Montane Cordillera	Rocky Mountain elk, fisher, silver-haired bat, gopher snake, tailed frog, varied thrush, three-toed woodpecker, Williamson's sapsucker, Lewis' woodpecker, Vaux's swift, mountain chickadee	—
Boreal Shield	silver-haired bat, barred owl, boreal owl, black-backed woodpecker, three-toed woodpecker, grey-cheeked thrush, red crossbill	white pine, black spruce, white spruce
Boreal Plains	silver-haired bat, barred owl, boreal owl, black-backed woodpecker, three-toed woodpecker, varied thrush	white spruce

Appendix 18: Commercial and Recreational Fish, Game and Furbearer Species in Alberta
 Lists contain only those species inhabiting forested landscapes.

Mammals

Arctic Fox	Badger	Beaver
Bighorn Sheep	Black Bear	Bobcat
Canada Lynx	Coyote	Elk
Ermine	Fisher	Gray Wolf
Grizzly Bear	Martin	Mink
Moose	Mountain Lion (Cougar)	Mule Deer
Muskrat	Northern Flying Squirrel	Raccoon
Red Fox	Red Squirrel	River Otter
Snowshoe Hare	White-Tailed Deer	Wolverine

Birds

American Wigeon	American Coot	Barrow's Goldeneye
Blue Grouse	Blue-winged Teal	Bufflehead
Canada Goose	Canvasback Duck	Cinnamon Teal
Common Goldeneye	Common Merganser	Common Snipe
Gadwall	Gray Partridge	Greater Scaup
Green-winged Teal	Hooded Merganser	Mallard
Northern Pintail	Northern Shoveler	Oldsquaw
Red-breasted Merganser	Redhead Duck	Ringneck Duck
Ruddy Duck	Ruffed Grouse	White-winged Scoter
Sharp-Tailed Grouse	Spruce Grouse	Wood Duck

Fish

Arctic Grayling	Brook Trout	Brown Trout
Cutthroat Trout	Dolly Varden	Golden Trout
Goldeneye	Kokanee	Lake Trout
Lake Whitefish	Mountain Whitefish	Northern Pike
Rainbow Trout	Walleye	Yellow Perch

Appendix 19: Checklist of Monitoring Programs in Alberta

Government of Alberta Monitoring Programs

Avifauna Monitoring Programs

Peregrine Falcon Monitoring Program, 1970

See also Holistic Monitoring Programs

Mammal Monitoring Programs

Alberta Caribou Studies, 1991

See also Holistic Monitoring Programs

Amphibian Monitoring Programs

Alberta Amphibian Monitoring Program, 1991

Reptile Monitoring Programs

None

Fish Monitoring Programs

See Holistic Monitoring Programs

Invertebrate Monitoring Programs

None

Vegetation Monitoring Programs

Permanent Sample Plots (PSPs), 1960

Holistic Monitoring Programs

Alberta Natural Heritage Information Centre (ANHIC), 1996

Biodiversity/Species Observation Database (B/SOD), 1986

Fish, Game Species (waterfowl, 1955; late 1960's other gamebirds; early 1960's, ungulates; late 1970's for most large carnivores), and Furbearers (1920, Canadian Fur Production Database; 1971, Fur Affidavit Database; mid 1980's, Fur Registration Database)

Museum and University Collections

Government of Canada Monitoring Programs

Avifauna Monitoring Programs

Prairie Shorebird Survey, 1985

Spring Waterfowl Breeding Population Survey, 1955

Waterfowl Brood Survey

Double-Crested Cormorant Survey (Elk Island National Park), 1988

Great Blue Heron Survey (Elk Island National Park), 1984

Owl Survey (Elk Island National Park), 1985

Red-Necked Grebe Survey (Elk Island National Park), 1978
White Pelican Survey (Elk Island National Park), 1993
Harlequin Duck Monitoring (Jasper National Park)
Harlequin Duck Survey (Waterton National Park), 1992
Loon Survey (Jasper National Park), 1993
Songbird Monitoring (Waterton Lakes National Park), 1997
Trumpeter Swan Monitoring (Waterton Lakes National Park), 1976
Whooping Crane Monitoring (Wood Buffalo National Park), 1957

Mammal Monitoring Programs

Bear Observation Database (Banff National Park), 1977
Bow Valley Aerial Elk Count (Banff National Park), 1985
Bow Valley Classified Elk Count (Banff National Park), 1985
Corridor Track Survey for Mid- to Large-Sized Carnivores (Banff National Park), 1993
Sensitive Species Winter Count for Mid- to Large Sized Carnivores (Banff National Park), 1993
Wildlife Highway/Railway Mortality Database (Banff National Park), 1977
Wildlife/Human Conflict Database (Banff National Park), 1980
Aerial Survey for Ungulates (Elk Island National Park), 1960
Beaver Survey (Elk Island National Park), 1984
Muskrat Survey (Elk Island National Park), 1995
Roadside Elk Survey (Jasper National Park), 1982
Small Mammal Survey (Elk Island National Park), 1993
Aerial Caribou Survey (Jasper National Park), 1993
Bat Hibernaculum Study (Jasper National Park), 1994
Bear Observation Database (Jasper National Park), 1975
Mountain Sheep Monitoring (Jasper National Park), 1970
Sow/Cub Grizzly Bear Monitoring (Jasper National Park), 1991
Wildlife Highway/Railway Mortality Database (Jasper National Park)
Wildlife/Human Conflict Database (Jasper National Park), 1988
Wolf Den Inventory (Jasper National Park)
Antler Marking Program (Waterton Lakes National Park), 1991
Bison Paddock Study (Waterton Lakes National Park), 1985
Grizzly Bear Monitoring (Waterton Lakes National Park), 1984
Wolf Studies (Waterton Lakes National Park), 1994
Bison Count (Wood Buffalo National Park), 1993
Bison Segregation Count (Wood Buffalo National Park), 1970
Fur Sales (Wood Buffalo National Park), 1950

Amphibian Monitoring Programs

Salamander Study (Waterton Lakes National Park), 1993

Reptile Monitoring Programs

Reptile Study (Jasper National Park), 1994

Fish Monitoring Programs

Creel Survey (Jasper National Park), 1985
Fish Stocking Records (Jasper National Park), 1917
Creel Survey for Lake Trout (Waterton Lakes National Park), 1993

Invertebrate Monitoring Programs

Banff Springs Snail Monitoring (Banff National Park), 1996
Biological Survey of Canada (Terrestrial Arthropods)
Forest Insect/Disease Survey (Banff National Park)
Forest Insect/Disease Survey (Elk Island National Park), 1980
Forest Insect/Disease Survey (Jasper National Park)

Vegetation Monitoring Programs

Vegetation Monitoring (Elk Island National Park), 1984
Plant Biodiversity Database (Jasper National Park), 1978
Fire history and Vegetation Study (Jasper National Park)
Non-Native Plant Study (Jasper National Park), 1992
Knapweed Monitoring (Waterton Lakes National Park), 1978
Wildflower Monitoring (Waterton Lakes National Park), 1987
Spring Flora Count (Waterton Lakes National Park), 1977
Grapefern sp. Monitoring (Waterton Lakes National Park), 1989
Plant Biodiversity Database (Waterton Lakes National Park)
Huckleberry Productivity Monitoring (Waterton Lakes National Park), 1989
Vegetation Monitoring (Wood Buffalo National Park), 1993

Holistic Monitoring Programs

Ecological Monitoring and Assessment Network (EMAN)
Warden Wildlife Observation Database (Banff National Park)
Warden Wildlife Observation Database (Jasper National Park), 1975
Streamside Surveys (Waterton Lakes National Park), 1997
Warden Wildlife Observation Database (Wood Buffalo National Park)

Non-Government Monitoring Programs

Avifauna Monitoring Programs

Birdlist Survey, 1994
Breeding Bird Atlas, 1986
Canadian Lakes Loon Survey, 1990
Canadian Migration Monitoring Network Intensive Surveys, 1992
Christmas Bird Count (CBC), 1906
Monitoring Avian Productivity and Survivorship (MAPS), 1992
Nest Record Scheme (NRS), 1981
North American Breeding Bird Survey (BBS), 1966
Project Feederwatch, 1987

Rocky Mountain Eagle Research Foundation, 1992
Spring Bird Count, 1976

Mammal Monitoring Programs

Bat House Program, 1995
Central Rockies Wolf Project, 1987
North American Bat House Research Project
Spring Mammal Count, 1976

Amphibian Monitoring Programs

Amphibian Monitoring Program, 1992
Researching Amphibian Numbers in Alberta, 1997

Reptile Monitoring Programs

None

Fish Monitoring Programs

None

Invertebrate Monitoring Programs

Coast-to-coast Moth and Butterfly Survey, 1996
July Fourth Butterfly Count, 1992
Ladybug Survey, 1995

Vegetation Monitoring Programs

Plantwatch, 1987
Spring Flower Count, 1976

Holistic Monitoring Programs

None

Appendix 20. Contact List of Monitoring Programs and Agencies within Alberta

GOVERNMENT OF ALBERTA MONITORING PROGRAMS

Program	Contact	Associated Organization or Agency	Position	Phone
ALBERTA AMPHIBIAN MONITORING PROGRAM	Lisa Takats	Natural Resources Service		(403) 422-9533
ALBERTA CARIBOU STUDIES	Steve Brechtel	Natural Resources Service	Non-Game Status Biologist	(403) 422-9535
	George Hamilton	Natural Resources Service-St. Paul		(403) 645-6313
	Blair Rippen	Natural Resources Service-St. Paul	Head Wildlife Biologist of the Northeast Boreal Region	(403) 545-6313
	Elston Dzus	Natural Resources Service	Research Coordinator	(403) 453-4109
	Ron Millson	Natural Resources Service-Peace River	Head of Wildlife Management	(403) 624-6406
	Dave Hervieux	Natural Resources Service-Grand Prairie		(403) 538-5618
	Kirby Smith	Natural Resources Service-Edson	Regional Wildlife Biologist	(403) 723-8248
	Jan Edmons	Natural Resources Service-Edson	Wildlife Biologist	(403) 723-8245
ALBERTA NATURAL HERITAGE INFORMATION CENTRE	John Rintoul	Alberta Natural Heritage Information Centre	Database Manager	(403) 427-6639
	Joyce Gould	Alberta Natural Heritage Information Centre	Botanist	(403) 427-7702
BIODIVERSITY/SPECIES OBSERVATION DATABASE	Lorna Allen	Alberta Natural Heritage Information Centre	Community Ecologist	(403) 427-6621
	Mike Norton	Natural Resources Service/Alberta Conservation Association	Database Manager	(403) 422-9536
DEVONIAN BOTANIC GARDEN	Dale Vitt	Devonian Botanic Garden/ University of Alberta	Director	(403) 987-3054
	Rene Belland	Devonian Botanic Garden	Research Database Director	(403) 987-3054
	Barry Grieg	Devonian Botanic Garden	Horticulturist	(403) 987-3054

GOVERNMENT OF ALBERTA MONITORING PROGRAMS (CONTINUED)

Program	Contact	Associated Organization or Agency	Position	Phone
FISH, GAME, AND FURBEARER SPECIES MONITORING FISH SPECIES	Duane Radford	Natural Resources Service	Assistant Director and Head of the fisheries Management Division	(403) 427-6730
	Dave Barry	Natural Resources Service		
	Jim Stelfox	Natural Resources Service	Fisheries Biologist	(403) 297-6183
GAME SPECIES	Ken Zelt	Natural Resources Service	Head of Culture, Science, and Data Management	(403) 427-7769
	Doug Culbert	Natural Resources Service		(403) 427-2000
	Harold Carr	Natural Resources Service	Big Game Management Coordinator	(403) 427-6619
	George Hamilton	Natural Resources Service- St. Paul		(403) 645-6313
	Blair Rippen	Natural Resources Service- St. Paul	Head Wildlife Biologist of the Northeast Boreal Region	(403) 645-6313
	Kirby Smith	Natural Resources Service - Edson	Wildlife Biologist	(403) 723-8248
	Eldon Bruns	Natural Resources Service – Rocky Mountain House	Head, Wildlife Management	(403) 845-8235
	Ron Bjorge	Natural Resources Service – Red Deer	Wildlife Biologist	(403) 340-7699
	Gary Erickson	Natural Resources Service - Lethbridge	Wildlife Biologist	(403) 382-4364
	Ron Millson	Natural Resources Service – Peace River	Head, Wildlife Biologist	(403) 624-6405
FURBEARER SPECIES	Floyd Kunnas	Natural Resources Service		(403) 645-6313
	Al Cook	Natural Resources Service	Head of Commercial Wildlife Branch	(403) 427-3344
	Arlen Todd	Natural Resources Service-Whitecourt	Wildlife Management Planner	(403) 778-7112
	Michelle Aasgard	Natural Resources Service	Commercial Licensing Coordinator	(403) 427-9324
	Bruce Treichel	Natural Resources	Status Technician	(403) 422-9535

GOVERNMENT OF ALBERTA MONITORING PROGRAMS (CONTINUED)

Program	Contact	Associated Organization or Agency Service	Position	Phone
PEREGRINE FALCON MONITORING PROGRAM	Dave Moore	Natural Resources Service-Vermilion	Area Biologist for Vermilion Area, Parkland District	(403) 853-8137
	John Folinsbee			(403) 415-1328
PROVINCIAL MUSEUM OF ALBERTA COLLECTIONS	Bruce McGillivray	Provincial Museum of Alberta	Manager of Curatorial and Collections Administration	(403) 453-9172
	Jocelyn Hudon	Provincial Museum of Alberta	Curator of Ornithology	(403) 453-9179
STATUS OF ALBERTA WILDLIFE	Steve Brechtel	Natural Resources Service	Non-Game Status Biologist	(403) 422-9535
UNIVERSITY COLLECTIONS	Wayne Roberts	University of Alberta	Zoology Museum Curator	(403) 492-4622
	Brij Kohli	University of Alberta	Plant Museum Curator	(403) 492-5523
	C.C. Chinnappa	University of Calgary	Professor and Head of the Department of Biological Sciences Herbarium	(403) 220-7465
	Rob Longair	University of Calgary	Professor and Head of Insect Collections	(403) 20-7387
	Warren Fitch	University of Calgary	Collections Manager for the Zoological Museum	(403) 220-5269

GOVERNMENT OF CANADA MONITORING PROGRAMS

Program	Contact	Associated Organization or Agency	Position	Phone
BIOLOGICAL SURVEY OF CANADA (TERRESTRIAL INVERTEBRATES)	Hugh Danks	Canadian Museum of Nature	Head of Biological Survey of Canada (Terrestrial Invertebrates)	(613) 566-4787
	Lloyd Dosdall	Alberta Research Council		(403) 632-8225
ECOLOGICAL MONITORING AND ASSESSMENT NETWORK	Bruce McGillivray	Provincial Museum of Alberta	Manager of Curatorial and Collections Administration	(403) 453-9172
	Ellie Prepas	University of Alberta/Meanook Biological Research Station, TROLS	Professor	(403) 492-6659
	Walter Willms	Agriculture and Agri-Food Canada		(403) 381-5486
	Barry Adams	Alberta Agriculture, Food and Rural Development		(403) 381-5486
	Len Shandruk	Canadian Wildlife Service		(403) 951-8673
	Kevin Van Tighem Norm Cool	Waterton Lakes National Park Elk Island National Park	Conservation Biologist Warden Conservation Biologist	(403) 859-2014 (403) 992-2958
SPRING WATERFOWL BREEDING POPULATION SURVEY	Ken Lungle	Natural Resources Service	Bird Game Management Coordinator	(403) 427-6612
	Paul Pryor	Canadian Wildlife Service	Wildlife Technician, Migratory Birds Division (NAWAMP Contact)	(403) 951-8676
	Al Richard	Ducks Unlimited	Biologist/GIS Technician	(403) 489-2002
PRAIRIE SHOREBIRD SURVEY	Gerard Beyersbergen	Canadian Wildlife Service	Research Technician	(403) 951-8670
CANADIAN HERITAGE, PARKS CANADA	David Poll	Canadian Heritage, Parks Canada-Western Regional Office		(403) 292-4691
	Jillian Roulet	Banff National Park	Ecosystem Secretariat Manager	(403) 762-1523
	Cliff White	Banff National Park	Park Conservation Biologist	(403) 762-1422

GOVERNMENT OF CANADA MONITORING PROGRAMS (CONTINUED)

Program	Contact	Associated Organization or Agency	Position	Phone
CONTINUATION OF CANADIAN HERITAGE, PARKS CANADA	Dave Dalman	Banff National Park	Park Conservation Biologist	(403) 762-1535
	Ian Pengelli	Banff National Park	Fire Vegetation Specialist Warden	(403) 762-1417
	Tom Hurd	Banff National Park	Wildlife Specialist Warden	(403) 762-1402
	Charlie Pacas	Banff National Park	Aquatic Specialist Warden	(403) 762-1418
	Gord Antoniuk	Elk Island National Park	Warden Operations Coordinator	(403) 992-2956
	Brent McDougall	Elk Island National Park	Senior Park Warden	(403) 992-2966
	Norm Cool	Elk Island National Park	Conservation Biologist	(403) 992-2958
	Steve Otway	Elk Island National Park	Warden Service Manager	(403) 992-2977
	Doug Hodgins	Jasper National Park	Ecosystem Secretariat Manager	(403) 852-6108
	Wes Bradford	Jasper National Park	Human/Wildlife Conflict Specialist	(403) 852-6155
	Peter Achuff	Jasper National Park	Conservation Biologist	(403) 852-6197
	Alan Westhaver	Jasper National Park	Fire and Vegetation Specialist	(403) 852-6169
	George Mercer	Jasper National Park	Wildlife Specialist	(403) 852-6224
	Ward Hughson	Jasper National Park	Aquatic Specialist	(403) 852-6205
	Bill Dolan	Waterton Lakes National Park	Ecosystem Services Manager	(403) 859-5118
	Kevin Van Tighem	Waterton Lakes National Park	Conservation Biologist Warden	(403) 859-2014
	Randall Schwanke	Waterton Lakes National Park	Fire and Vegetation Specialist Warden	(403) 859-5124
	Rob Watt	Waterton Lakes National Park	Wildlife and Aquatic C.R.M. Specialist Warden	(403) 859-5125
Chuck Blyth	Wood Buffalo National Park	Conservation Biologist	(403) 872-2349	
WATERFOWL BROOD SURVEY	Ken Lungle	Natural Resources Service	Bird Game Management Coordinator	(403) 427-6612
	Paul Pryor	Canadian Wildlife Service	Wildlife Technician, Migratory Birds Division (NAWAMP Contact)	(403) 951-8676
	Al Richard	Ducks Unlimited	Biologist/GIS Technician	(403) 489-2002

NON-GOVERNMENT MONITORING PROGRAMS

Program	Contact	Associated Organization or Agency	Position	Phone
AMPHIBIAN MONITORING PROGRAM	Larry Powell	University of Calgary, Dept. of Biological Sciences	Research Associate	(403) 220-2687
BAT HOUSE PROGRAM	Bob Young	Bat Conservation Society of Canada	President and Co-Founder of the Bat Conservation Society of Canada	(250) 489-1546
	Brian MacLeod	Bat Conservation Society of Canada	Vice President and treasurer of the Bat Conservation Society of Canada	(403) 251-6322
	Cindy MacLeod	Bat Conservation Society of Canada	Bat House Coordinator	(403) 251-6322
BIRDLIST SURVEYS	Glen Semenchuk	Federation of Alberta Naturalists	Executive Director	(403) 453-8629
	Trevor Wiens	Federation of Alberta Naturalists	Volunteer System Administrator	(403) 453-8629
BREEDING BIRD ATLAS	Glen Semenchuk	Federation of Alberta Naturalists	Executive Director	(403) 453-8629
	Trevor Wiens	Federation of Alberta Naturalists	Volunteer System Administrator	(403) 453-8629
CANADIAN LAKES LOON SURVEY	Kathy Jones	Long Point Bird Observatory/Bird Studies Canada	Aquatic Surveys Officer	(519) 586-3531
	Russ Weeber	Long Point Bird Observatory/Bird Studies Canada	Aquatic Surveys Coordinator	(519) 586-3531
CANADIAN MIGRATION MONITORING NETWORK INTENSIVE SURVEYS	Jon McCracken	Long Point Bird Observatory/Bird Studies Canada	Program Manager	(519) 586-3531
	Doug Collistor	Inglewood Bird Sanctuary	President of the Calgary Bird Banding Society	(403) 240-1635
	Steve Lane	Lesser Slave Lake Bird Observatory	Chairman of Lesser Slave Lake Bird Observatory	1 800 267-4654
	Jason Duxbury	Beaverhill Bird Observatory	Chairman of Beaverhill Bird Observatory	(403) 430-1694
CENTRAL ROCKIES WOLF RESEARCH PROJECT	Paul Paquet	Central Rockies Wolf Project Head Office	Director	(403) 678-4633
	Caroline Calahan	Central Rockies Wolf Project Head Office	Assistant Director	

NON-GOVERNMENT MONITORING PROGRAMS (CONTINUED)

Program	Contact	Associated Organization or Agency	Position	Phone
CHRISTMAS BIRD COUNT	Brenda Dale	Canadian Wildlife Service	Wildlife Biologist	(403) 951-8686
	Geoff Holroyd	Canadian Wildlife Service	Research Scientist	(403) 951-8689
COAST-TO-COAST MOTH AND BUTTERFLY SURVEY	Sandy Baumgartner	Canadian Wildlife Federation	Manager of Programs and Communications	1-800-565-9453
FOREST INDUSTRY	Brent Rabik	Alberta Pacific Forestry Industries	Environment/Science Project Coordinator	1 800 661-5210
	Richard Bonar	Weldwood of Canada Limited Hinton Division	Senior Wildlife Biologist	(403) 865-8193
	Daniel Gilmore	Canadian Forest Products Ltd.	Forest Ecologist	(403) 538-7705
	Bob Wiens	Daishowa Marubeni International Ltd.	Forest Resources Coordinator	(403) 624-7426
	Richard Krygier	Millar Western Industries Ltd.	Silviculture Manager	(403) 778-2221
	Dave Beck	Ainsworth Lumber Co. Ltd.	Silviculture Forester	(403) 831-2522
	J.P. Beliech	Manning Diversified Ltd.		(403) 836-3111
JULY FOURTH BUTTERFLY COUNT	Ron Hooper	Royal Saskatchewan Museum	Contributor of the July Fourth Butterfly Count	(306) 787-2801
	Keith Roney	Royal Saskatchewan Museum	Acting Chief Curator and Contributor of the July Fourth Butterfly Count	(306) 787-2801
LADYBUG SURVEY	Scott Plunkett	Canadian Nature Federation	Coordinator of the Endangered Plants and Invertebrates in Canada (EPIC) Program	(613) 562-3448
MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP	Lucie Metras	Canadian Wildlife Service		(819) 997-4213
	Doug Collistor	Inglewood Bird Sanctuary	President of the Calgary Bird Banding Society	(403) 240-1635
	Steve Lane	Lesser Slave Lake Bird Observatory	Chairman of Lesser Slave Lake Bird Observatory	1 800 267-4654
	Jason Duxbury	Beaverhill Bird Observatory	Chairman of Beaverhill Bird Observatory	(403) 430-1694
NEST RECORDS SCHEME	Jack Dubois	Manitoba Museum of Man and Nature	Associated Curator of Mammalogy and Ornithology	(204) 956-2830
NORTH AMERICAN BAT HOUSE RESEARCH PROGRAM	Robert Benson	Bat Conservation International		(512) 327-9721
NORTH AMERICAN BREEDING BIRD	Brenda Dale	Canadian Wildlife Service	Wildlife Biologist	(403) 951-8686

NON-GOVERNMENT MONITORING PROGRAMS (CONTINUED)

Program	Contact	Associated Organization or Agency	Position	Phone
SURVEY	Jack Park Geoff Holroyd	Canadian Wildlife Service	Coordinator of the BBS Research Scientist	(403) 469-8127 (403) 951-8689
PLANTWATCH	Elisabeth Beaubien	Devonian Botanic Garden	Research Associate	(403) 987-5455
PROJECT FEEDERWATCH	Bird Studies Canada			(519) 586-3531
RESEARCHING AMPHIBIAN NUMBERS IN ALBERTA	Brian Eaton	University of Alberta	Founder of RANA	(403) 492-4737
ROCKY MOUNTAIN EAGLE RESEARCH FOUNDATION	Peter Sherrington	Rocky Mountain Eagle Research Foundation	Chairman of the Rocky Mountain Eagle Research Foundation	(403) 932-5183
SPRING BIRD COUNT	Glen Semenchuk Trevor Wiens	Federation of Alberta Naturalists Federation of Alberta Naturalists	Executive Director Volunteer System Administrator	(403) 453-8629 (403) 453-8629
SPRING FLOWER COUNT	Glen Semenchuk Trevor Wiens	Federation of Alberta Naturalists Federation of Alberta Naturalists	Executive Director Volunteer System Administrator	(403) 453-8629 (403) 453-8629
SPRING MAMMAL COUNT	Glen Semenchuk Trevor Wiens	Federation of Alberta Naturalists Federation of Alberta Naturalists	Executive Director Volunteer System Administrator	(403) 453-8629 (403) 453-8629