An Environmental Assessment of High Conservation Value Forests in the Alberta Portion of the Mid-Continental Canadian Boreal Forest Ecoregion

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for

World Wildlife Fund (Toronto, Ontario)

and

Alberta-Pacific Forest Industries (Boyle, Alberta)

by

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Executive Summary

This reports presents an assessment of high conservation value forest and non-forest ecosystems (HCVFs) in the Alberta portion of the Mid-Continental Canadian Boreal Forests. It confirms the existence of these ecosystems within and near the Alberta-Pacific Forest Management Agreement area. The assessment focuses on the environmental attributes that convey high conservation value. It does not consider cultural or social attributes.

Among the many attributes that warrant HCVF status, the FMA area and its vicinity contain large intact landscape blocks, woodland caribou range, old-growth forests, and nationally environmentally significant areas, support species and communities at risk and endemic species, contain critical breeding areas and migration sites, support species at the edges of their ranges, and support both rare and declining species and communities. Taken in aggregate, the ecoregion supports features of international to regional significance.

The HCVs include:

Ecosystems and Landscapes: the Peace-Athabasca Delta, the Athabasca Dunes, Utikuma Lake, the Athabasca and Clearwater Rivers, and large intact forests and landscapes.

Communities and Habitats: old-growth forests, saline wetlands, large wetland complexes, rare forest types, dry grasslands, woodland caribou habitat.

Rare Species: Peregrine Falcon, Whooping Crane, Sprague's Pipit, Loggerhead Shrike, Woodland Caribou, Grizzly Bear, Cougar, Wolverine, and sand dune endemic plants.

Characteristic species that may be of conservation concern include Canadian and Western Toads; American White Pelican, Bay-breasted, Black-throated Green, Blackburnian, Canada, and Cape May Warblers, Black-backed and Pileated Woodpeckers, Sandhill Crane, Western Tanager; Fisher, Lynx, River Otter; several sedge species, and Pitcher Plant.

In order to produce a spatially explicit delineation of conservation values, eight data layers were overlain. The highest ranked areas, supporting 4-6 overlapping attributes, were associated with the Athabasca River valley upstream of Ft. McMurray. The highest ranked area overall lies northeast of Calling Lake in the McMillan Lake and Parallel Creek area of the Athabasca River. Other high-ranked areas included the Thickwood Hills, the area north of the Thickwood Hills, areas north and east of both Utikuma and Calling Lakes, the Athabasca, Clearwater, and Firebag Rivers, McClelland Lake and Fen, the area east of the Cold Lake Air Weapons Range, areas along the Saskatchewan border, and the Liege River.

About 80% of the FMA area supports at least one HCVF attribute; 44% of the FMA area supports one attribute, 27% supports two attributes, 7% supports three attributes, 1.2% supports four attributes, 0.083% supports five attributes, and 0.003% supports six overlapping attributes. Many of the areas supporting high numbers of overlapping HCVs are associated with river valleys or wetlands.

While the region has great potential to protect a significant portion of Canada's biodiversity, there are serious conservation challenges. Chief among these challenges is multiple tenure-- in which multiple users lay claim to the same landscape. Innovative thinking and timely action will be needed to protect high conservation values in the region.

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Introduction

The objective of this study, undertaken on behalf of World Wildlife Fund (Toronto) and Alberta-Pacific (Al-Pac) Forest Industries, is to assess the presence and nature of high conservation value forests within or near the Al-Pac FMA area, Alberta, Canada. The assessment hopefully will provide a scientific basis for assessing current landscape management in relation to Forest Stewardship Council (FSC) Principle 9.

Principle 9 of the Forest Stewardship Council National Boreal Standard states that: "Management activities in High Conservation Value Forests shall maintain or enhance the attributes which define such forests. Decisions regarding the High Conservation Value Forests shall always be considered in the context of a precautionary approach" (FSC 2003).

A first step in the FSC certification process is to determine whether HCV forests are present within a management area. If so, next steps would be to determine what attributes convey the high conservation value, where those attributes are located, and how current management relates to these values.

The concept of high conservation value forests focuses on the environmental, social, or cultural values that render a forest outstanding significance.

The Forest Stewardship Council (FSC 2003) recently defined High Conservation Value Forests as those that possess one or more of the following attributes (key points are underlined):

a. globally, nationally, or regionally significant:
    i. concentrations of biodiversity values (e.g., endemism, endangered species, refugia); and/or
    ii. large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance
b. forest areas that contain species of special concern, or are located within or contain threatened or endangered ecosystems
c. forest areas that provide basic services of nature in critical situations (watershed protection, erosion control)
d. forest areas fundamental to meeting basic needs of local communities (e.g., subsistence, health) and/or critical to local communities' traditional cultural identity

For the manager, high conservation value forests carry certain obligations: a higher level of care than other landscape units, a management strategy that maintains the high conservation values, and a monitoring program to ensure that the values are maintained.

Conservation of HCVFs is not a trivial matter as the western Canadian boreal forest is subject to complex, interacting stressors, both anthropogenic and natural, whose cumulative effects are both significant and difficult to predict. Chief among the stressors are oil and gas activities which consume large volumes of forest, dissect and fragment habitat, affect ground and surface water and air quality, and provide for increased access; agriculture; forestry; wildfire; climate variation and change; increased UV radiation; insect attacks and disease; mining; hydroelectric developments; and hunting,

trapping, fishing, and recreational demands, all set within the context of a global economy that lies beyond local control (Schindler 1998a, b; Thomas 1998; Schneider 2002; Timoney 2003).

Forest management polices in Alberta are a relic of earlier times, essentially unchanged since the 1950s (Schneider et al. 2003). Since the 1950s, the once 'wilderness' has become occupied densely by industry with interference between companies and other stakeholders commonplace. Ecological values and ecosystem goods and services cannot be maintained under the current system of forest management in Alberta.

The assessment began with data gathering and analysis, the presentation of which occupies roughly the first half of the report. Thereafter, the report follows the questions posed as a guideline to HCVF assessment by Johnson and Iacobelli (2002). I have not attempted to address fully the cultural aspects of HCVFs.

Study Region

The study region is nominally Ecoregion 92 (Mid-Continental Canadian Forests, after Ricketts et al. 1999) (Figure 1). The analysis focuses on boreal northeastern Alberta, with greatest emphasis on the Al-Pac forest management agreement (FMA) area. The chief boreal subregion of interest is the Central Mixedwood (Figure 2). While the study region extends from Alberta to Manitoba, the focus on boreal Alberta and the FMA area in particular is justified due to practicality. This is the region where Al-Pac has a mandate to manage. In general, when I use the term 'study region' I refer to the entire ecoregion while 'study area' refers to the FMA area.

Ecoregion 92 is described by Shay et al. (1999) upon which I base this summary. The description of soils and vegetation is based upon my field experience and familiarity with the literature. Plant common names follow those of Alberta Forestry, Lands and Wildlife (1990).

The region extends as a NW-SE band from the south shore of Great Slave to west-central Manitoba. The climate is subhumid, mid-boreal with mean annual temperatures from -2 to +1C, mean summer temperatures from 13 to 15.5C, and mean winter temperatures from -17.5 to -13.5 C. Mean annual precipitation ranges from 300 to 625 mm (lower precipitation values in the west and higher values in the east). Three physiographic regions lie within Ecoregion 92: the Slave River Lowland of northeastern Alberta and southern NWT, the mid-Boreal Lowland of the Manitoba Plain, and the mid-Boreal Uplands stretching from north-central Alberta to southwestern Manitoba.

The mid-Boreal Uplands, the geographic focus of this study, are underlain for the most part by Cretaceous shales covered by kettled to dissected, deep loamy to clayey till, and lacustrine and glaciofluvial deposits. Locally, there are noteworthy occurrences of Devonian salt and gypsum, the latter associated with karst topography. Elevations in the mid-Boreal Uplands range from 400 to 800 m asl. Permafrost in the upland regions is found only in peatlands. Small lakes and sloughs fill numerous shallow depressions in the rougher morainal areas.

Western Canadian boreal soils on medium to fine-textured upland sites are usually Luvisols. Coarser-textured uplands are often Brunisols in areas of lower precipitation and Podzols in areas of higher precipitation. In areas of recent deposition or continual disturbance (e.g., river valleys, deltas, active dunes) soils are often Regosols. On poorly- and imperfectly-drained mineral soils, Gleysols predominate. On organic terrain, both Organics and Organic Cryosols (in bogs) predominate. On saline parent materials, Solonetzic soils predominate. Folisols and Rockland are found in areas where there is little or no mineral matter overlying bedrock. Some Melanic Brunisols under boreal grasslands resemble Chernozemic soils.

Uplands are dominated by pure and mixed forests of trembling aspen, white spruce, and

balsam poplar. Shrublands (carrs) dominated by willows, river alder, birch, and other shrubs, and meadows dominated by bluejoint reedgrass, may persist in some disturbed areas. Wetland forests are dominated by black spruce, larch, and white spruce. Sand deposits are dominated by jack pine. Riparian forests are dominated by white spruce and balsam poplar. Old forests may have a high proportion of balsam fir, particularly in the more eastern areas. White birch may be abundant locally; Alaska birch may be abundant on wetter mineral soils. Peatlands are dominated by open fens of brown mosses, willows, and *Carex* species, wooded fens may support combinations of larch, white spruce, or black spruce; open bogs are dominated by *Sphagnum*, dwarf birch, and ericaceous shrubs; wooded bogs typically support a low canopy of black spruce. Bog-fen complexes are common. Dry grasslands and savannahs are found on dry/fire prone sites with admixtures of wheat grasses, needle/porcupine grasses, hairy wild rye, rice grass, June grass, and others. Marshes, sloughs, and wet savannahs, often associated with deltas and lake shores, may be dominated by awned sedge, cattail, bulrush, spangletop grass, bluejoint reedgrass and willows such as plane-leaved, pussy, basket, Bebb's, and other willows. Saline areas are usually dominated by a diverse array of marsh halophytes.

Alberta Peatland Inventory data (Vitt et al. 1996) (Table 19a) indicate that ~32% of the FMA area was covered by wetlands (forested and non-forested, at the time of most recent 1:40,000 imagery). This proportion of wetland in the FMA area is essentially identical to the proportion of wetlands in the Central Mixedwood of Alberta (31.1%, ex Table 35 in Vitt et al. 1996), ~40% of which are treeless and 60% of which are forested or wooded.

Several rare/endemic vegetation types and species are supported in the region, including gypsum diatom ponds, interior patterned salt marshes, and the Athabasca Dunes. The areal pattern and temporal variations in fire, flooding/drying cycles, moisture and nutrient regime, and parent material texture, slope, and aspect influence the spatio-temporal pattern of the vegetation.

Characteristic wildlife includes moose, black bear, gray wolf, lynx, white-tailed deer, beaver, muskrat, snowshoe hare, many species of ducks and geese, wood warblers, American white pelican, sandhill crane, ruffed grouse, common loon, and forest tent caterpillar. The world's largest wild populations of wood bison and whooping crane inhabit Wood Buffalo National Park and environs. Wetlands in the region are of hemispheric to international significance, including the Peace-Athabasca Delta, the Whooping Crane Nesting Area, and the Cumberland Delta. Its biological distinctiveness has been classified as bioregionally outstanding (Ricketts et al. 1999).

The Al-Pac FMA area spans ~5.8 million ha in boreal northeastern Alberta, composed of ~2.1 million ha of productive forest open to harvest (36.1%), 0.34 million ha of non-harvest productive forest (5.8%), and 3.4 million ha of bogs, fens, and other land cover types which do not produce commercial timber (58%) (Al-Pac 2000). Current land uses within or adjacent to the FMA area include deciduous and coniferous forestry; oil and gas exploration, extraction and transportation; oil sands and coal mining; agriculture; peat mining; commercial, traditional, and recreational hunting, trapping, fishing, boating, and gathering; support industries; and infrastructure (Al-Pac 2000).

Methods

Data Queries

Data queries were made to the Alberta Natural Heritage Information Centre (ANHIC, Edmonton), to the Fishery Management Information System (FMIS, Alberta Fish and Wildlife) for fisheries, to the Alberta Breeding Bird Atlas (Federation of Alberta Naturalists, Edmonton) for breeding bird data, to Ducks Unlimited (Edmonton) for waterfowl data, and to the Saskatchewan and Manitoba Conservation Data Centres (CDCs). Requests to ANHIC and to the Saskatchewan and Manitoba conservation data centres were for a list of locations of all tracked elements of rarity rank S1 and S2 in Ecoregion 92 (see Appendix 1 for definitions or rarity ranks). Output from ANHIC included records from the Alberta Biodiversity Species Observation Database (BSOD) and encompassed plants (vascular, bryophyte, lichen), vertebrate, odonate, and butterfly species occurrences; bird colonies were also listed. The element presence data indicate known presence. Absence of an element may indicate true absence or insufficient data.

It is important to remember that most species (represented by invertebrates [with the exception of butterflies and odonates], fungi, and bacteria) are not tracked and thus were excluded from this process. Similarly, the tracking of rare or otherwise significant plant communities or ecosystems is in its infancy. Thus the results reported here are minimum estimates.

For the sake of readability, I have placed the lengthy tabular results (Tables 1-12, 16) in Appendix 2.

For Alberta, bird colonies were listed only as 'bird colony' in the data output, but included nesting colonies of American White Pelican, California Gull, Common Tern, Double-crested Cormorant, Franklin's Gull, Ring-billed Gull, and Western Grebe (J. Rintoul, ANHIC, December 2002, pers. comm.). Table 1 provides information for 461 significant element occurrences in Alberta. Table 2 provides information for 484 significant element occurrences in Saskatchewan. Table 3 provides information for 46 significant element occurrences in Manitoba. Table 4 lists the general location of Peregrine Falcon and Whooping Crane nesting sites in Alberta (the focus on Peregrine Falcon and Whooping Crane results from the Alberta government's classification of these elements as 'sensitive' whereas elements in Table 1 are 'non-sensitive'). Figure 3 shows the location of rare element occurrences in Ecoregion 92.

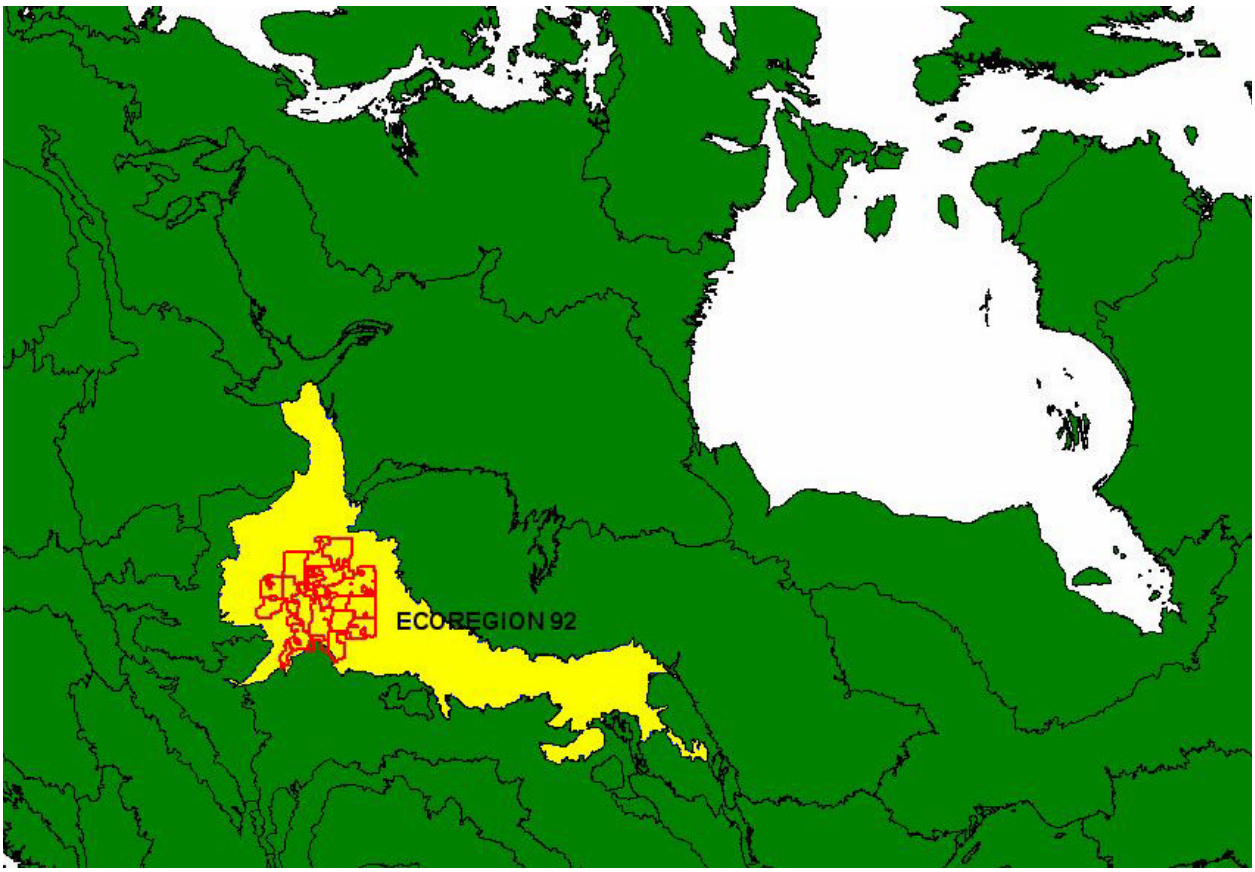
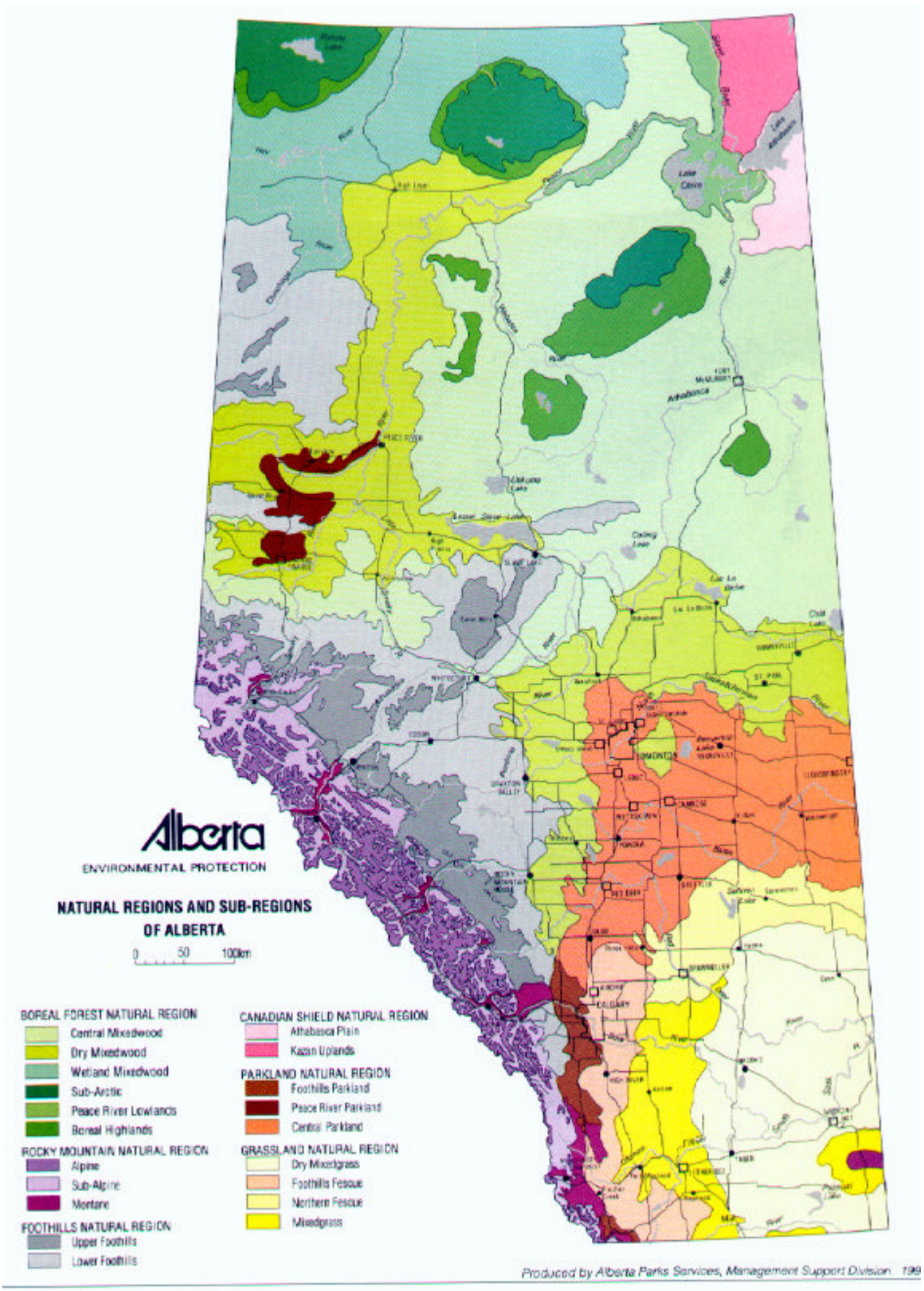


Figure 1. Ecoregion 92 (Mid-Continental Canadian Forests) in the context of other ecoregions of central Canada, after Ricketts et al. (1999) with the Al-Pac FMA area highlighted in red. East to west extent of image is circa 3000 km.

Figure 2. Alberta natural regions and subregions (map produced by Alberta Parks Services, Management Support Division, 1994 edition).



Plant community (non-spatial) data were provided by Allen (2002) and L. Allen, pers. comm. (ANHIC, December 2002). Output from the Saskatchewan CDC included vascular plants, mammals, birds, and migratory bird concentration sites. Output from the Manitoba CDC included vascular plants, one mammal (bison), breeding colonies of piping plover, and one plant community.

Gathering and organizing data relevant to the HCVF questions involved a multi-step process. The process is described below.

I structured the questions with reference to focal species, ecosystem types, and species identified as significant through consultation in keeping with the approach of Johnson and Iacobelli (2002). For brevity, I have termed this approach Focal Species and Communities.

The questions are designed to determine if there are potential HCV forests in the study area. For the sake of management, effort is made to answer the questions in a spatially explicit manner. In the discussion of the report, I attempt to synthesize six attributes in an effort to rank the conservation values spatially.

Focal Species and Communities

Use of the terms 'focal', 'indicator', 'species-at-risk', 'featured', 'umbrella',' keystone', and 'flagship', among others, has not been standardized. Common meanings and usages of these terms are provided by Hannon and McCallum (2002). For the purposes of this report, I offer the following definitions and observations.

'Focal' species are defined by Lambeck (1997) as those "species whose requirements for management or habitat reconstruction encapsulate the needs of all other species." Whether the requirements of 'focal' species do indeed encapsulate the needs of all other species remains to be seen. Some of the uncertainty surrounding focal species stems from lack of data; some of the discomfort with the concept may stem from semantics, or values attached to terms. Addressing such points is beyond the scope of this report. The reader uncomfortable with the 'focal' term may replace it with 'priority'. The purpose of the 'focal' exercise was to provide a subset of species and communities which may prove useful to management due to pre-existing data, ease of monitoring, indicator value, or general interest to society.

'Vulnerable' in this report refers to species and communities that are 'rare' (that is, elements tracked by conservation data centres), or species rated as 'At Risk', 'May Be at Risk', or 'Sensitive' by Alberta Environment (2001), or species rated as 'Endangered','Threatened', or as 'Special Concern' by COSEWIC (2002). Following a precautionary approach, in this report, 'Vulnerable' is synonymous with 'Rare, Threatened, or Endangered'.

Controversy surrounds the application of the 'keystone' species concept. Paine (1966) used the term keystone species to denote those predator species whose predation on competitively dominant prey species has the potential to maintain high species diversity (Davic 2000). In general, a keystone species exerts an influence on a system that is disproportionate to its abundance (F. Schmiegelow, pers. comm., Univ. of Alberta, June 2003). Over time, the keystone concept has been broadened to be synonymous in some respects to ecologically dominant species: those species whose removal might engender dramatic changes in the structure and function of the community (De Leo and Levin 1997)-- e.g., changes to landscape cover types or to aquatic food webs, and to nutrient cycling and energy flow. This latter sense is used in this report. Thus, keystone species by their very nature are usually common. The removal of trembling aspen, e.g., from the western boreal landscape, would engender dramatic changes to boreal structure and function.

'Significant' in this report refers to elements (ecosystems, communities, species) which may not be rare but have been identified to be of high value, concern, utility, or interest. Significant

elements may have particular habitat requirements, availability of pre-existing data, perform important ecological roles, have indicator value, be under threat, be easily monitored, declining, of unknown status.

For questions pertaining to regionally rare species, I have included species classified as 'sensitive' so that important elements are not lost due to classification issues.

The identification of focal species followed a multi-step process which, in general, followed the process outlined by Lambeck (1997, Figure 1). The Lambeck approach was expanded to include communities, in particular old-growth forests. The rationale for this expansion was (a) wise management of communities is likely to meet the needs of many species; (b) communities are, in general, more useful management units than are species populations; (c) rising disturbance regimes in the western Canadian boreal forest place many communities at risk (Schindler 1998a; Paine et al. 1998; Flannigan et al. 1998, 2001; Thomas 1998), particularly old-growth and rare types (Timoney 2003).

Step 1 identified vulnerable species and communities (those expected to be lost from the study region in the absence of action). This step involved reference to several information sources (A through E, below).

A. Identification of rare species. Lists of taxa were prepared for Alberta (172 taxa) (Table 5), Saskatchewan (73 taxa) (Table 6), and Manitoba (24 taxa) (Table 7). Bird colonies were deleted.

B. Addition of significant species missed in the ANHIC rare species filter by reference to other data sources (e.g., Alberta Environment 2001).

C. Evaluation of rare or significant species.

Species with fewer than 5 occurrences in the study region were excluded at this point, but excluded species were allowed to re-enter the vulnerable list after reference to literature. Reference was made to Smith (1993, mammals), Allison (1973, mammals), Banfield (1974, mammals), Russell and Bauer (1993, amphibians and reptiles), Ruggiero et al. (1994, mammals), Alberta Environment (2001, vertebrates), Bird et al. (1995, butterflies), Thomas (1998, general guide), Vujnovic and Gould (2002, vascular plants and bryophytes), Kershaw et al. (2001, vascular plants), Argus and Pryer (1990, vascular plants), Vitt et al. (1988, bryophytes and lichens), Lawton (1971, mosses), and Ireland (1982, mosses). This step resulted in the deletion of many species and the addition of a smaller suite of species that, while not technically 'rare' merit consideration as focal species. Many species were omitted at this point due to extreme rarity (e.g., *Sparganium glomeratum*, Globe Bur-reed), known only from a few localities and in special habitats; *Thelungiella salsuginea*, Mouse-ear Cress), or were rare aquatic or wetland plants at range edges (*Gentiana detonsa* ssp. *Raupii*, Northern Fringed Gentian, *Najas flexilis*, Slender Naiad) and therefore of little use as indicators of management success.

D. Focal communities were added to this list by reference to Allen (2002) who reported Alberta plant communities based on consultation with experts on Alberta vegetation. This formed the basis for Table 8, which was augmented by reference to new studies and local knowledge.

E. Boreal old-growth forest types were excerpted from Timoney (2001) and are abbreviated as Tables 9-11). The characteristic age at which old-growth status is reached is provided in Table 10

(Stand Age Min / Max column).

The result of this evaluation and amalgamation was a list of vulnerable species and communities (Table 12).

Step Two categorized the vulnerable species and communities into one of five categories responsible for the vulnerability of that species (Area-limited, Dispersal-limited, Resource-limited, Process-limited, or Range Edge, appearing in the left-most columns of Table 12).

Area-limited species are those whose abundance is limited by the amount of habitat available to them. In the case of communities or ecosystems, it refers to the areal extent of the type.

Dispersal-limited species are those whose abundance is limited by their ability to move across the landscape.

Resource-limited species are those whose abundance is limited by the availability of resources within their habitats (e.g., fire-killed trees, cliffs, large logs).

Process-limited species are those whose abundance is limited by processes such as fire, exotics, domestic grazing, pesticides, etc.

Range Edge species are those whose abundance is related to the fact that they are at their range edge. The rationale for addition of the Range Edge category was that many species become rare at their range edges—presumably as a function of sub-optimal conditions at range boundaries. Sub-optimal conditions might involve decreased survival or reproductive fitness as a result of climatic stress that, in turn, might limit available habitat, limit dispersal or resources, lead to differences in competitive relationships, susceptibility to disease, or result in a different fire regime at range edge than at range center. In other words, species and communities at their range edges might be vulnerable for a number of poorly-documented reasons.

The assignment to vulnerability category was based on available literature, data, and experience. There is likely a wealth of difficult to find information in unpublished reports. Often, definitive explanations of causes of vulnerability are lacking (e.g., Taiga Vole). In other cases, there may be multiple causes for vulnerability, the relative importance of which is not always clear. For example, is woodland caribou dispersal-limited due to its avoidance of industrial disturbances in a fragmented/dissected landscape (Dyer et al. 2001), or would such behavior be a process limitation since both industrial disturbances and wolf predation are processes?

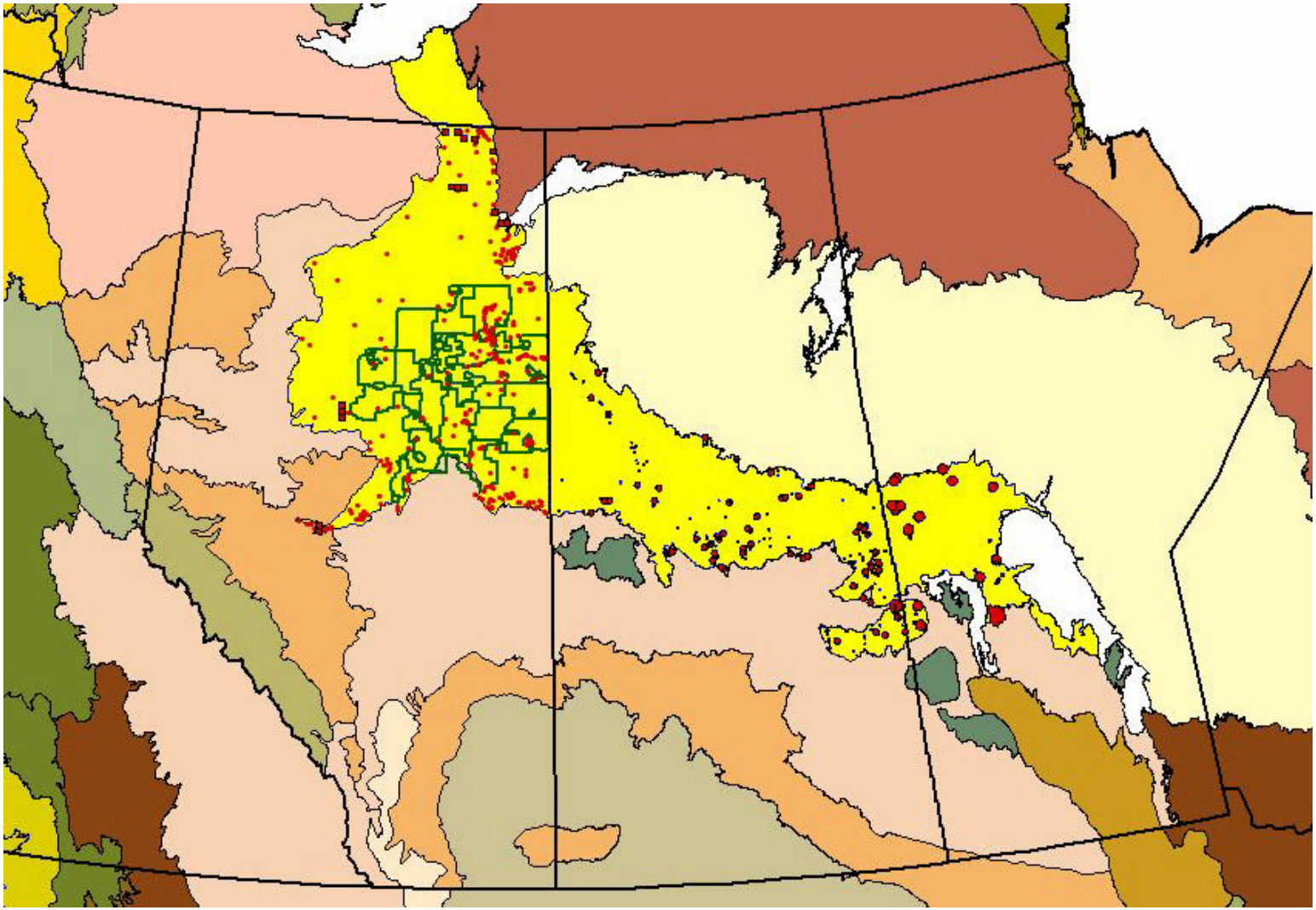


Figure 3. Distribution of rare element occurrences (species, bird colonies) in Ecoregion 92. In Alberta, black-outlined squares are generalized to township (nesting sites of peregrine falcons and whooping cranes); red circles are non-sensitive element occurrences. In Saskatchewan and Manitoba, red circles are rare element occurrences (large circles indicate approximate locations). The Al-Pac FMA is outlined. Lack of element occurrences in the northwest extremity of Ecoregion 92 is artifact— the ecoregion extends beyond Alberta ANHIC data into the Northwest Territories. Rare element occurrences courtesy of Alberta ANHIC and Saskatchewan and Manitoba Conservation Data Centres.

High Conservation Value Forest Assessment

Note: at the end of each question, an overall assessment is provided (whether Global (International), National, or Regional significance).

Question 1.
Does the forest management unit contain species at risk or potential habitat of species at risk as listed by international, national, or state/regional/provincial authorities?

Yes. Refer to Tables 1-12.

Sub-questions.
A. Does your forest contain critical habitat for rare, threatened, or endangered species?
Yes. Rare, threatened, or endangered species use a range of habitat types. The species and the habitats used depend on the definitions of rarity applied. At the global level, listed species are: Peregrine Falcon (*anatum* subspecies), Whooping Crane, Sprague's Pipit, Tyrrell's willow, sand dune chickweed, Indian tansy, Cougar, Wood Bison, Wolverine, and Western Toad (Table 12, Global/National Rank column). At the Alberta provincial level, there are circa 17 S1, 2 S1S2, and 14 S2 species and communities (Table 12, ANHIC rank).

B. Are any of the rare, threatened, or endangered species found in your forest a keystone or focal species? Yes.

The wood bison is rare, but a keystone species within its current range. See Table 13. The remainder of the keystone species are not rare, threatened, or endangered. Most of the species are common. If a keystone species must be one whose influence is disproportionate to its abundance, then most of the species of Table 13 would not qualify as keystone.

Among the keystone species, the trees *Populus balsamifera, P. tremuloides, Picea glauca,* and *Larix laricina* are represented in some rare community types (see Appendix Table 8).

Among the focal species and communities, examples are: Woodland Caribou, Northern Long-eared Bat, Grizzly Bear, Wolverine, Short-eared Owl, Loggerhead Shrike, Sprague's Pipit, Northern Leopard Frog, Western Toad, Short-jawed Cisco, Pygmy Whitefish, and old-growth riparian white spruce and mixedwood forests.

Table 13. Canadian western boreal forest keystone species or groups.

Common Name	Scientific Name	Rationale, Comments	Reference
Vascular Plants			
Trembling Aspen	*Populus tremuloides*	a dominant on mesic boreal uplands, usually on fine-textured soils; common	Ecoregions Working Group (1989); Achuff (1994); Scott (1995); Timoney (2003)
Balsam Poplar	*Populus balsamifera*	a dominant on mesic boreal uplands and riparian areas; common	Ecoregions Working Group (1989); Achuff (1994); Scott (1995); Timoney (2003)
Black Spruce	*Picea mariana*	a dominant in treed bogs, and secondarily on poor, drier soils in the north and east; common	Ecoregions Working Group (1989); Achuff (1994); Scott (1995); Timoney (2003)
Bluejoint Reedgrass	*Calamagrostis canadensis*	dominant of boreal meadows; common	National Wetlands Working Group (1988); Achuff (1994); Johnson et al. (1995); Timoney (2003)
Jack Pine	*Pinus banksiana*	a dominant on sandy soils; common, but as a dry boreal savannah component, less common	Ecoregions Working Group (1989); Achuff (1994); Scott (1995); Timoney (2003)
Larch (Tamarack)	*Larix laricina*	a dominant in treed fens; common	Ecoregions Working Group (1989); Achuff (1994); Scott (1995); Timoney (2003)
White Spruce	*Picea glauca*	a dominant on mesic boreal uplands and riparian areas; common	Ecoregions Working Group (1989); Achuff (1994); Scott (1995); Timoney (2003)
Non-Vascular Plants			
Brown Mosses	Amblystegiaceae group (*Drepanocladus, Scorpidium, Campylium, Calliergon*, etc.)	dominant cover and peat formers, along with Carex spp., in fens; some species in this group are rare (e.g, *Campylium polygamum*)	National Wetlands Working Group (1988)

Peat Mosses	*Sphagnum* group	dominant cover and peat formers in bogs; some species in this group are rare (e.g, *Sphagnum balticum*)	National Wetlands Working Group (1988)
Fungi			
Armillaria root rot	*Armillaria ostoyae**	"one of the most important diseases of young trees... in the prairie provinces"; conifers and broadleaf trees; common	Hiratsuka (1987)
Red ring rot	*Phellinus pini*	"probably economically the most important decay fungus in the prairie provinces"; conifers; common	Hiratsuka (1987)
Root, butt, and stem rot of broadleaf trees	*Phellinus tremulae@*	causes significant losses in merchantable volume; common	Hiratsuka (1987)
Mycorrhizae	many species	enhance uptake of nutrients and water, protect against pathogens, bind soil to create favorable soil structure, alter competitive relationships, assist in tree regeneration after disturbance; some species in this group are rare	Wiensczyk et al. (2002)
Insects			
Forest Tent Caterpillar	*Malacosoma disstria***	can cause complete defoliation of aspen forests for a number of consecutive years which can affect dominant trees, nutrient cycling, and animal community structure; the most serious defoliator of aspen; also feeds on balsam poplar and birch; common	Roland (2003); Ives and Wong (1988)
Mammals#			
Beaver	*Castor canadensis*	affect hydrology and aquatic, wetland, and upland community structure and function through feeding and water works; common	Ecoregions Working Group (1989); Achuff (1994); Thomas (1998)

Bison	*Bos bison*	affect vegetation and soils where abundant (e.g., in WBNP); rare keystone species	Ecoregions Working Group (1989); Achuff (1994); Thomas (1998)
Cattle	*Bos taurus*	pre-empt habitat and cause changes to nutrient flows and communities; common	Ecoregions Working Group (1989); Achuff (1994); Thomas (1998)
Moose	*Alces alces*	influence vegetation structure and succession where abundant (e.g., in WBNP); often common	Ecoregions Working Group (1989); Achuff (1994); Thomas (1998)
Snowshoe hare	*Lepus americanus*	affect vegetation and predator abundance, especially during peak and crash; common	Henry (2001); Higdon (2002)
Fishes			
Jackfish	*Esox lucius*	top level predator in shallow, warm waters; locally common	Scott and Crossman (1979)
Lake Trout	*Salvelinus namaycush*	top level predator in deep, cold lakes; common to rare	Scott and Crossman (1979)

* Tree mortality is probably caused by many species of *Armillaria*, but the main species appears to be *A. ostoyae* (Hiratsuka 1987)
@ Other important decay fungi include *Peniophora polygonia, Ganoderma applanatum*, and *Fomes fomentarius* (Hiratsuka 1987)
**Other important western boreal forest insects which may play keystone roles include, for broadleaf trees, large aspen tortrix (*Choristoneura conflictana*), Bruce spanworm (*Operophtera bruceata*), aspen leaf roller (*Pseudexentera oregonana*, and for conifers, spruce budworm (*Choristoneura fumiferana*), jack pine budworm (*C. pinus*), mountain pine beetle (*Dendroctonus ponderosae*), spruce beetle (*Dendroctonus rufipennis*), and hemlock looper (*Lambdina fiscellaria*) (Timoney 2003)
It might be argued that wolves play a keystone role as a recent study by Berger et al. (2001) indicates for the Grand Tetons: removal of wolves and grizzly bears resulted in a trophic cascade affecting moose density, riparian vegetation communities, and avian species richness

C. Are there several taxa represented among rare, threatened, and endangered species?
Yes.
The number of taxa represented depends upon the degree of rarity. See Tables 1-7 for details.

D. Is there a concentration of rare, threatened, or endangered species or communities in a single taxon?
Yes. If the survey is limited to focal species and communities (Table 12): there are seven taxa of sedge (*Carex*) species or communities, five white spruce, five balsam poplar, three black spruce, three jack pine, three aspen, and two larch communities, four wood warbler (*Dendroica*), two crane (*Grus*), and two toad (*Bufo*) species, four *Elymus* communities, and three willow (*Salix*) species or communities.

If the survey is limited to rare Alberta species with three or more taxa represented (Table 5): there are 13 sedge (*Carex*), seven reindeer lichen (*Cladonia* and *Cladina*), five pondweed (*Potamogeton*), four peat moss (*Sphagnum*), three *Splachnum* moss, three grape fern (*Botrychium*), three rush (*Juncus*), three dog lichen (*Peltigera*), three *Ramalina* lichen, and three *Bryum* moss species.

E. Are any rare, threatened, or endangered species a top predator or focal species?
Yes. Top (i.e., high trophic level) predators include Peregrine Falcon, Whooping Crane, Grizzly Bear, Wolverine, American White Pelican, Short-eared Owl, and Loggerhead Shrike (Table 12). For focal species, see sub-question B above. Table 14 lists the top five focal 'species' in each of five vulnerability categories.

Adapting management practices to conserve these focal species may provide important guidance to improve management. Table 14 lists 19 species or communities; this number is probably too large for management to consider. Therefore, I have shortened the list to five focal species or communities (Table 15) which were chosen for their 'umbrella' or 'coarse-filter' status— that is, adapting management to these elements will conserve a large number of other elements. These elements are riparian old-growth white spruce forests; Woodland Caribou; Wolverine; Black-backed Woodpecker; and American White Pelican.

A considerable amount of triage was used in reducing a large and diverse set of data to five focal species. Furthermore, the process was driven by available data. Many other species might have been chosen, in particular those whose abundance is linked to old deciduous or mixedwood forests the focus of Al-Pacs operations. These might include Yellow-bellied Sapsucker, Least Flycatcher, Mourning Warbler, and American Redstart, among others (Schieck and Nietfeld 1995).

Table 14. Top five focal ‘species’ in the study area within each of the five vulnerability categories.

Vulnerability Type	Scientific Name	Common Name	Keystone ‘Species’?
Area-limited			
1	*Grus americana*	Whooping Crane	No
2	*Anthus spragueii*	Sprague's Pipit	No
3	*Picea glauca / Alnus - Betula / Equisetum*	Riparian White Spruce	Yes
4	*Picea glauca - Populus balsamifera*	Riparian Mixedwood	Yes
5	*Myotis septentrionalis*	Northern Long-eared Bat	No
Dispersal-limited			
1	*Rangifer tarandus caribou* pop 14	Woodland Caribou -- boreal ecotype	No
2	*Ursus arctos*	Grizzly Bear	No (Too uncommon to be keystone?)
3	*Gulo gulo*	Wolverine	No
4	*Rana pipiens*	Northern Leopard Frog	No
5	*Microtus xanthognathus*	Taiga Vole (Yellow-cheeked Vole)	No
Edge of Range			
1	*Lanius ludovicianus*	Loggerhead Shrike	No
2	*Asio flammeus*	Short-eared Owl	No
3	*Coregonus zenithicus*	Shortjaw Cisco	No
4	*Anthus spragueii*	Sprague's Pipit	No
5	*Prosopium coulteri*	Pygmy Whitefish	No
Process-limited			
1	*Falco peregrinus anatum*	Peregrine Falcon	No
2	*Grus americana*	Whooping Crane	No
3	*Rangifer tarandus caribou* pop 14	Woodland Caribou -- boreal ecotype	No
4	*Anthus spragueii*	Sprague's Pipit	No
5	*Bos bison (Bison bison athabascae)*	American Bison (Wood Bison)	Yes (Within WBNP)
Resource-limited			
1	*Falco peregrinus anatum*	Peregrine Falcon	No
2	*Grus americana*	Whooping Crane	No
3	*Picoides arcticus*	Black-backed Woodpecker	No
4	*Pelecanus erythrorhynchos*	American White Pelican	No
5	*Atriplex / Cyanophyta - Bacillariophyceae*	interior patterned saline marsh	No

Table 15. 'Umbrella' (coarse-filter) species and communities suggested to management (see Table 12 for details).

Element	Rationale
Riparian old-growth white spruce forest	ANHIC S3 status in Alberta; threatened and declining due to logging; many rare or significant species depend upon riparian old-growth, e.g, long-eared bat, many wood warblers; important in maintaining landscape connectivity and riparian and riverine health; mappable with AVI; Recommend: protect riparian old-growth forests from disturbance, maintain riparian connectivity.
Woodland Caribou	ANHIC S2; Alberta Environment: species at risk; COSEWIC: threatened; sensitive to disturbance; good database for management; Recommend: protect wetlands from disturbance, minimize dissection, fragmentation, and habitat loss.
Wolverine	IUCN: Red List; Alberta Environment: May be at risk; COSEWIC: special concern; area-demanding, sensitive species; best densities in areas of high habitat diversity and high prey abundance; Recommend: maintain remote areas and high diversity of habitats.
Black-backed Woodpecker	Alberta Environment: sensitive; dependent on old-growth forest and recent conifer burns; negatively-affected by fire suppression and salvage logging; Recommend: use of modified fire response strategies, minimize or eliminate salvage logging.
American White Pelican	Alberta Environment: sensitive; prefers shallow turbid lakes remote from human activities with good fish populations; colonies susceptible to human disturbance; Recommend: maintain undisturbed shorelines and remoteness of water bodies, protect fisheries.

F. Are any rare, threatened, or endangered species dependent on multiple ecosystems?
Yes. Such species would include Grizzly Bear, Peregrine Falcon, Whooping Crane, Wolverine, Western Toad, and Cougar (Table 12, habitat columns).

Assessment: Significance Global to Regional. Critical areas might be mapped through a combination of consultation with experts, caribou telemetry data, use of data contained in the Appendix Tables, and wildlife occurrence data.

Question 2.

Is your forest within an ecoregion that contains a concentration of endemic species?

Yes.

There are three species of endemic plants from the Athabasca Dunes known to exist in Alberta: Tyrrell's willow (*Salix tyrrellii*), sand dune chickweed (*Stellaria arenicola*), and Indian tansy (*Tanacetum bipinnatum* ssp. *huronensis*). Also, due to range shrinkage, the only wild, natural breeding population of the whooping crane is restricted to this ecoregion.

Sub-questions.

A. Does your forest contain critical habitat for endemic species?

Yes. The Athabasca Dunes (see Raup and Argus 1982, and Landals 1978). If the whooping crane is considered an endemic species, there is marsh, pond, and peatland breeding habitat in Wood Buffalo National Park which extends outside the park in the Northwest Territories (Timoney 1997, and 1999), and migratory stopover sites in northeastern Alberta and northwestern Saskatchewan.

B. Does your forest or ecoregion include >10% of the continental population for the species?

It is difficult to tell for the sand dune endemics, as most of the area appears to lie within ecoregion 93 (of Ricketts et al. 1999) in Saskatchewan. If the whooping crane is considered an endemic species, most of its population is contained in this ecoregion.

C. Are any of the endemic species found in your forest a keystone or focal species?

Yes. The Whooping Crane.

D. Are there several taxa represented among the endemic species?

There are four taxa (*Salix, Stellaria, Tanacetum,* and *Grus*).

E. Is there a concentration of endemic species in a single taxon?

No.

F. Are there any endemic species that are a top predator or focal species?

Yes. The Whooping Crane.

G. Are any endemic species dependent on multiple ecosystems?

Yes. The answer depends on how ecosystem is defined. The whooping crane depends upon a variety of habitat types for breeding within a wetland complex; chief habitats are bulrush marsh, shallow gypsum diatom ponds, mixed marshes, and shrubby mixed marshes (Timoney 1999). During migration, the birds presumably use similar habitats (with the possible exception of gypsum diatom ponds) distributed along the flyway in Alberta and Saskatchewan. One known whooping crane site is McClelland Lake which lies on the birds' flyway between their wintering grounds at Aransas, Texas and their breeding grounds in and near northern Wood Buffalo National Park. In spring 1994, a flock of 11 whooping cranes was recorded in the fen; there have been at least three records since (Thomas 2002).

Assessment: Global significance. Known critical areas would lie outside the Al-Pac FMA area.

There may be important stopover sites, and future potential breeding grounds, for the whooping crane and other species, but this question requires more work.

Question 3.

Is your forest within an area that contains critical breeding sites, migration sites, fly-ways, or seasonal concentrations of species?

Yes.

The Peace-Athabasca Delta is a well-known wetland of international importance to ducks, geese, swans, shorebirds, gulls and terns, and other wetland-dependent birds (Hohn 1973; Pollard et al. 2000). This mosaic of marshes, shallow lakes, ponds, mudflats, willow communities, and lowland forests is used for breeding, feeding, and staging depending on the species and season.

The Cumberland Delta (Saskatchewan) is of hemispheric importance to waterfowl, particularly for staging (Shay et al. 1999).

The Whooping Crane Nesting Area, in northern Wood Buffalo National Park and vicinity is the breeding and summering grounds for migratory whooping cranes (Timoney 1999).

Utikuma Lake (north of Lesser Slave Lake, AB) is an important waterfowl breeding and feeding/staging area (E. Butterworth, Ducks Unlimited, pers. comm., December 2002).

Loon Lake (west of the hamlet of Red Earth, AB) and Lubicon Lake (between Red Earth and Cadotte Lake) are important waterfowl feeding/staging lakes (E. Butterworth, Ducks Unlimited, pers. comm., December 2002).

Northeastern Alberta lies within a convergence zone for birds using the Mississippi, Central, and Pacific Flyways (perhaps some Atlantic Flyway birds use the area also) (E. Butterworth, Ducks Unlimited, pers. comm., December 2002). As such, the entire area is of continental importance to migratory birds.

Trumpeter Swan nesting lakes are known from at least four locations in the region: Mistehae Lake (west of Wabasca) and three lakes in the Lac La Biche area (S. Dyer, pers. comm., Al-Pac, December 2002).

The region supports some of the highest densities of breeding birds found in North America (F. Schmiegelow, pers. comm., June 2003).

Table 16 lists the locations, dates, abundance, and breeding codes of 16 rare Alberta breeding birds documented from the Alberta portion of Ecoregion 92. Table 17 provides a summary of the breeding records for these species.

Nesting occurrences are mapped in Figure 4. Clusters of breeding records are apparent near Ft. Vermilion (Peace River); near Tall Cree IR173 (Wabasca River); near Tall Cree IR173A (between the Peace and Wabasca Rivers); north of Peerless Lake; the east half of Lesser Slave Lake; between Lesser Slave Lake and Calling Lake; the east half of Lac La Biche; east and north of Lac La Biche; Cold Lake; and near Pelican Portage (Athabasca River). Whether these clusters are due to accessibility, to prime nesting habitat in these areas, to chance, or to all three factors is not clear. It is clear, however, that the Lac La Biche area is well known for its rich bird fauna. The area supports circa 264 bird species, with many noteworthy birds documented, including Turkey Vulture, Trumpeter Swan, Surf Scoter, Whooping Crane, Hudsonian Godwit, Caspian Tern, Northern Hawk Owl, Great Gray Owl, Boreal Owl, Three-toed Woodpecker, Black-backed Woodpecker, Say's Phoebe, Warbling Vireo, Purple Martin, Brown Creeper, Sedge Wren, Cape May Warbler, Western Meadowlark, Red Crossbill, and Hoary Redpoll (Thomas and Klauke 2001). The lake itself was

designated an Important Bird Area in 2001 (Thomas and Klauke 2001).

Table 17. Summary of breeding records of 16 rare Alberta birds in boreal northeastern Alberta. Breeding codes: X - species observed, but no indication of breeding; P - pair observed in suitable nesting habitat; FL - recently fledged or downy young observed; T - territory assumed through territorial nesting behavior; CF - adult seen carrying food or fecal sac for young; H - species observed or breeding calls heard in suitable nesting habitat; NY - nest with young. Data provided courtesy of the Federation of Alberta Naturalists, Edmonton, January 2003. Provincial ranks after Alberta Environment (2001).

Species	Highest Breeding Evidence	Total Abundance	Total Records	Provincial Rank
American White Pelican	P	245	17	Sensitive
American Bittern	X	1	1	Sensitive
Trumpeter Swan	FL	29	3	At risk
Peregrine Falcon	X	1	1	At risk
Sandhill Crane	P	197	24	Sensitive
Black Tern	FL	445	33	Sensitive
Short-eared Owl	X	1	1	May be at risk
Black-backed Woodpecker	P	25	15	Sensitive
Pileated Woodpecker	T	81	44	Sensitive
Brown Creeper	P	166	44	Undetermined
Cape May Warbler	FL	119	31	Sensitive
Black-throated Green Warbler	NY	278	42	Sensitive
Blackburnian Warbler	NY	30	10	Sensitive
Bay-breasted Warbler	CF	204	35	Sensitive
Canada Warbler	H	84	22	Sensitive
Western Tanager	CF	280	61	Sensitive

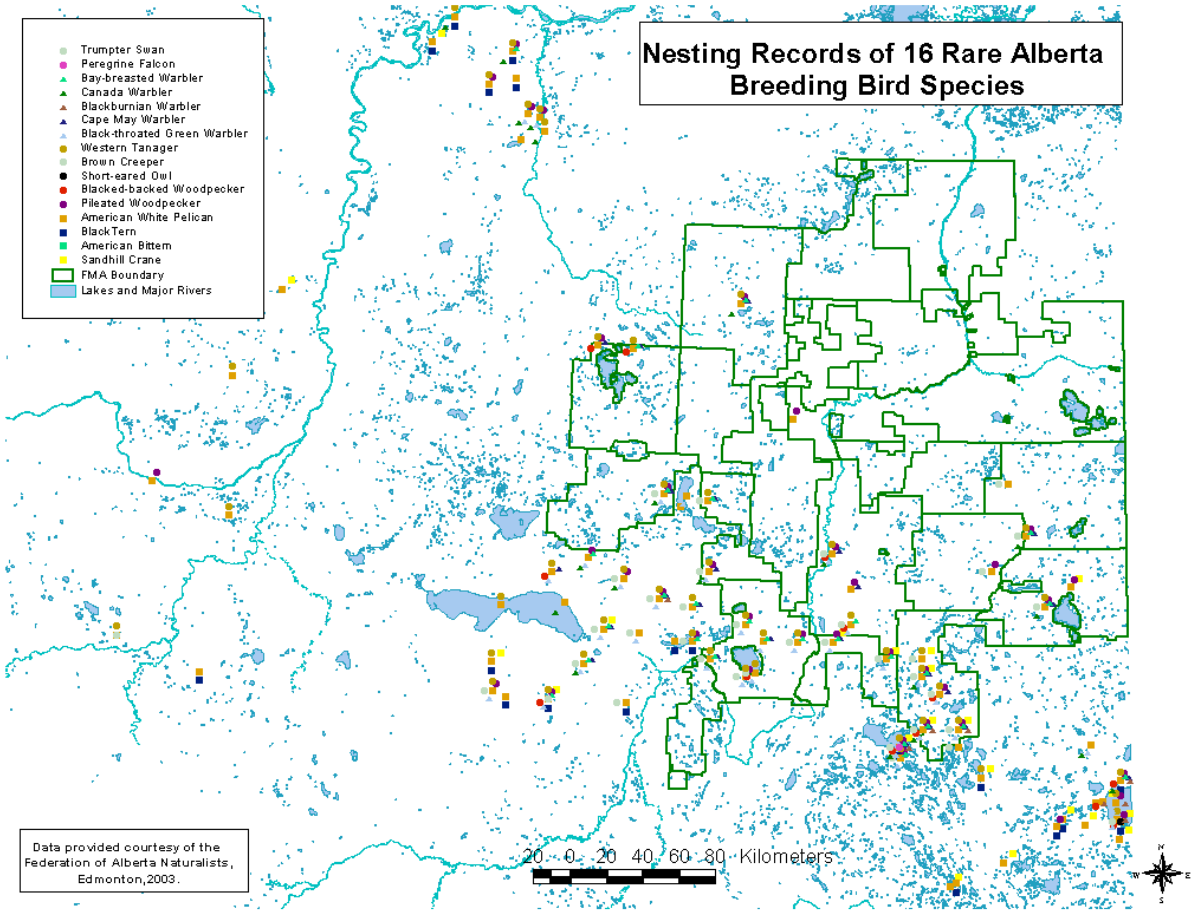


Figure 4. Nesting records of 16 rare Alberta breeding bird species in the vicinity of the Al-Pac FMA. Data courtesy of the Federation of Alberta Naturalists.

Sub-questions.

A. How protected are similar critical breeding areas, etc. within the region?

The Whooping Crane Nesting Area and Peace-Athabasca Delta are protected within Wood Buffalo National Park. The other significant areas noted above remain unprotected. Utikuma, Loon, and Lubicon all lie within areas of intense oil and gas activities (Figure 5).

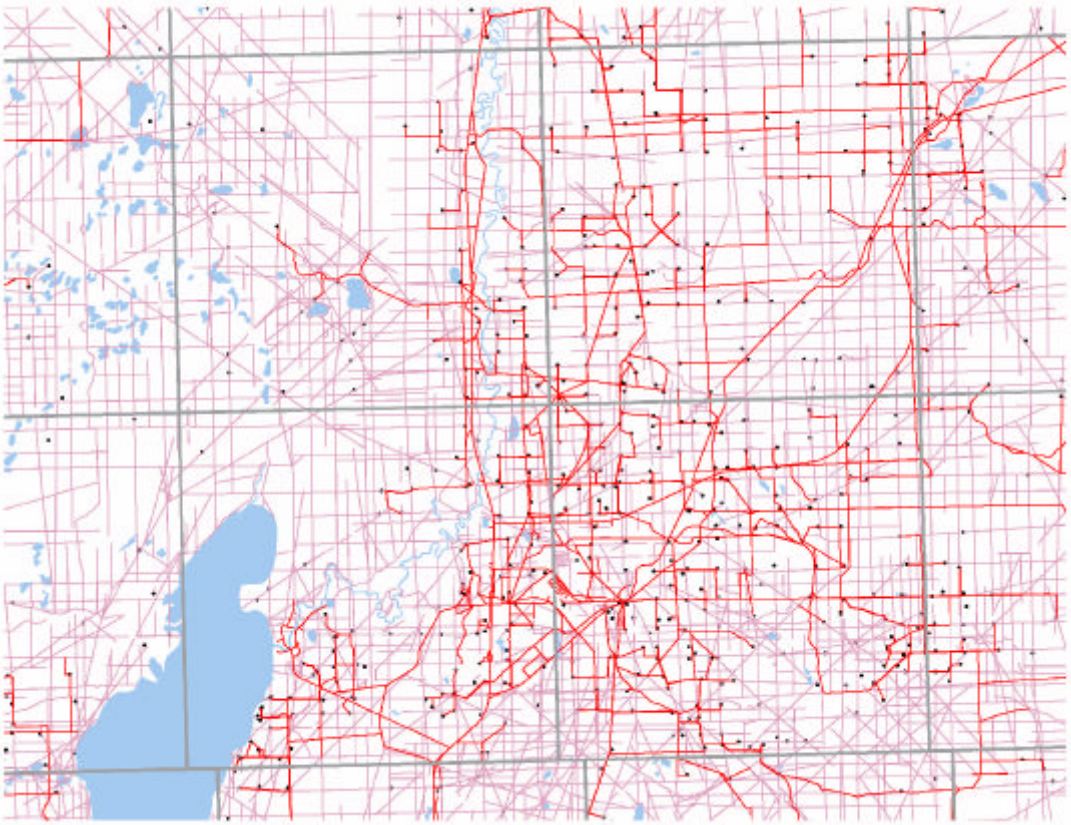


Figure 5. Linear disturbances in the vicinity of Red Earth, with Loon Lake in lower left. Each gray box measure one township (6 by 6 miles). View is centered on Twps 87 and 88, Rges 8 and 9 W5. Dark Red = Roads and Utility Corridors, Light Red = Cutlines, Black Dots = Wells (both active and abandoned). Image courtesy of ANHIC, Edmonton, Alberta.

B. What proportion of the global, regional, or national population uses the staging/migration area?

Utikuma Lake supports roughly 5% of the continental population of breeding Western Grebes (E. Butterworth, Ducks Unlimited, pers. comm., December 2002).

The Whooping Crane Nesting Area supports the entire world breeding population of wild migratory whooping cranes (Timoney 1999).

Assessment: Global to regional. The globally significant areas lie outside the FMA area (Peace-Athabasca Delta, Whooping Crane Nesting Area). The nationally/hemispherically significant areas (Cumberland Delta, Utikuma Lake) lie outside the FMA area. Some nationally or regionally significant areas lie within the FMA area (Loon Lake, Lubicon Lake, Trumpeter Swan nesting lakes, Northeastern Alberta migratory flyway). These latter sites, along with the breeding bird records from Table 16, could be mapped. Major river valleys are known for their seasonal concentrations of mammals, and support and provide connectivity for the region's fishes. More work needs to be done.

Question 4.

Does your forest support concentrations of species at the edge of their natural ranges or outlier populations?

Yes.

Eighteen focal species and community types were classified as vulnerable due to range edge considerations, e.g., Loggerhead Shrike, Short-eared Owl, Shortjaw Cisco, Sprague's Pipit, Pygmy Whitefish, Western Toad, Logperch, and white spruce / *Cetraria islandica* (Table 12, Edge Vulnerability column). In addition, many more focal species are at their range edges or exist as outlier populations, such as pitcher plant, willow ptarmigan, fringed milkwort, beaked sedge, and communities including four boreal dry grassland types dominated by slender wheat grass, porcupine grass / snowberry, jack pine / northern rice grass, Drummond's willow / bulrush, and tamarack / prairie sedge (Table 12 and Kershaw et al. 2001).

Sub-questions.

A. What are the existing legal requirements for managing these species and communities?

The degree of legal protection varies by land 'owner' rather than by degree of threat. The recently-passed federal Species at Risk Act (SARA, Bill C-5) protects the habitats of only those at-risk species living on federal lands or waters, leaving most habitats and their species unprotected in any formal way. Species, communities, and ecosystems in national parks, e.g., Wood Buffalo National Park, are given *de facto* protection regardless of risk status. On Alberta crown land, species deemed at-risk may be considered under management plans, but such plans are not legally binding and conflicts between resource extraction and conservation seldom result in outcomes acceptable to the conservation community. The Alberta Wildlife Act prohibits killing of non-game species, but the Act does not protect habitat.

B. Are there several taxa of range edge and/or outlier species?

Yes.

In addition to the focal elements noted above, many rare, non-focal elements are at their range

edge or are disjunct, e.g., northern fringed gentian, mouse-ear cress, globe bur-reed, stemless lady's slipper, northern slender ladies'-tresses (Kershaw et al. 2001), and Arctic lamprey (*Lampetra japonica*, Slave River near NWT/Alberta border; Table 5). Some elements appear to be so rare it is not possible at present to determine whether the element is disjunct/outlier or endemic, e.g., interior patterned saline marsh and gypsum diatom pond. The northernmost known bat hibernacula in North America are located within this ecoregion in Manitoba (Shay et al. 1999).

C. Are any range edge and/or outlier species dependent on multiple ecosystems?

This depends upon the definition of ecosystem and whether disjunct areas of the same habitat classify as multiple ecosystems. This category would include species such as globe bur-reed (cool lakes, ponds, slow streams), stemless lady's slipper (wetlands, woods, sand dunes), and tall blue lettuce (moist woods, clearings, swampy sites, clearings) (Kershaw et al. 2001).

D. Is the population of the range edge and/or outlier species viable or locally at risk?

The answer depends on the species. In many cases, it is probably not possible to answer this question as data are lacking. Certainly, some of the species noted above appear to be at risk due to extreme rarity and/or population declines (e.g., Loggerhead Shrike, Sprague's Pipit, Western Toad).

Assessment: Global to regional. Some of the range edge species are of global significance (e.g., Sprague's pipit). Occurrences of many of the species at their range edges could be mapped from the Appendix Tables, but the occurrences of range edge communities require much documentation before maps could be prepared.

Question 5.

Does the forest contain concentrations of regionally rare species?

Yes.

Clustering of peregrine nests is shown at Utikuma Lake, in the vicinity of the west end of Lake Athabasca, the Peace River, and in the Slave R / NWT border (along with whooping crane nests) in Figure 6. Both of these species are globally/nationally rare rather than regionally rare. Clustering of rare species is shown in Figure 6 in the sand hills between Ft. McMurray and the Athabasca River Delta, along the Clearwater and Athabasca Rivers, and along transportation corridors south of Lesser Slave Lake, the Hondo area between Lesser Slave Lake and Calling Lake, and between Lac La Biche and Cold Lake (including the Lakeland area). Many of these species would be regionally rare (S2, S2S3, S3 rank). Clustering of rare element occurrences is linked to river valleys, wetlands, aquatic habitats, old-growth forests, and sand dunes. Some of the clustering in other cases would may be due to observation effort as accessible areas are better known than isolated areas.

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Sub-questions.

A. Are there several taxa represented among the species?

Yes.

Many taxa are represented in the set of regionally-rare Alberta species. If regionally rare is defined as species of S2, S2S3, or S3 status, several examples are: *Aloina, Artemisia, Botrychium,*

Brachythecium, Bryum, Campylium, Carex, and *Cladonia* (Table 5).

Many regionally rare species are missed in the process of filtering to provincial S1, S2, etc. status. Because species distributions are non-random across the province, many species are common in one area and absent or rare in another. The majority of species is not rare in the province, by the strict number of provincial occurrences, but may be rare or absent from large portions of the province. Within the boreal forest there is a host of species whose geographic distribution is centered in other regions, such as in Grassland, Foothills, Montane, Subarctic, or Alpine/Subalpine ecoregions, and whose presence in the boreal ecoregion is related to particular habitats, natural disturbances, relict status, or to chance.

Some examples of species that are rare within the boreal region but common elsewhere are: *Calamovilfa longifolia* (sand dunes), *Sporobolus cryptandrus* (eroding dry sands), *Agropyron albicans* and *Stipa richardsonii* (droughty, open sites), *Monolepis nuttalliana* (salt plains), *Salix drummondiana* (subalpine floodplains and shores), *Scolochloa festucacea* (marshes) (Moss 1983); Clay-colored Sparrow (brushy fields), Sharp-tailed Sparrow (sedge marshes with scattered willows) (Semenchuk 1992); Bronze-copper Butterfly (*Lycaena hyllus*, in sloughs and along stream margins near host plant *Polygonum;* Bird et al. 1995); Western Jumping Mouse (moist meadows bordered by shrubs, or along streams) and Long-tailed Weasel (grasslands, parklands, and open conifer forest; Smith 1993). These elements of regional biodiversity can be lost when uncommon habitats are lost.

B. Is there a concentration of species in a single taxon?
Yes.

Some taxa contain several species, such as sedge (*Carex*), reindeer lichen (*Cladonia* and *Cladina*), pondweed (*Potamogeton*), peat moss (*Sphagnum*), *Splachnum* moss, grape fern (*Botrychium*), rush (*Juncus*), dog lichen (*Peltigera*), *Ramalina* lichen, and *Bryum* moss species. Some of these species within these would be provincially rare (S1) rather than regionally rare.

C. Are there any species that are top predators or focal species?
Yes.

Regionally rare species that are top predators or focal species include Cougar, Fisher, and Sandhill Crane (Table 12).

D. Are any species dependent on multiple ecosystems?
Yes.

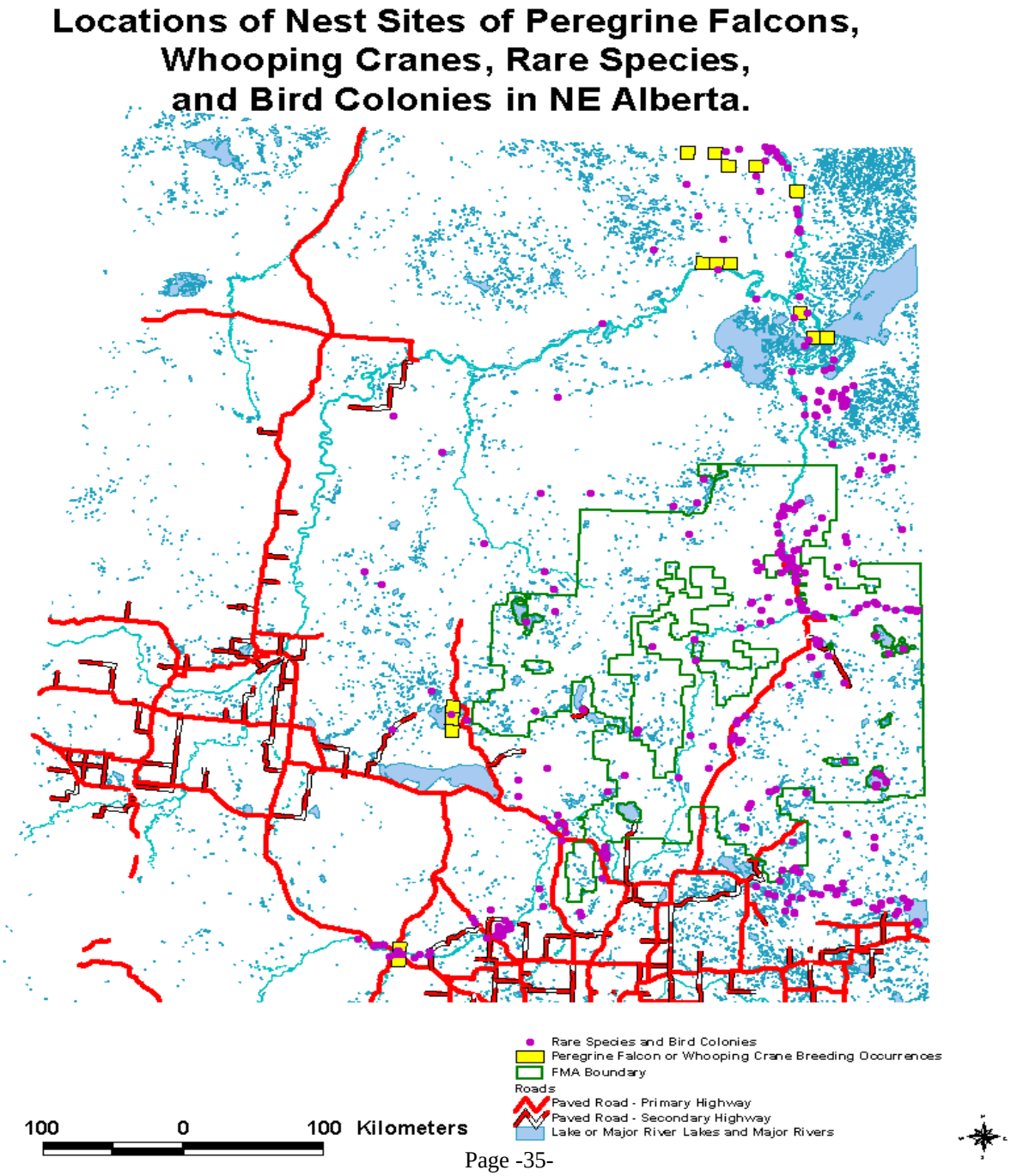
Many of these species would be dependent on multiple ecosystems, including Cougar, Pileated Woodpecker, and Lynx.

E. Is the population of each species viable or locally at risk?

In many cases, it is probably not possible to answer this question as data are lacking. Some of the species noted above may be at risk due to rarity of appropriate habitats or sensitivity to human disturbance.

Assessment: Regional significance. Occurrences of many of the species noted above are mapped in Figure 6. Occurrence maps of individual species or species groups could be prepared from the Appendix Tables.

Figure 6. Locations of nest sites of peregrine falcons, whooping cranes, rare species and bird colonies in NE Alberta.



Question 6.

Does the forest contain critical habitat for species that are regionally in decline?

Yes.

A detailed response to this question would demand a great deal of searching and interviews with experts. In many cases, there would be insufficient temporal population data to answer the questions with precision. For the purposes of providing documentation for the affirmative response above, it is noteworthy that declines of Cougar, American Bittern, Black Tern, Short-eared Owl, Sprague's Pipit, Northern Leopard Frog, Canadian Toad, Western Toad, and boreal Woodland Caribou have been documented (Table 12).

With regards to Woodland Caribou, decadal-scale declines have been documented for the 'East Side Athabasca River', 'Red Earth', 'Caribou Mountain', and the CLAWR (SK) western boreal caribou populations by Dzus (2001). Woodland caribou telemetry locations and management zones in or near the FMA area are shown in Map 7.

Sub-questions.

A. Is the regional population decline >50%?

Difficult to determine in most cases.

Sprague's Pipit: A population decline of circa 53% was noted from 1975 to 1985 in Canada (IUCN 2002).

Black Tern: Serious, long-term declines across Canada (Peterjohn and Sauer 1997)

Canadian Toad: declined from about 1971 to mid-1980s, but percent unknown (Russell and Bauer 1993).

Grizzly Bear: This bear is rare in boreal Alberta, and grows increasingly rare in general from west to east across the province. In northeast Alberta, there were six documented sightings from 1988 to 2001, with five of the last six sightings between 2000 and 2001 (S. Dyer, pers. comm. 2002). With such rarity, it is difficult to determine a trend. Farther west, and northwest, particularly in boreal highlands, the Grizzly Bear is seemingly more abundant (see Kansas 2002). Figure 7 shows the aforementioned grizzly bear locations, in addition to important fishery areas. Kansas (2002) estimated that grizzly bears in Bear Management Area 1 (primarily, boreal northwestern Alberta) increased from 1988 to 2000. The Al-Pac FMA areas lies outside of Alberta provincial bear management areas, and thus outside of any regular data gathering. Therefore population trend in the area is unknown. A low density across a vast area would indicate the species is vulnerable to extirpation. Grizzly bears in the area may be suffering high mortality (e.g., being shot); their abundance and range might be larger if mortality rates were lower, but more study is needed to test this notion.

B. Is the regional decline due primarily to human impacts?

Cougar: nationally and internationally, persecution (pest control), and degradation of habitat and prey base have been noted as contributing to decline (IUCN 2002). The regional population trend in unknown.

Black Terns: habitat loss (McGillivray and Semenchuk 1998).

Sprague's Pipit: habitat loss or degradation due to agriculture, invasive alien species (IUCN 2002)

Northern Leopard Frog: pesticides, herbicides, habitat loss due to conversion of ponds to reservoirs, stocking with predatory fish, and pond drawdown (Russell and Bauer 1993; Finch 1992).

Western Toad: population trend in Alberta is unknown, but declines in parts of it range elsewhere

have been linked to pollution (Russell and Bauer 1993)

C. Is the species population viable or locally at risk (e.g., population trend is in decline rather than stable or improving)?

Difficult to determine. Within each of the boreal meta-populations, there may be viable and nonviable populations. Additional work is required.

D. Does habitat suitability mapping identify areas within the management unit that can support the declining population?

I did not find any habitat suitability mapping of the above species. Such maps may exist.

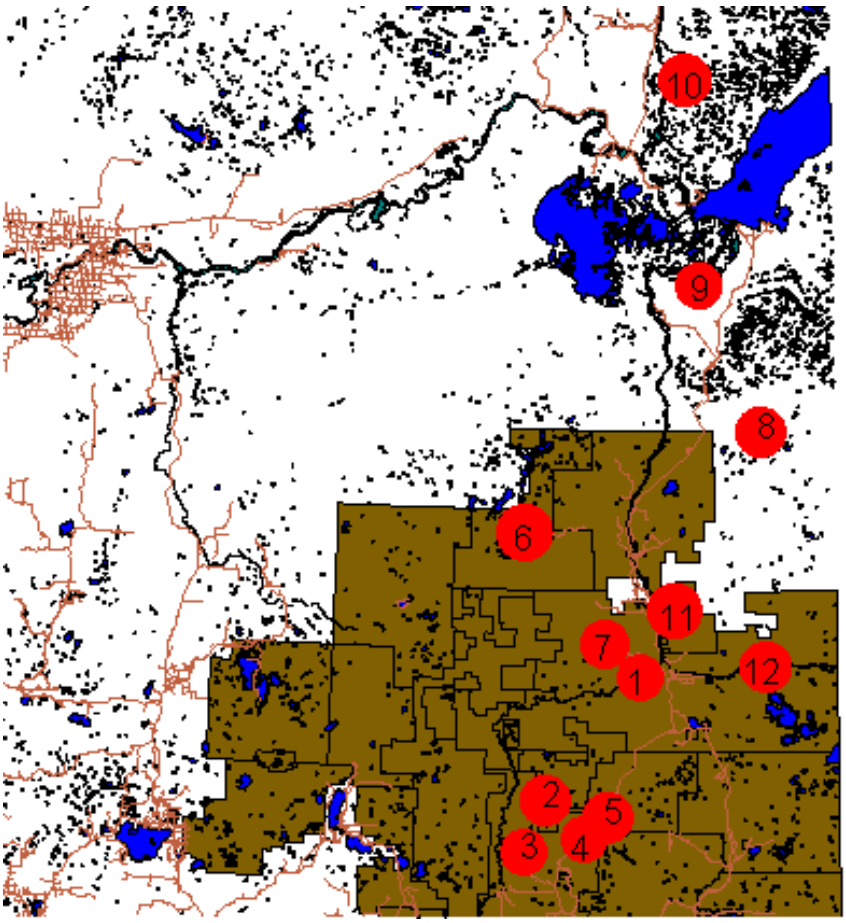


Figure 7. Distribution of selected special features in northeast Alberta. 1 = Cascade and Mountain Rapids, Athabasca River (upstream of Ft. McMurray), spawning area for lake whitefish. The Athabasca River is an important overwintering area for fishes of tributaries; Near Ft. McMurray, last known occurrence of brassy minnow (*Hybognathus hankinsoni*); 2 = grizzly bear seen from helicopter (T82, R15, W4, 7 May 2000); 3 = grizzly bear over bait killed by outfitter's client (T79, R16, W4, 7 May 2000); 4 = grizzly bear tracks at Mariana Lakes garbage pit, June 2001; grizzly was seen by several people); 5 = grizzly bear seen tearing into trapper's cabin (T81, R12, W4, 26 July 2000); 6 = upper third of Ells River important area for arctic grayling; 7 = grizzly bear snared near Thickwood Tower (T90, R12, W4, 1988); 8 = grizzly bear observed (T101, R4, W4, 13 July 2000); 9 = Richardson Lake, important spawning area for walleye, and important stopover lake for the rare Ross's goose (Fuller and La Roi undated); 10 = Barrow Lake, only known location for shortjaw cisco in Alberta; 11 = Steepbank River (north of Ft. McMurray), and 12 = High Hill River (east of Ft. McMurray, tributary of Clearwater R.): both rivers support spawning populations of arctic grayling. Fish notes after L. Rhude, Alberta Fish and Wildlife Division, Ft. McMurray, pers. comm. December 2002; grizzly bear notes from R. Ramcharita, Alberta Govt. biologist, northeast region, provided courtesy of S. Dyer, Al-Pac, December 2002.

Assessment: Regional significance. Some of the data are mappable (e.g., occurrences of Sprague's pipit). Locations for some species in regional decline that occur in the forest management area are provided in Tables 1 and 16. Additional work is needed to answer this question fully.

Question 7.

Does the forest lie within or contain a conservation area designated by an international authority?

Yes.

Note that the presence of a conservation area designated by an international authority constitutes a high conservation value.

UNESCO World Heritage Sites

Wood Buffalo National Park, straddling the border of Alberta and the Northwest Territories is a UNESCO World Heritage Site designated in 1983. It spans circa 44,800 km^2 (UNESCO 2002).

Ramsar Sites

Two Ramsar wetlands of international significance lie within northern Alberta, both of which are located in Wood Buffalo National Park. These sites are the circa 3,213 km^2 Peace-Athabasca Delta and the circa 16,895 km^2 Whooping Crane Summer Range. Both were designated as Ramsar Sites in 1982. Additionally, a third area lies northwest of the study area in northwestern Alberta (within Ecoregion 90 of Ricketts et al. 1999): the 500 km^2 Hay - Zama Lakes wetland complex (Ramsar 2002).

International Biological Programme (IBP) Sites

During the 1970s, the International Biological Programme sampled a worldwide network of sites in an effort to advance scientific knowledge of the planet's ecosystems. In Alberta, 242 sites were documented, of which circa 156 sites are located in Alberta's "boreal" region (in that classification, boreal included foothills and aspen groves and parklands; La Roi and Babb 1979). Detailed sample and location data are stored presently at the University of Alberta Archives in Edmonton. Some of the sites are provincial natural areas; for these sites there will be additional data stored at ANHIC (Edmonton). Only a small number of these sites (~15?) are located within the Al-Pac FMA area, but the exact number can be determined only after precise coordinates are ascertained. The check sheets for boreal Alberta were copied and sent to Al-Pac for incorporation into its database.

Each check sheets lists some or all of the following: area name, sample date, size, elevation, NTS map sheet, conservation status, administrative classification, plant community types, significant plant species, representative animal species, special biological features, landscape types, soils, aquatic habitats, physical features, human impacts, access, information contact, and surveyor names.

Much of the information on the check sheets is brief and general. However there is potential that many of the sites might serve as benchmarks of ecological change as the sample information was gathered circa 24-33 years ago. The archives may contain a wealth of data of scientific and management interest. Given this potential, the IBP sites should be noted along with the UNESCO and Ramsar as sites that contribute to high conservation value.

Sub-questions.

A. Why was each area designated?

UNESCO World Heritage Sites are designated for their globally outstanding contribution to natural and human heritage. Outstanding features of Wood Buffalo National Park include the large boreal inland Peace-Athabasca Delta, world's largest herd of free-roaming Wood Bison, migratory Whooping Cranes and their only nesting area, Peregrine Falcons, the Slave and Peace River valleys, riparian old-growth forests, karst topography, a high diversity of wetland types (some of which may be unique), intact predator-prey relationships, and intact ecosystems.

Ramsar sites are designated as globally outstanding examples of wetlands. The Whooping Crane Summer Range was designated for its function as the nesting ground of the only wild, migratory flock of the endangered Whooping Crane. The Peace-Athabasca Delta was designated as an outstanding example of a large boreal inland delta, for its support of hundreds of thousands of waterfowl and as the main range of Wood Bison in Wood Buffalo National Park. The Hay-Zama Lakes Wetland complex was designated for its support of hundreds of thousands of waterfowl, and as a large wetland complex of lakes, floodplains, and deltas.

IBP sites were designated because of a potential to contribute to scientific knowledge of the world's ecosystems.

B. What should be done to ensure that these values are maintained?

The UNESCO and Ramsar Sites within Wood Buffalo National Park. are protected under federal legislation. The Hay-Zama Lakes have an Alberta Fish and Wildlife Crown designation which may be insufficient protection in light of the petroleum reserves under exploitation. Most of the IBP Sites are Alberta Crown land (some of which are Natural Areas, others reserved Crown land, some are in provincial parks), some are on federal holdings, and some are private. Other than for the natural areas on federal land, there is inadequate protective legislation for these sites. Due to discontinuation of the IBP, agencies and the public might be unaware of the international designation of the majority of these sites. All of the sites, which are usually smaller than 200 ha, should be protected from oil and gas extraction, logging, mining, and intensive domestic grazing.

C. What are the legal requirements for managing each area and maintaining the values?

Legislated protection would be necessary for protection of the IBP sites. On Alberta Crown land, this would require a protective notation based on scientific and natural heritage value.

Assessment: Global (to regional?). The UNESCO and Ramsar sites are located outside the forest management area. These areas are protected, for the most part, within Wood Buffalo National Park. But the Whooping Crane Nesting Area extends outside the park into the Northwest Territories and the Hay-Zama protection status is compromised by ongoing oil and gas activities. Mapping the location of the IBP sites would require work at the University of Alberta Archives in order to procure coordinates. While the IBP sites were designated by an international authority, some of the sites may be more significant than others. Further work is needed to determine whether any of the IBP sites lie within protected areas and what is the

conservation/scientific value of the sites.

Question 8.

Does the forest management unit lie wholly or partly within a protected area or area proposed by a relevant legislative body for future protection?

Yes. Map 1 shows the location and extent of 35 proposed 'best prospects' for protected areas in boreal Alberta based on a report prepared for the Special Places 2000 Provincial Coordinating Committee, a program of the Alberta government. These 'best prospects' are a subset of the environmentally significant areas of boreal Alberta. Map 2 shows the distribution and significance levels of environmentally significant areas in the region. An excellent additional source for detailed information on environmentally significant areas of northeastern Alberta (essentially the Al-Pac FMA area) is that of Westworth and Associates (1990) who identified 234 sites of significance (three national, 44 provincial, and 187 regional). Their descriptions and series of large-scale maps should be examined for HCVF attributes.

One of the stumbling blocks to achieving protected status for many of these areas is that much of northeastern Alberta has been leased to the petroleum and mining industries (Figure 8). Such resource leases present a problem for Al-Pac in that the company does not have management control of its forest management area. The problem of multiple tenure lies beyond the scope of this study but is an overarching concern influencing the fate of the HCVF features in the ecoregion.

Sub-questions.
The forest manager would be expected to understand:

A. Why is the area proposed for protection?

World Wildlife Fund (1998) identified 32 priority protection areas in the boreal forest region of Alberta (Table 18, Map 1). See Table 18 for a list of the areas proposed and Map 1 to compare the recommendations for protection with the current state of protection. The ANHIC office in Edmonton would have detailed ecological information for many if not all of the areas.

B. What should be done to ensure that these values are maintained?

The management requirements would be specific to each protected area. These would include protection of fragile dune habitats, riparian connectivity, wetland water regimes, old-growth forests, and river reaches.

C. What are the legal requirements for managing these areas and maintaining these values?

The legal requirements would depend on the protective designation of each site.

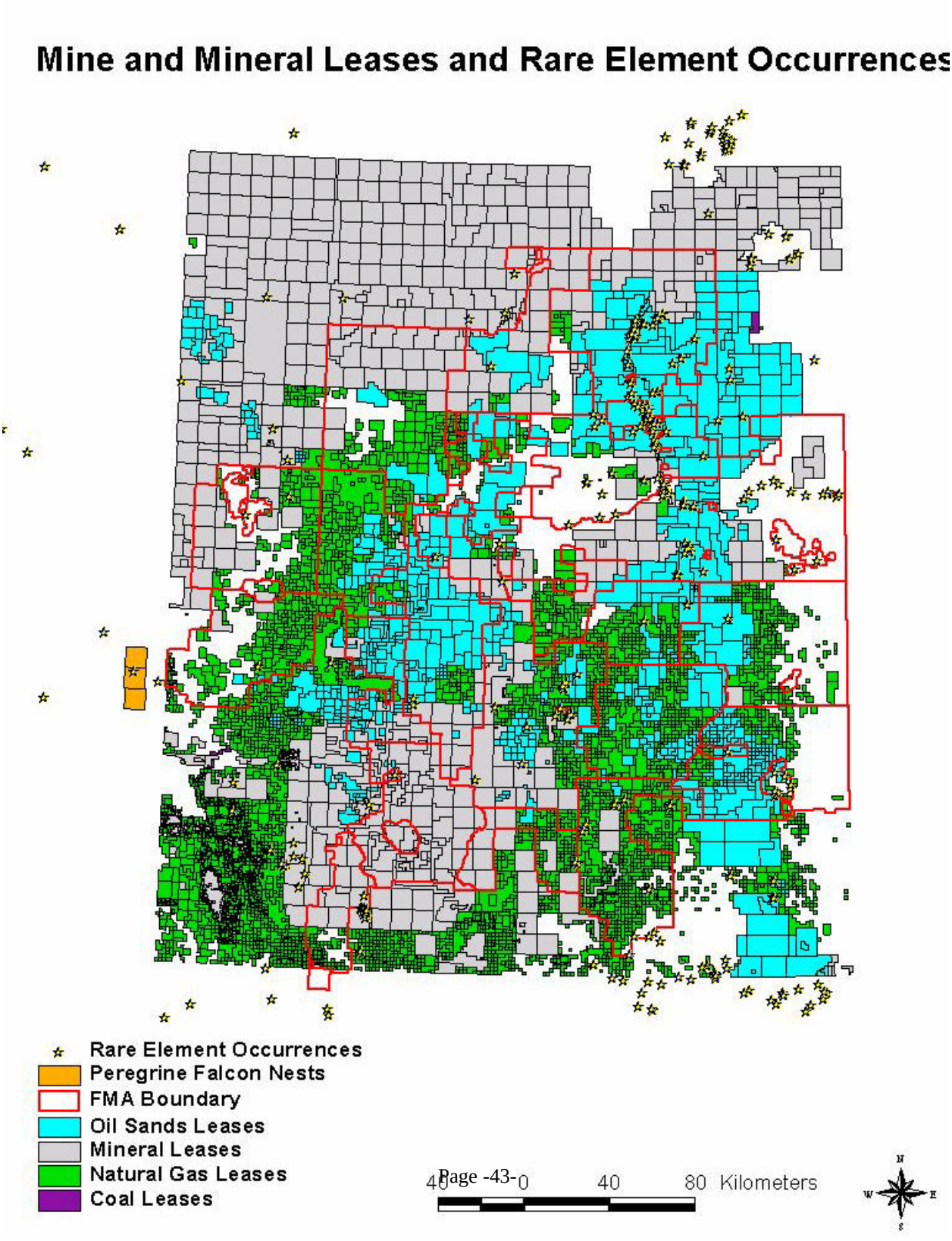
Assessment: Global to regional. The globally and nationally significant potential protected areas and environmentally significant areas lie, for the most part outside the forest management area. The major exception in this regard is the nationally significant Athabasca and Clearwater Rivers (Map 2).

Table 18. Key Landscape Areas of Interest, by Boreal Subregion (abbreviated from Table 19 of World Wildlife Fund 1998).

Area	***Subregion**	**Km^2**	
Athabasca Rapids	1	2990	
Birch-Wabasca	1	4535	
Clearwater-Gypsy-Gordon	1	2503	
Crow Lake	1	112	
Firebag	1	1264	
Harper	1	401	
Marguerite-Kame	1	227	
Martin Mountain	1	105	
Maybelle-Delta	1	655	
McClelland	1	300	
Primrose	1	5663	
Stony Mountain	1	248	
Trout Delta	1	206	
Total, Subreg %		*19,209*	*12.4%*
Amisk	2	526	
Cache Creek-Wolverine	2	1515	
Caribous	2	374	
Martin Mountain	2	31	
Pouce Coupe	2	14	
Primrose	2	23	
Total, Subreg %		*3,440*	*3.4%*
Caribous	3	159	
Hay-Zama	3	418	
Lower Chinchaga	3	465	
Upper Chinchaga	3	359	
Total, Subreg %		*1,401*	*3.6%*
Birch-Wabasca	4	3270	
Bistcho	4	2456	
Caribous	4	5737	
Total, Subreg %		*11,463*	*52.1%*
Maybelle-Delta	5	964	
Slave River	5	599	
Total, Subreg %		*1,564*	*15.6%*
Birch-Wabasca	6	5698	
Caribous	6	651	
Stony Mountain	6	431	
Trout Delta	6	154	
Total, Subreg %		*6,934*	*32.7%*

* 1= Central Mixedwood, 2 = Dry Mixedwood, 3=Wetland Mixedwood, 4=Subarctic, 5 = Peace River Lowlands, 6=Boreal Highlands

Figure 8. A view of rare element occurrences in the Al-Pac FMA area in the context of mine and mineral leases. Note that the majority of peregrine nests, and all whooping crane nests, have been trimmed from this view as they occur outside of the Al-Pac FMA area.



Question 9.

Does the forest lie within or contain a conservation area identified in regional land use plans or conservation plans?

Yes. The largest of these is Wood Buffalo National Park which dwarves all the other areas combined. Within the ecoregion, there are several provincial parks (e.g, Lakeland, Ft. Assiniboine Sandhills, Notikewin), ecological reserves (e.g., Lake Athabasca Dunes, Holmes Crossing Sandhills), wildland parks (e.g, Birch Mountains, Marguerite River) and natural areas (e.g., Pine Sands, Sand Lake). See Figure 40 in Thomas (1998) for details.

Sub-questions.

The sub-questions under this topic are expectations of the manager to evaluate documentation to determine if HCVs are present in the protected areas, to understand the planning process so that HCVs are not impacted, and to evaluate the areas in the context of gap analysis.

Map 3 presents a gap analysis of adequacy of protection conducted by World Wildlife Fund (Toronto). In general the analysis shows that the southern and western portions of the natural regions that intersect the FMA area have 'little or none' or 'partial' protection. The more northerly areas are better protected, principally due to the presence of Wood Buffalo National Park. Within the FMA area proper, much of the area is covered by 'partial' protection, with lesser amounts of 'little or none', 'moderate' and 'adequate' protection.

Whether the adequate protection afforded by Wood Buffalo National Park and vicinity is relevant to the FMA area is a matter for discussion. Much of the area mapped as 'adequate' lies within Peace River Lowlands, Sub-Arctic, Wetland Mixedwood, and Boreal Highland natural regions which are not represented or are little represented within the FMA area. The key to adequacy of protection is the Central Mixedwood which is areally dominant in the FMA area.

Assessment: Regional significance. There are several existing protected areas in the FMA area. See Maps 1 and 3 (and Figure 40 in Thomas (1998)) for details.

Question 10.

Does the forest constitute or form part of a forest landscape that is natural/near natural in terms of species composition, stand structure, and habitat composition (in terms of original intact forest)?

The brief answer is yes, but the answer differs within the ecoregion.

Deviation from a natural species composition, stand structure, and habitat composition is proportional to the type, history, intensity, and extent of anthropogenic disturbance. Landscapes that have been disturbed by oil and gas activities, logging, agriculture, settlement, etc. differ from those that have been disturbed by fire, flooding, wind, insects, disease, herbivory, etc. This fundamental dichotomy is central to the above question as natural and anthropogenic disturbances are not interchangeable. While all ecosystems on Earth are disturbed to some degree, natural disturbances are integral to the suite of processes that determine ecosystem structure and function. 'Naturalness' is not an all or none phenomenon, but rather a gradient from systems in which human effects are

minimal (essentially undetectable) to systems which are thoroughly artificial.

Continuous phenomena are common in nature, but humans often need discrete categories for the purposes of discussion and decision making. At some point along the complex disturbance gradient, humans decide when a system passes from natural to anthropogenic. Where that point is reached depends upon knowledge of the system and upon human values and expectations. Similarly, for ease of discussion, since natural disturbances are implicit, communities subject to natural processes only may be referred to as 'undisturbed', while those subject to anthropogenic disturbances may be referred to as 'disturbed.'

From a simple numeric standpoint, the majority of the ecoregion should be at a natural or near natural species composition as the area disturbed by oil and gas activities, logging, and agriculture is still exceeded by natural community cover. This is not to say that the current level of disturbance is not having significant impacts upon landscape function— due in large part to habitat loss, dissection, fragmentation, barriers to movement and dispersal, disturbance to water regimes, etc.

Species composition after anthropogenic disturbance would differ from natural conditions in proportion to the type, severity, scale, and frequency of the disturbance (Paine et al. 1998; Frelich and Reich 1998). In particular the degree of soil disturbance, the abundance of remnant biological legacy (e.g., soil organic matter and biota, snags, logs), near and on-site refugia, and viable propagules, the size/isolation of the disturbed patch, and distances to sources of recolonization determine in large part how the post-disturbance community differs from that of the pre-disturbance community (see e.g., Wiensczyk et al. 2002). The largest changes would be observed in communities converted to well sites, facilities, and roads, or those converted to annual agricultural crops, followed by land seeded to forage, or clearcut and site-prepared, followed by those converted to seismic lines.

Stelfox et al. (undated) observed increases in dandelion, smooth brome, and Kentucky bluegrass, and decreases in mosses and lichens in scarified cutblocks relative to undisturbed mature mixedwood forest. Boreal riparian forest plant species composition has been shown to differ between natural and logged communities decades after logging (Timoney et al. 1997a). Plant community composition has been observed to differ between post-harvest and post-fire up to 60 years after disturbance (Crites 1999). Decades-long differences in bird communities between post-fire and post-harvest western boreal forests have been demonstrated (Hobson and Schieck 1999). Spider communities may converge in post-fire and post-harvest forests after about 30 years (Hannon and McCallum 2002, Table 4). Fires lead to forests with different structure than those subjected to harvest, and this has important implications for sustainable forestry practices and for biodiversity conservation, e.g., of invertebrates (Spence et al. 1997).

Long-term succession on seismic lines similarly raises concerns. Conversion to persistent shrubs (primarily willows and river alder), grasses, and exotics (such as smooth brome, timothy, red fescue) is common (Timoney and Lee 2001). Tree regeneration and growth on seismic lines may be slow; seismic lines may be removed from forest production for up to one full logging rotation (Environment Council of Alberta 1979; Revel et al. 1984). Specific to Al-Pac FMA area, MacFarlane (1999) observed poor tree growth on seismic lines and well sites. Tree growth on seismic lines was negatively correlated with degree of disturbance, and on wellsites was negatively correlated with grass and herb cover. MacFarlane (1999) noted that the Al-Pac FMA area contained circa 62,915 ha of seismic lines and Al-Pac (2000) estimated circa 68,506 ha of seismic lines and 13,000 ha of wellsites. Schneider et al. (2003) estimated a wellsite/oil sands footprint of 21,345 ha, composed of 15,516 ha of wellsites (based on a 90 by 90 m wellsite size) and 5829 ha of oil sands mines.

Sub-questions.

A. Compare the species composition with 'natural' benchmarks or potential vegetation estimates (i.e., deviation from expected distributions).

In order to address this topic directly, a comparison of Alberta permanent sample plot composition data within and outside the region would be required. This would allow an evaluation of deviation from expected conditions, but such an analysis is beyond the scope of this study.

A priori, there is no reason to suspect that species composition on the majority of the landscape differs from 'natural' conditions. Unlike in the parkland and grassland regions to the south, where invasive species such as smooth brome (*Bromus inermis*) and leafy spurge (*Euphorbia esula*) have impacted native species composition (White et al. 1993), in the boreal forest weeds tend to persist primarily in areas that have been heavily disturbed or are periodically disturbed (e.g., scarified cutblocks, fields, roadsides).

An indirect but tractable approach to the question of native species composition is to plot the location of mature forests as few non-native plants are able to establish or persist in an undisturbed forest floor under a mature boreal forest canopy. As of circa 1950, natural forests, including forested wetlands, covered the majority of the forest management area (Map 4). About 32% of the FMA area is covered in wetlands (Table 19a, Map 8), ~40% of which are non-wooded in the Central Mixedwood subregion of Alberta (Vitt et al. 1996).

Post-1950 disturbances have diminished the proportion of natural landscape. Schneider et al. 2003 estimate that 155,162 ha (~2.6% of their total 5.9 million ha study area) was in a non-forest state as of 2002, exclusive of cutblocks and recent burns. As a worst case scenario, assume (a) that cutblocks have a non-native species composition, and (b) a reported, estimated total cutblock area of 111,950 ha from 1993-2002 (~1.9%, based on recent annual harvest rates, see Table 21), and (c) a rough total 1950-1992 conifer harvest in the FMA area of 80323 ha (~1.4%) [estimated as: (25618.9 ha/yr mean conifer harvest for Alberta, pre-1993 data)/(47562.8 ha/yr mean conifer harvest for Alberta, 1993-1997) * 3468 ha/yr current FMA conifer harvest * 43 years, 1950-1992), data from Alberta Environmental Protection scaled timber volume and crown land area logged, Timoney data file timvolab.sys].

By a worst case, failed natural regeneration scenario, roughly 2.6 + 1.9 + 1.4% = 5.9% of the FMA area might be dominated by a non-native species assemblage. Based on the available incomplete or imperfect data, the majority of the forest management area should have a predominantly native species composition.

The distribution of AVI cover types is shown in Map 4a and summarized in Table 19b.
I present both the categories and the areal estimates at face value. The most abundant cover type in the general FMA area is black spruce, followed by deciduous, and mixedwood forests, then by 'non-forested' and recent burn.

Table 19a. Wetland cover for the 6.1 million ha FMA area, including the 'donut hole' (data excerpted from the Alberta Peatland Inventory; Vitt et al. 1996).

Wetland Type	Number of Polygons	Area km2	% of Wetlands	% of 6.1 million ha
Bog	731	5225.52	26.7	8.6
Fen	1177	14312.19	73.1	23.5
Marsh	24	33.23	0.17	0.05
Swamp	7	10.88	0.06	0.02
Total	1939	19581.82	100.0	32.17

Table 19b. AVI cover type areal estimates for the entire AVI coverage (6.4595 million ha).

AVI Cover Type	Polygons	Area Km2	% of AVI area
Anthropogenic Non-Vegetated	1967	417	0.6450
Anthropogenic Vegetated	6430	196	0.3035
Balsam Fir	210	7	0.0110
Black Spruce	273164	20277	31.3915
Burn (Recent)	34131	4727	7.3172
Cutblock (Recent)	11271	1434	2.2198
Deciduous	144427	10850	16.7972
Jack Pine	65007	3948	6.1116
Larch	34835	3501	5.4202
Lodgepole Pine	18	2	0.0030
Mixedwood	137601	8245	12.7637
Natural Non-Forested	13053	2456	3.8021
Non-Forested	74278	5001	7.7423
White Spruce	48408	2050	3.1736
Unclassified Polygons	505	1485	2.2987
Totals	845305	64595	100.0005

B. Identify and evaluate indicators of species composition such as proportion of later seral forests, understorey vegetation development, and/or structural features (woody debris, snags).

It is difficult to produce a single image that summarizes the spatial distribution of 'naturalness' in terms of species composition within the study area. Because of regeneration problems on seismic lines, these disturbance features can serve as an indicator for deviation from natural composition (Figure 9). The northeast portion of the FMA area stands out as the least disturbed area. Road density in the FMA area is lower than that both to the south and to the west of the FMA area. With regard to seismic features, the scale of the area is so large that, when mapping, pen thickness exaggerates the areal footprint, thus exaggerating the apparent deviation from natural species composition. Figure 10 provides a local view of characteristic seismic disturbances (in which pen thickness is not a factor).

Another surrogate to view degree of deviation from natural species composition is the distribution of large intact patches (Figure 11). [The assumption is that fragmented areas are significantly less 'natural' in terms of species composition.] The north, northeast, and northwest-central portions of the FMA area, and areas to the north of the FMA area, stand out as the largest undisturbed habitat patches. However, this depiction provides a pessimistic surrogate view of natural species composition. There is no reason to suspect that patches even as small as 1 km^2 would not support a natural or near natural species composition, with the exception of area-demanding or sensitive species such as grizzly bear and woodland caribou.

Yet another way to visualize an indicator of natural species composition is the distribution of mature and older forests. In Map 4 all forests older than 50 years at the time of AVI analyses are shown. This depiction may be viewed as the extent of natural forests that existed circa 1950, prior to large-scale industrial development. Wetherell and Kmet (2000) concluded that the Al-Pac FMA area could be characterized as boreal wilderness until about 1950.

A large portion of the FMA area was covered by forests older than 50 years at the time of AVI analyses (circa 1992-2002). These forests presumably supported a natural or near natural species assemblage. It is critical to realize, however, that some of the >50 year old forest has since been lost to wildfire, oil and gas activities, logging, and other consumptive uses, and these losses are not reflected in the map (for characteristic seismic line disturbance, see Figure 12, and refer to Table 21 for estimated annual disturbance rates).

C. Does the size of the forest qualify as globally significant for the broad habitat type?

The answer depends upon what is meant by 'forest'. Is it the forest region (i.e., ecoregion, including non-forest types), the FMA area, or the largest contiguous block?

FSC Canada (2003) provides suggested thresholds for intact forest significance as follows: globally significant = block >500,000 ha, free of permanent infrastructure, with <1% non-permanent disturbances; nationally significant = block 200,000 to 500,00 ha, free of permanent infrastructure, with <5% non-permanent disturbances; regionally significant = block 50,000 to 200,000 ha, free of permanent infrastructure, with <5% non-permanent disturbances. For reference purposes, note that a 500,000 ha block corresponds to a square 71 km on a side, a 200,000 ha block to a square 45 km on a side, and a 50,000 block to a square 22.4 km on a side.

Map 5 presents an FMA area-specific view of intact landscape extent. There are eight blocks larger than 50,000 ha, two blocks larger than 200,000 ha, and one block larger than 500,000 ha in the FMA area. Within the 11 large intact blocks, there are ~1,950 km^2 of old-growth forests, comprising ~9.4% of the total intact forest area. Deciduous and mixedwood types are areally dominant (Table 19c). It is noteworthy that the proportion of old-growth within the intact blocks

(~9.4%) is virtually the same as the old-growth proportion reported for the entire productive forest area ("about 10 per cent", Al-Pac 2000). It is important to note that the criterion used to delimit intact forest blocks (the absence of licensed roads) produces an 'optimistic' view of intactness. Had all linear and point disturbance been considered, the extent of intact landscape would be far lower than indicated in Map 5 (cf. Figures 5, 9, 10, 11, 13). A more quantitative (less binary/discrete) approach to intactness would be to plot polygons of equal density of disturbance (e.g., 0 km/km2, 0.01-0.5 km/km2, etc. of linear disturbance features and density of point features such as well sites). Such an approach might have produced a better depiction of intactness.

In summary, the region supports a landscape that is likely dominated by communities of natural or near natural composition. The north and the northeast of the FMA area seem to hold the best prospects for large, intact natural communities. The situation is in flux as new developments proceed.

Assessment: International to regional significance. The largest intact area is internationally (globally) significant. The two intermediate-sized blocks are nationally significant. The smaller intact areas are regionally significant. Map 5 shows the location and extent of three size classes of intact areas.

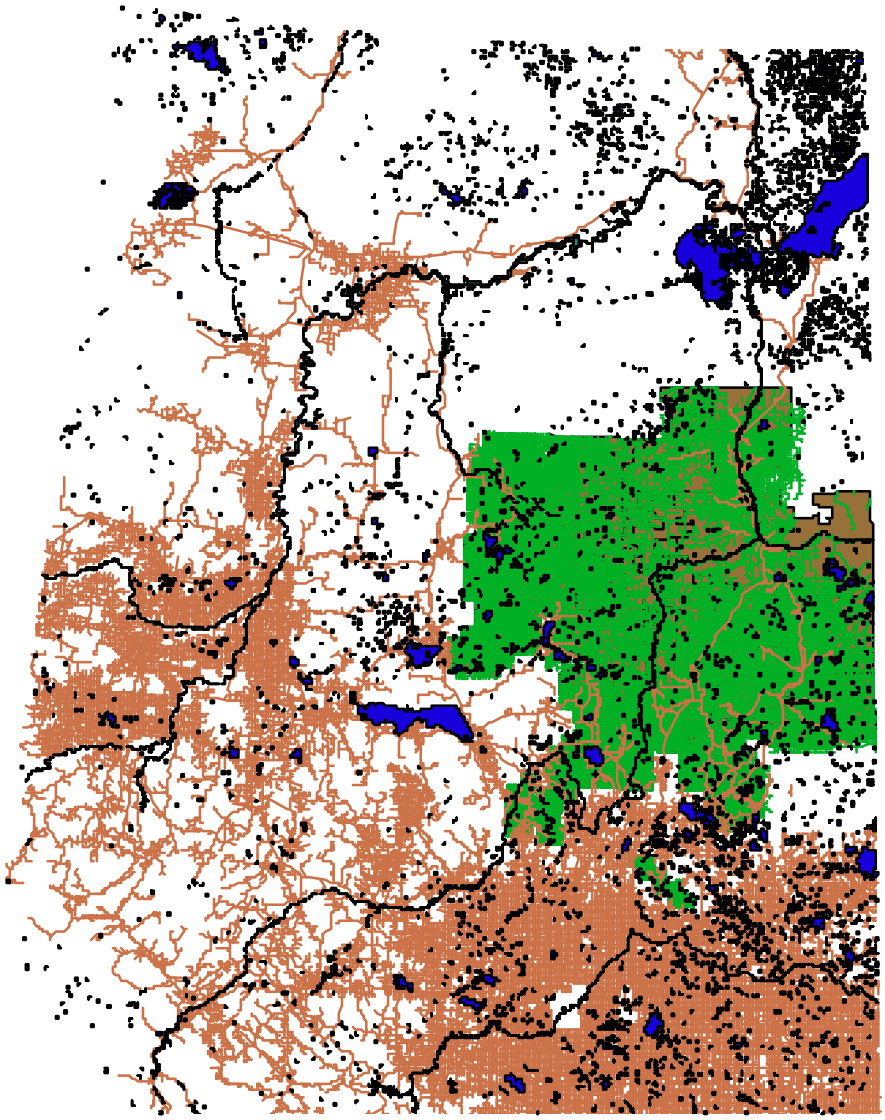


Figure 9. Seismic lines (green) and roads (reddish brown) within the Al-Pac FMA area (brown). The seismic line data are restricted to the FMA area whereas the road data extend outside the FMA area. The high density of seismic lines is indicated by the apparent ‘wall to wall’ green coverage, a partial artifact due to pen thickness. Compare Figures 4, 10, and 12 for detailed local views of seismic patterns.

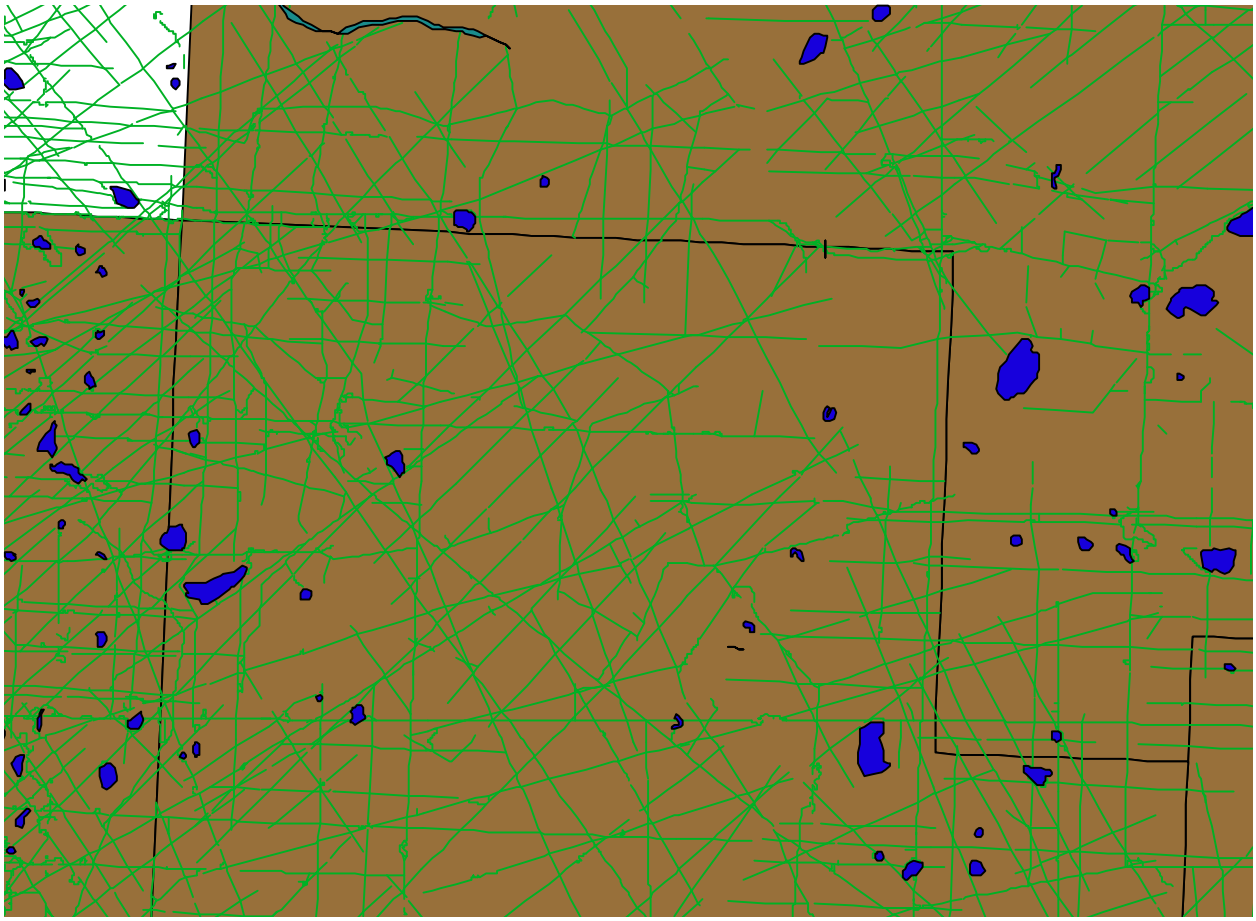


Figure 10. Detailed view of seismic disturbances near the headwaters of the Wabasca River in the northwest portion of the Al-Pac FMA area. Scale is roughly 48 km east to west across the image.

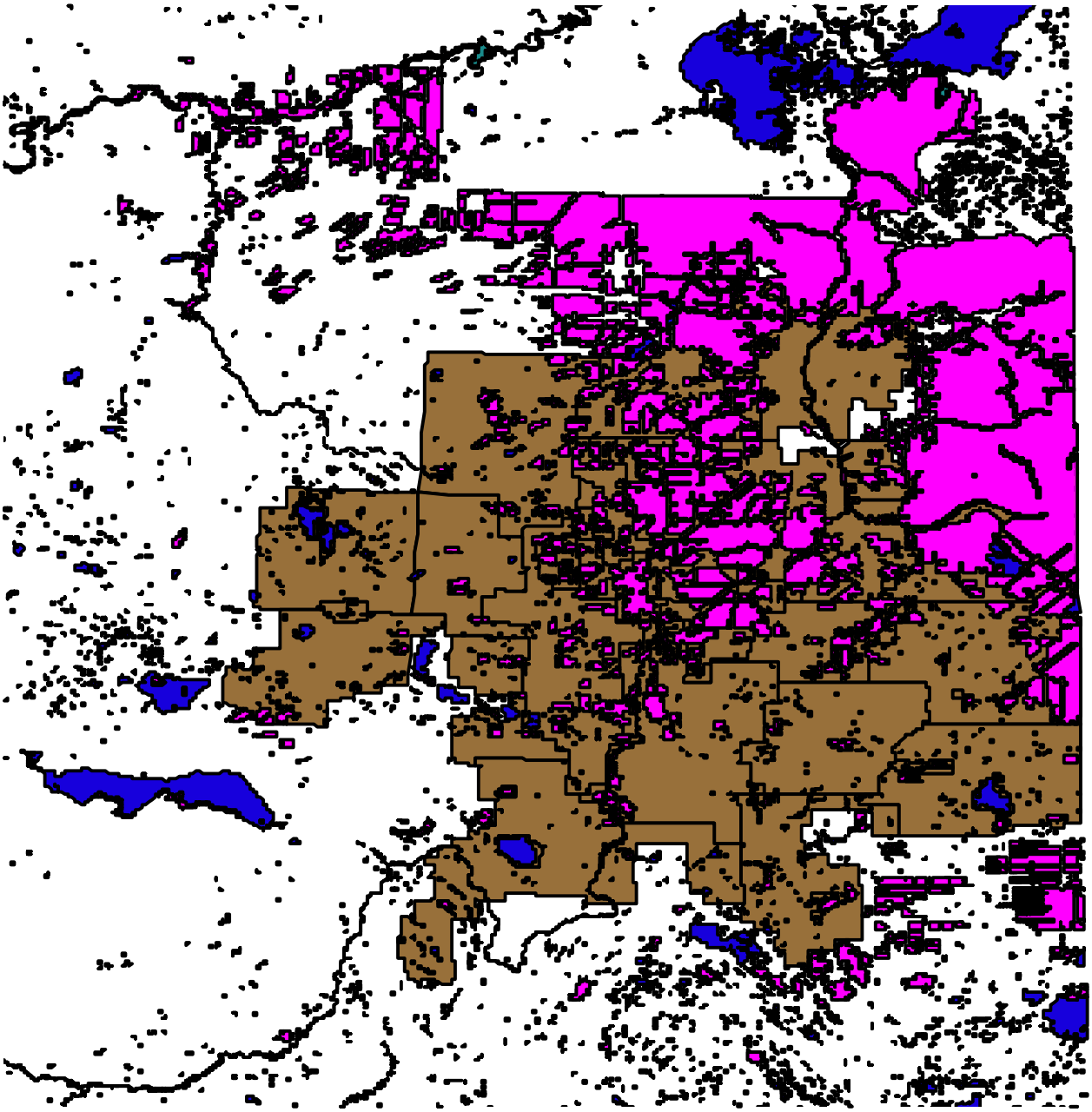


Figure 11. Core habitat areas (magenta) within and adjacent to the Al-Pac FMA area (brown). A core habitat area is defined here as an unfragmented area of at least 10km^2 whose outside edge is at least 500 m from any linear disturbance. Note the shape file used in this figure lacked mapped core areas for northwestern Alberta, thus the view has been truncated so as not to give the impression that core areas do not exist in northwestern Alberta (see Thomas 1998, Figure 27). Compare this figure with Map 5 which used a different set of criteria for intactness.

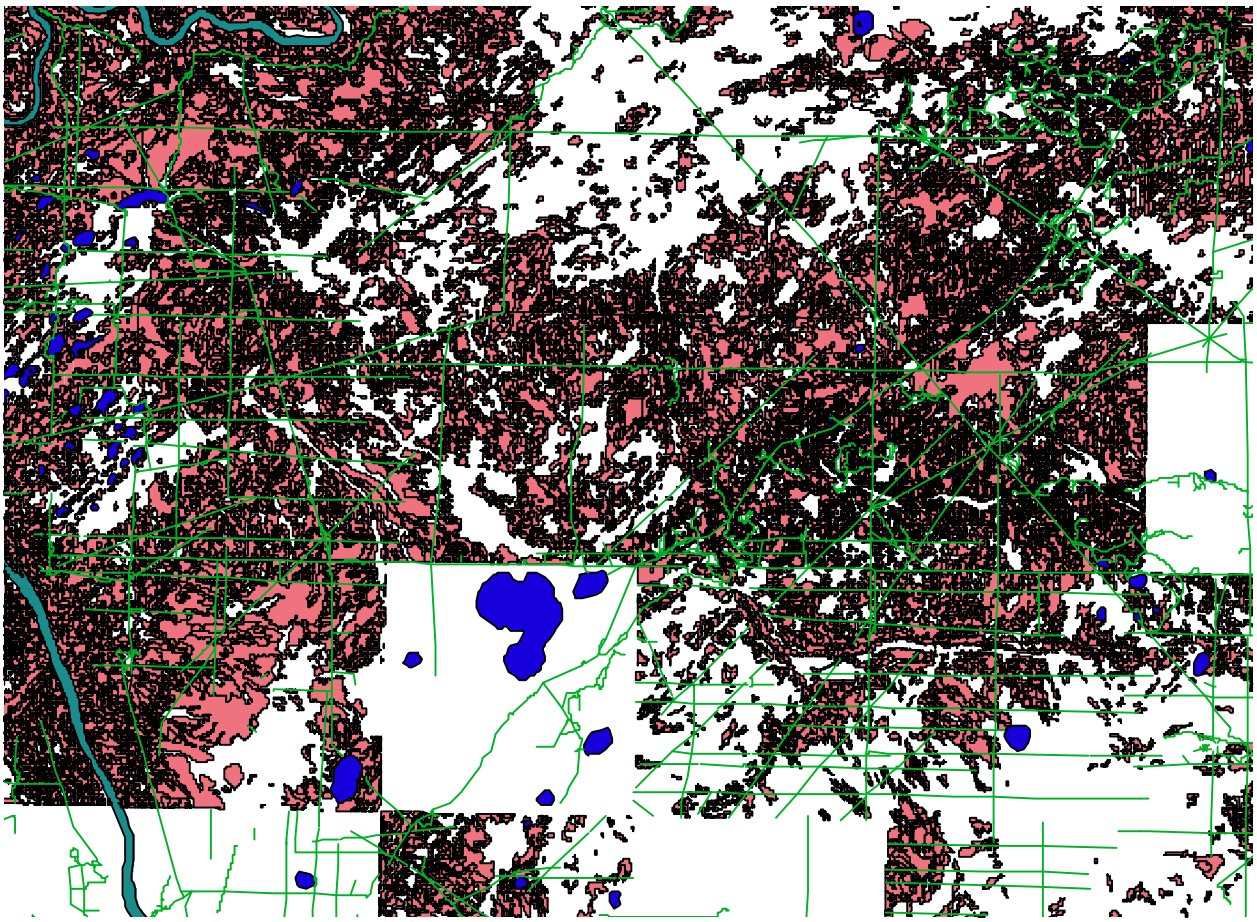


Figure 12. Comparison of forests older than 80 years (red) with seismic lines in a randomly chosen portion of the FMA area (along the Athabasca River in area of Twps 84-86). Scale is roughly 48 km east to west across the image. The lake below figure center is Algar Lake. The Algar Lake Sandhills were identified by Westworth and Associates (1990) as significant due to their exceptional diversity.

Question 11.

Does the forest constitute or form part of a forest landscape that is unfragmented or little fragmented by direct or indirect human impact?

The degree of fragmentation varies across the study area.

Before addressing this question it is appropriate to consider fragmentation as part of a suite of land transformation processes. Forman (1995) noted that "Perforation is the process of making holes in an object such as a habitat or land type... Dissection is the carving up or subdividing of an area using equal-width lines (e.g., by roads or powerlines). Fragmentation is the breaking of an object into pieces... Shrinkage is the decrease in size of objects, and attrition is their disappearance." These five spatial processes overlap in time during the transformation of a landscape, with perforation and dissection most importance at the outset, fragmentation and shrinkage predominant in the middle phases, and attrition predominant near the end of the landscape transformation.

Consideration of the study area in terms of its degree of fragmentation should be done within this larger context. Currently, landscape transformation in the FMA area, and in the ecoregion as a whole, is dominated by dissection (seismic lines and roads), followed in importance by fragmentation (cutblocks, agricultural expansion), and by perforation (well sites) (Figures 9, 10, 12). The region, relative to more developed areas farther south would currently be less fragmented. Fragmentation in boreal Alberta is more advanced than in boreal Saskatchewan and Manitoba (Figure 13). However, the situation shown in Figure 13 may be more pessimistic than conditions warrant. Some of Wood Buffalo National Park, the Slave River Lowlands, and the south shore of Lake Athabasca, e.g., are mapped 'white'— indicating fragmentation. In reality, however, much of that area is non-forested wetland and open habitat (e.g., dunes).

Notwithstanding these reservations, the contrast between Saskatchewan's and Alberta's remaining unfragmented forest blocks is striking, highlighting the need for swift conservation action in Alberta. The greater fragmentation in the Alberta portion of Ecoregion 92 relative to that in Saskatchewan and Manitoba may be due in part to geological influences. Much of northeastern Alberta is underlain by sedimentary rocks (Cretaceous and Paleozoic), while much of northern Saskatchewan and Manitoba is underlain crystalline, metacrystalline, and sedimentary rocks (Archean and Proterozoic). The latter 'Shield' terrains do not contain petroleum deposits, are poor for agriculture, and less suitable for commercial forestry, in general, than are sedimentary terrains.

The distribution of intact forest blocks is compared with other high conservation attributes in the summary portion of the report. It should be noted that these intact forest blocks are not free of human disturbances. Seismic lines, unregistered roads, and other energy industry features were not considered in preparation of Map 5 (see Figure 9, 10, and 12 for views of seismic disturbances).

Table 19c. Old-growth forest cover within the 11 intact forest blocks >50,000 ha in the Al-Pac FMA area.

	km^2	Old-Growth Forest Cover (km^2) Within the Intact Forest Blocks						
Forest Block	Area of Block	Black Spruce	Deciduous	Jack Pine	Mixedwood	White Spruce	Total Old-growth	Proportion of Old-growth in each block
1	575.04	3.47	29.13	3.05	35.96	15.22	86.84	0.151
2	612.46	4.12	5.54	0.27	4.17	2.59	16.68	0.027
3	618.49	1.54	1.99	0.21	7.35	7.94	19.03	0.031
4	804.94	2.96	5.41	0.09	4.18	7.43	20.07	0.025
5	860.73	20.40	29.96	7.76	20.23	14.60	92.95	0.108
6	916.06	0.69	22.47	0.50	21.10	7.66	52.42	0.057
7	929.03	17.27	34.01	1.80	115.94	38.01	207.03	0.223
8	938.22	14.85	76.53	0.73	85.37	52.82	230.30	0.245
9	3124.47	4.32	64.55	75.59	60.32	70.75	275.54	0.088
10	4080.86	46.92	136.42	8.47	138.07	121.19	451.07	0.111
11	7297.04	19.2	197	36.18	136.9	108.75	498.03	0.068
Totals	20757.34	135.74	603.01	134.66	629.6	446.95	1949.96	0.094
Proportion of Old-growth across all blocks	---	0.07	0.309	0.069	0.323	0.229	1	---

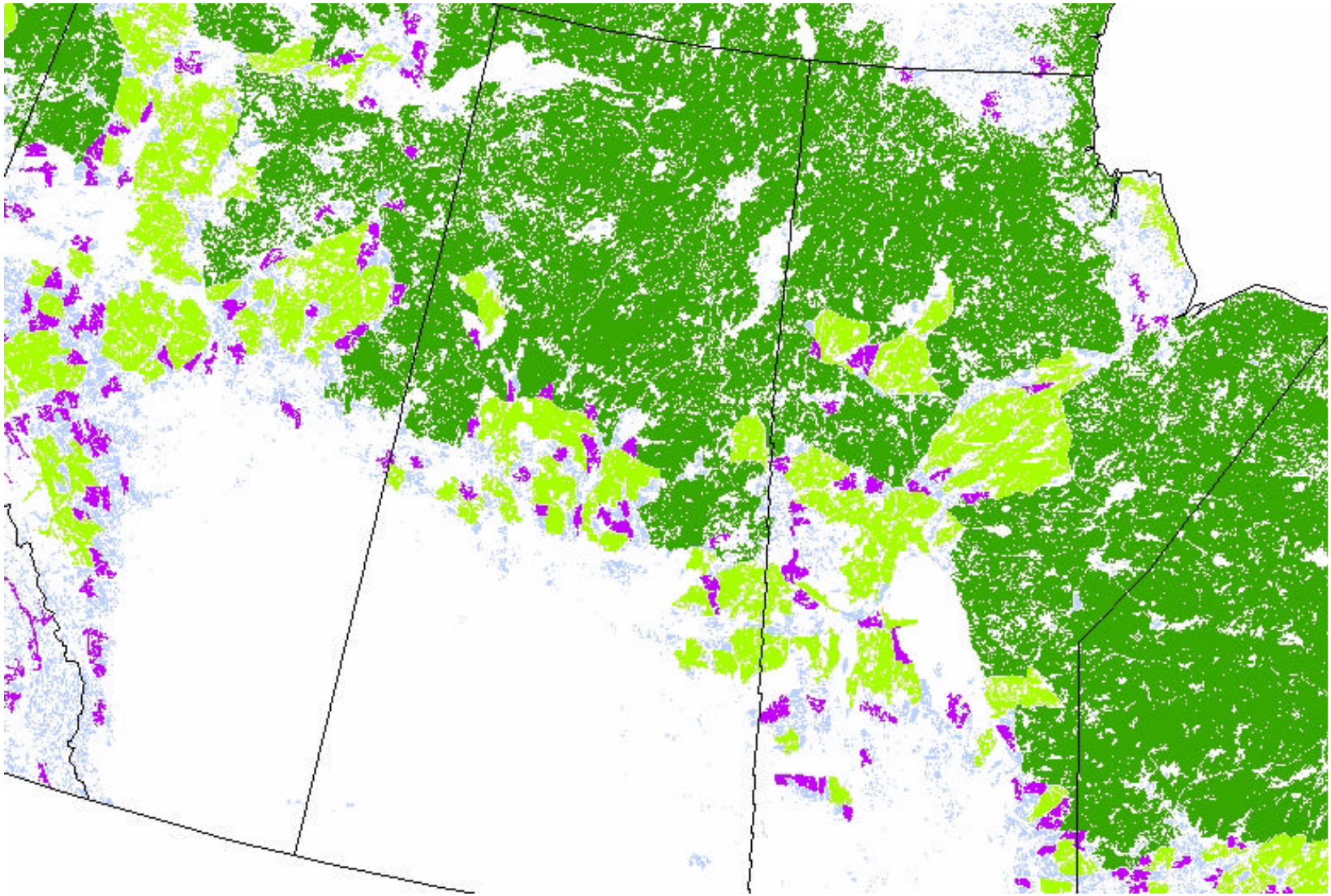


Figure 13. Large remaining unfragmented forest areas in boreal and subarctic western Canada (after World Resources Institute 2000). Dark green denotes patches >1,000,000 ha, light green 50,000 to 1,000,000 ha, and magenta 20,000 to 50,000 ha.

Sub-questions.

A. Does the size of the forest qualify as globally significant for the broad habitat type?

See question 10, sub-question C.

B. Does the forest contain suitable habitat to help maintain metapopulations of focal species?

The short answer to this question is a qualified yes (see Table 14 for a list of top focal species). Whether the habitat for each 'species' is sufficiently connected to allow for effective movements of the subpopulations cannot be answered at present. That oil and gas, logging, agriculture, and wildfire, and climate change may interact to remove old-growth from the landscape and to dissect and fragment the remaining habitat remains a serious concern that may undermine conservation efforts.

Assessment: National to regional significance. See the maps pertaining to question 10.

Question 12.

Does the forest constitute or form part of a landscape that is significantly more natural in terms of species composition, stand structure and habitat composition that what is usual in the area or region?

This question is similar to question 10 but uses a regional rather than a global context. As such, the same answers apply here.

It is difficult to determine if the forests of the region are more 'natural' than those elsewhere. The communities within the FMA area would be less disturbed than those to the south of the FMA area, and more disturbed than those to the north (in Wood Buffalo National Park and vicinity), and perhaps more disturbed than in Saskatchewan and Manitoba. The least disturbed portions of the FMA area are in the north and northeast. This ecoregion has been classified as bioregionally significant by Shay (et al. 1999).

Assessment: National to regional significance. See the maps pertaining to question 10.

Question 13.

Does the forest constitute or form part of a forest landscape that is significantly less fragmented by human impact than what is usual in the area or region?

This question is similar to question 11 but uses a regional rather than a global context. As such, the same answers apply here.

Sub-question.

A. Do fragmentation indices suggest a low level of human impact (e.g., core index >70%)?

Based on the fragmentation filter used, a significant portion of the region remained, as of 1998, in core area. Inspection of Figure 27 of Thomas (1998), which mapped core area for the entire boreal region of Alberta, indicates that the core area within and north of the FMA area contain the largest blocks of core habitat remaining in boreal Alberta. This fact affords the core area a high conservation value.

If less rigorous core requirements were used (e.g., areas as small as 1 km^2, with a buffer of 100 m) the core area would be larger. Such requirements would likely meet the requirements of all

but the most demanding species. Whether such a filter would bring the core area to >70% of the FMA area awaits analysis.

Assessment: Regional significance. See the maps pertaining to question 10.

Question 14.
Are there ecosystem types within the management unit or ecoregion that have significantly declined?

Several old-growth forest types have declined in Alberta in recent decades (Table 20). The most threatened are riparian old-growth white spruce and mixedwood types. Loss of old-growth is due to a number of causes: logging, fire, oil and gas activities, and agricultural expansion.

Disease and insects in the western subhumid boreal forest ecoregion may cause declines in growth increment or change competitive relationships, but seldom result in tree mortality (unlike, e.g., in cordilleran forests where mountain pine beetle may kill lodgepole pine and eastern boreal forests where spruce budworm may kill balsam fir). Defoliators impacted a median annual 1,674,000 ha/yr from 1975-99, but only a small portion of this area would have been subject to mortality (Timoney 2003).

Wildfire causes the most tree mortality on average but does not select against old-growth. Over the period 1970-99, fire burned a median 375,000 ha/yr across Alberta, Saskatchewan, and Manitoba, while logging consumed a median 75,000 ha/yr over the period 1975-99. As with defoliation, not all fires are stand-replacing, and mapped fire extent does not take into account fire skips and variations in fire intensity.

Because terrain and fuel continuity influence fire spread, forests in valleys, on shores or islands, in wet peatlands, on rock outcrops, etc., tend to be missed by fire more often forests on plains (Timoney 2000). These long fire return site types are more likely to support old-growth forests than site types that carry fire well. Wildfire, oil and gas activities, and agriculture show no forest age bias. Logging, however, selects against old-growth by government 'sustained-yield' policy which stipulates that old forests are cut first in order to truncate the age-class distribution to produce an even age-class structure (Bergeron et al. 1998).

Map 4 shows the distribution of forests patches older than 50 years. Map 6 shows the distribution of old-growth forests in the FMA area. Clusters are evident along Athabasca River in various areas; along the Clearwater River; north of Ft. McMurray, west of the Athabasca River; at Chipewyan and Carrot Lakes and the headwaters of the Wabasca River; along the Snipe River, south of Namur Lake (Birch Mtns); along Chelsea Creek (Birch Mtns); near Birch Mtn. Tower; near Calling Lake; near May Tower; and near the Christina River.

The contrast between the abundance of >/=50 year-old and old-growth forests is striking. Whatever the causes for the decline in abundance from 50 yr old status to old-growth status, it is clear that the older forests should be made priorities for protection.

The majority of old-growth forests in Map 6 are associated with river valleys, lakes, organic or wetter terrains, and moist highlands, indicative of terrain influences on firespread. Westworth and Associates (1990, Figure 3) used Phase III inventory data and plotted the location of conifer-dominated forest stands >100 years old and >1000 ha in size. It is noteworthy that they found a similar geographic pattern to that indicated by the AVI data (the association with river valleys, etc.).

The trends in abundance for other rare community types (from Table 12) are not known. By nature of their rarity, and the increasing industrial footprint in the region, most of the rare communities may be vulnerable— with the possible exception of those within Wood Buffalo National Park. Two interior patterned saline marshes, an extremely rare wetland type, have been observed at Clearwater Springs (56° 40'30''N, 110° 55'W, and 56° 44'30''N, 110° 30'W) that require study and protection (Timoney 2001b). Diatom ponds may exist south of Wood Buffalo National Park, and there are occurrences of dry grasslands and savannahs on sand deposits, slope breaks, south-facing slopes, and salty soils. Whether these types are declining is uncertain, but they would be vulnerable.

Table 20. Old-growth forest types that are in decline in Alberta (refer to Tables 9-11 for details; after Timoney 2001).

Scientific Name	Common Name	Status	Old-Growth Minimum and Maximum Ages Observed*
Populus tremuloides	Aspen Forest	Declining	85->130
Populus balsamifera	Upland Balsam Poplar	Declining	80->120
Populus balsamifera / Picea glauca	Upland Populus - White Spruce	Declining	85->130
Picea glauca / Alnus / Cornus - Rosa	White Spruce / Shrub / Herb	Threatened	128 - >250
Picea glauca / Equisetum / Hylocomium	White Spruce / Horsetail / Feather Moss	Threatened	128 - >250
Picea glauca / Alnus - Betula / Equisetum	Riparian White Spruce	Severely Threatened / S3	160 - >330
Populus balsamifera / Alnus / Cornus	Riparian Balsam Poplar	Declining / S3	80 - >290
Picea glauca - Populus balsamifera	Riparian Mixedwood	Severely Threatened	80 - >330
Picea mariana / Vaccinium #	Black Spruce / Heath	Declining	~85 - >263
Picea mariana / Ledum / Feather Moss #	Black Spruce / Labrador Tea / (Feather Moss)	Declining	~85 - >263

* Age of oldest tree found in stand, not necessarily the age of the forest.
# these black spruce forests are found on mineral soils (Luvisols, Brunisols, Podzols, and Gleysols); they are not bogs

Sub-questions.

A. Is your forest within an ecoregion with little remaining original native forest type?

No. Most of the forest in the ecoregion is native.

B. What is the extent of the documented decline?

It is not possible with the data at hand to answer this question specific to the Al-Pac FMA area. The question can be addressed for Alberta as a whole, however.

The rapidity of old-growth loss in Alberta is illustrated in Figure 14. The 1991 inventory encompassed 20.08 million ha; the 1999 inventory encompassed 17.83 million ha. The deletion of ca. 2.25 million ha (11.2%) from the land base in 8 years is alarming and demonstrates how disturbed lands may shift into non-satisfactory regeneration (NSR), unstocked, regeneration, or unclassified categories and therefore out of sight. However, using percent cover by class permits a comparison of the two inventories with the proviso that the difference in the 0-20 year age class is larger than appears in the figure. Since such a treatment downplays recent disturbance, the data would lead to conservative interpretations. In spite of this, the proportion of land occupied by forests >120 years old fell from 28.8% in 1991 to 17.6% in 1999, a relative decline of 38.9% in eight years. The decline is due to a variety of disturbances, not just harvesting. For example, between 1961 and 1999, ca. 1.32 million ha of forest were lost due to energy and agriculture (primarily due to seismic lines) and 1.31 million ha logged (data from Anielski and Wilson 2001). By the late 1990s, the Pembina Institute (2001) calculated that Alberta had entered a timber sustainability deficit with more timber being liquidated than is being replenished. Studies conducted elsewhere indicate that the most intensively-logged forest types would be the old-growth riparian white spruce where >50% declines have been noted (Timoney and Robinson 1996).

Figure 15 depicts the areal abundance by age-class within the Al-Pac FMA based on the most recent AVI data (the oldest age-class includes all forests older than 180 years). Based on business as usual assumptions, Schneider et al. (2003) estimated that all conifer old-growth will be eliminated within 20 years and all deciduous old-growth eliminated in ~65 years from within the Al-Pac FMA area.

C. What is the distribution of the declining forest type within the management unit in comparison to the broader ecoregion?

Map 6 plots the locations of the oldest forests in the FMA area. It is not known how the distribution of declining types differs between the management unit and the broader ecoregion.

D. Is there a significant difference between predicted distribution and actual distribution of the forest ecosystem type?

This question can be interpreted statistically (based on age-class structure) or geographically. Schneider et al. (2003), among others, have shown that old-growth in the FMA area is being lost. In other words, the age-class structure is being truncated.

Geographically, an expected pattern over time in a commercial forest landscape, would be for older forests to become dominated by patches offering the lowest financial return. These patches tend to be small, isolated, roadless, more northerly, surrounded by peatlands, or have low standing volumes. From a landscape perspective, these patches also tend to be found on wetter soils, or on dry, discontinuous or rocky soils, in valleys, along shores, on islands, in peatlands, below slope breaks, or on north-facing slopes— whether conditions do not favor firespread. Thus, as logging proceeds,

old-growth forests would tend to be found in river valleys, on islands, etc. less than expected based on fire regime alone.

E. Does potential vegetation mapping identify areas within the management unit that can support the declining forest ecosystem type (i.e., regeneration potential)?

Potential vegetation mapping has not been done for the region. There is reason to believe, however, that ample regeneration opportunities exist.

Assessment: National to regional significance. The most significant types might be the riparian old-growth forests and interior patterned saline marshes. The oldest forests still extant in the region (Map 6), since they are targeted for harvest by government, provide a useful site-specific response to this question.

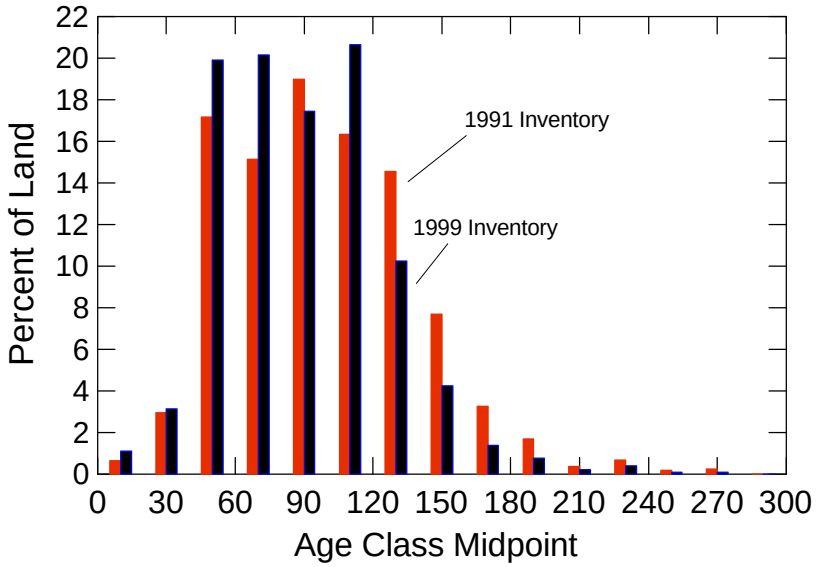


Figure 14. Comparison of areal extent of forest age classes in Alberta, 1991 and 1999. Alberta Forest Service data provided courtesy of M. Anielski, Pembina Institute for Appropriate Development, Edmonton (Figure from Timoney 2003).

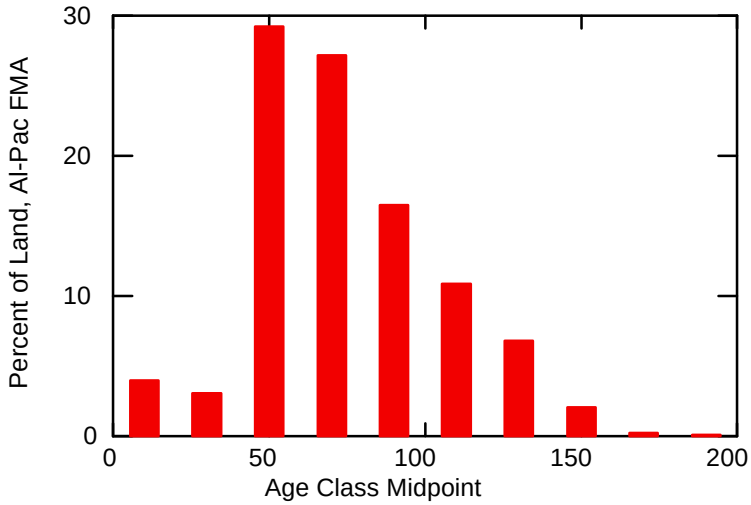


Figure 15. Areal extent of forest age-classes in the Al-Pac FMA area based on most recent AVI data. Data provided courtesy S. Dyer, Al-Pac Forest Industries, Boyle, AB.

Question 15.

Are there regionally/nationally significant diverse or unique ecosystems?

Yes. These include ecosystem types such as interior patterned salt marsh, salt springs (e.g., at La Saline Natural Area north of Ft. McMurray), the Peace-Athabasca Delta, the Whooping Crane Nesting Area, the Athabasca Dunes, riparian old-growth, salt meadows, aspen / ostrich fern forest, northern quillwort littoral submergent marsh, dry grasslands, and other communities listed under Other Rare Community Types (in Table 12).

Additionally, Map 1 shows the distribution and extent of proposed protected areas in boreal Alberta in relation to the areas currently protected. While there have been some important additions to the protected areas network in recent years (most notably the Caribou Mountains, Birch Mountains, and Marguerite River Wildland Parks), much remains to be done to secure an ecologically effective network (one large enough in aggregate, representative, and with enough connectivity to allow dispersal between protected areas). Each 'protected' area must be protected in substance not merely in name.

The areas range in significance from global to regional.

Sub-questions.

A. Are there important and/or unique geological areas that strongly influence vegetation cover?

Yes. These would include salt, gypsum bedrock, karst, and groundwater discharge systems in the Caribou Mountains and Wood Buffalo National Park; the Lake Athabasca Dunes; the Peace-Athabasca Delta; the Glacial Lake McConnell dune complex between Ft. McMurray and the Peace-Athabasca Delta; knob and kettle topography; mass wasting and seepage sites along major rivers; glaciofluvial sands and gravels overlying Cretaceous tar sands; glaciolacustrine and lacustrine clay, silt and sand deposits (Ozoray 1976; Fulton 1995; Timoney and Robinson 1998b).

B. Are there important and/or unique microclimatic conditions that strongly influence vegetation cover?

Yes. These would include permafrost in peatlands, e.g., in the Caribou Mountains; the broad alluvial valleys of the Peace and Athabasca Rivers which carry warm water northward and may be in part responsible for Peace-Athabasca Delta marsh wetlands that are characteristic of the Grasslands Ecoclimatic Region rather than of the Boreal Ecoclimatic Region; the droughty conditions of extensive sand deposits (e.g., Lake Athabasca Dunes, Glacial Lake McConnell Dunes); dry south and southwest aspect bluffs that encourage the presence of dry grasslands; the moderating influence of Lake Athabasca; and areas of high rainfall due to orographic uplift (e.g., Caribou and Birch Mountains).

Assessment: Global to regional significance. Many of the diverse or unique ecosystems are well-known and mappable. These include the Peace-Athabasca Delta, the Glacial Lake McConnell dune complex, the Athabasca Dunes, and the Caribou Mountains). Others are less well-known (e.g., occurrences of dry grasslands).

Question 16.

Does the forest provide one or more of the following basic services for people, communities or societies:

Water supplies for human use?

Yes. For example, from the Peace and Athabasca Rivers, Lake Athabasca, and groundwater wells.

Affect stream flow, quality and quantity of water supply, flood and drought prevention?

Yes. Snow and water storage across the landscape affect stream flow, lake levels, and groundwater recharge. Large wetlands and peatlands provide a storage service that decreases the likelihood and extent of flooding of surrounding areas. The area does not affect the occurrence of drought, but can provide water during times of drought.

Soil, terrain or snow stability, including erosion, sedimentation, landslides, or avalanches?

Yes. The vegetation cover acts to stabilize soils and to store snow and rain for slow release at a later date. Landslides (mass wasting) sometimes occur along river banks and in highlands and seepage sites.

Fire barrier or prevention?

Yes. Rivers and lakes and many wetlands provide effective barriers to firespread (Timoney 2000).

Control of wind and microclimate affecting agricultural production?

Not known.

Assessment: Regional significance. These features would include all major lakes, rivers and their valleys, and wetlands.

Question 17.

Are there local communities?

Yes. There are many communities (e.g., Ft. Chipewyan, Ft. McMurray, Ft. MacKay, Lac La Biche, Wabasca-Desmarais, Peerless Lake, Red Earth).

A complete answer to the cultural and social aspects of this question would require extensive research with the communities. A cultural spatial database layer should be incorporated into an HCVF assessment.

The answers I provide below are only a first step.

Is anyone within the community making use of the forest?

Yes. Community use is extensive and varied. Uses include hunting, trapping, fishing, pasturing of horses, and gathering of wild plants for food, medicine, smoking hides, and for religious purposes. Important wild plants include rat root (*Acorus americanus*; medicine), sweet grass (*Hierochloe odorata*; religion), blueberries (*Vaccinium myrtilloides*; food); raspberries (*Rubus idaeus*; food); gooseberries *(Ribes* spp.; food), mooseberries (*Viburnum edule*; food); strawberries (*Fragaria virginiana*; food); red osier dogwood (*Cornus stolonifera*; smoking, medicine, basketry); mint (*Mentha arvensis*; food and medicine); Labrador tea (*Ledum groenlandicum*; food and medicine), white spruce (*Picea glauca*; building material, woodworking, medicine), willows (*Salix* spp.; medicine, smoking, woodworking, basketry); saskatoon (*Amelanchier alnifolia*; food, medicine,

woodworking) (Adams and Associates 1998; Marles et al. 2000).

Important food animals include moose, caribou, white-tailed deer, mule deer, snowshoe hare, muskrat, beaver, ruffed grouse, Canada geese, mallards, snow geese, white-fronted geese, lake whitefish, goldeye, walleye, jackfish, and lake trout.

Is the use for their basic needs/livelihoods?

Yes. The degree to which needs and livelihoods are met by the 'country' has changed over time. Today a wide spectrum of usage will be found from those who depend on the land, water and sky for a dominant portion of their needs to those who depend little or not at all on the local ecosystem. Typically, older people depend the most and younger people depend the least on the bounty of the 'country'.

Assessment: Interviews with local residents would be required in order to assign a significance level to the use of the region by local communities.

Discussion

Data Gaps and Deficiencies

During the course of the HCVF assessment, data gaps and deficiencies were found. These are identified below.

A spatially-generalized (fuzzy) version of the cultural values of the landscape should be added to the assessment. Such a data layer was not ready prior to completion of this assessment.

Internationally recognized conservation areas, such as International Biological Programme sites, convey high conservation value. Work needs to be conducted at the University of Alberta Archives to procure accurate site location data and polygon shapes for the IBP sites in the area. All such sites should be provided protection. Ducks Unlimited has committed to retrieve this information.

Some areas important to fisheries were identified in this assessment. However, currently fisheries management information do not exist in a readily retrievable state. Data should be gleaned from fisheries management maps located at the Fish and Wildlife offices in Lac La Biche and Ft. McMurray.

As noted at the outset, this assessment is mute on the majority of species in the region (including the vast diversity of invertebrates, fungi, bacteria, cyanobacteria, algae, protists). For Alberta as a whole, there are ~91 species of resident mammal, 250 resident breeding bird, 60 fish, 10 amphibian, 1650 flowering plant, 650 moss, and about 650 lichen species (Alberta Environmental Protection, 1998a), in comparison to ~8-10,000 catalogueable forms of fungi (Hawksworth, 1991, R. Currah, pers. comm., 1999, Univ. of Alberta, Edmonton, AB). Alberta Environment (Undated) estimates there may be circa 20,000 species of insects in Alberta.

Even well-known groups such as vascular plants and mosses are inadequately documented. Good partial datasets exist for some groups, such as butterflies, but it will be many years before a functionally complete species list is complete.

Element occurrence data can be misleading and shortcomings should be recognized. The data are not spatially random observations but locations that are visited; they are mute on locations not visited. Grizzly bear observations may focus on dumps and bait stations rather than on typical habitat. Many observations follow the highway network.

Many of the questions posed in the assessment of high conservation value pertain to species. For some species there are adequate location data, but only qualitative estimates of abundance. The majority of species remain poorly documented. Even for well-known groups such as mammals and birds, the majority of townships in the boreal forest of Alberta lack species presence data (see Thomas 1998, Figure 2). With such data paucity, it can be difficult to answer questions relating to population trend. The problem becomes increasingly significant as a species becomes less abundant. Significant resources can be required to gather trend data, especially as a rare element becomes increasingly difficult to find.

In contrast, for communities and ecosystems, we often know how abundant a type is, but complete location data for all occurrences of the type rarely exist. The Alberta Natural Heritage Information Centre continues to gather type and location data for rare communities and ecosystems, but it is a mammoth undertaking and will require years of continued effort before the database is adequate for conservation needs.

Habitat maps do not exist for the FMA area. The only FMA-wide spatial dataset that pertains to landscape cover types is the Alberta Vegetation Inventory (AVI). This dataset is useful for general forest types on mineral soils, but inadequate for ecological applications such as locating significant or rare plant communities, wetland types, treeless communities, or habitat for particular species.

There are important identified and potential deficiencies of forest inventories such as Alberta Phase III and AVI. Forest ages may be underestimated. Cumming et al. (2000) found that mean canopy age is a biased estimator of stand age in stands older than 100 years. They concluded that gap dynamics may play important roles in forests previously thought to be even aged, that there is probable self-replacement of deciduous stands, and that vast tracts of boreal forest are being managed based on incorrectly estimated age structure and a misconception of landscape dynamics.

The questions on which the toolkit are based might be improved. Currently, there is an emphasis on attributes that are significant due in large part to rarity, vulnerability, or endangered/threatened/declining status. Some questions require more data than are currently available for most areas (e.g., reliable trend data or deviations from expected distribution). In the future, greater consideration might be given to attributes that perform critical ecological or societal functions (e.g., riparian zones), or render an area unique, or of populations of presently secure species that are characteristic of the area and may be sensitive. More emphasis should be placed on coarse-filter, landscape assessment (e.g, intactness) and less emphasis place on species. A cumulative impacts assessment should be incorporated into the HCVF assessment.

Generic Management Recommendations

When attempting to apply spatially explicit species and community data to aid in management, trend and location data may be inadequate. This may pose difficulties as to where to change

management practices or how to measure management success. Industrial development of boreal Alberta is proceeding at a pace that far outstrips the growth of scientific knowledge. In such a situation the only rational approach for a company wishing to qualify for Forest Stewardship Council certification is adherence to the precautionary principle. If it cannot be demonstrated that there is no high conservation value, then it is assumed there is and manage accordingly.

Fortunately, general principles of ecology, wildlife, and ecosystem and forest management can act as a compass to guide management.

1. Use the requirements of focal or umbrella species to help guide management actions.
2. At the landscape level:
   - Minimize perforation, dissection, fragmentation, and habitat loss.
   - Maintain connectivity and remote areas.
   - Maintain a diverse mosaic of stand ages and types.
   - Use extended rotations, modified fire response, and minimize or eliminate salvage logging.
   - Protect fisheries, riparian areas and old-growth, shores, and fragile sites such as wetlands; dry, sandy, or steep sites; saline soils; areas of groundwater discharge; and permafrost areas.
3. At the stand level:
   - Maximize residual structure.
   - Avoid site preparations that destroy organic residue and the soil biota (such as deep plowing, broadcast burning, slash piling and burning).
   - Manage for rapid and successful natural regeneration.
4. Maintain flexibility in annual harvest.

   In a widely oscillating system characterized by large perturbations, 'sustained yield' is an inappropriate model. In planning harvest levels, the current actual biomass and annual volume increment must be known, factoring in all current withdrawals due to wildfire, herbivory, disease, and anthropogenic disturbances. To assume that wildfire and non-forestry human disturbances have no impact on annual allowable cut is non-sustainable. The surest way to manage unsustainably is to remove organic matter faster than it can be replaced. The requirement by the Alberta government that Al-Pac currently harvest a minimum of 85% of the AAC, and 90% of the AAC by 2006 (Al-Pac 2000) restricts the company's flexibility.

Cumulative Impacts on the Land Base

Various authors have examined the cumulative effects of multiple use on the land base in Alberta. It is not my purpose here to duplicate those efforts, but rather to provide a brief tabular summary of annual disturbances in the Al-Pac FMA area (Table 21). The summary presents an average disturbance 'snapshot' based on roughly the last decade. It does not include insect and disease depletions in volume or increment, nor the 2002 House River fire, nor probable increases in disturbance rates due to expansion of the oil and gas industry. As such, the disturbance rates are probably minima. It is also important to bear in mind that annual disturbance rates vary, in particular those due to wildfire.

Deciduous harvest by Al-Pac accounts for ~22.64 % of the area disturbed each year within the productive land base (0.30% of the productive land base). Were this the only demand on the forests, it would take ~333 years to log all the productive forests (with zero regeneration). When all

forest harvesting operations are included, the total annual disturbance due to forestry is 44.91% of the area disturbed each year, or 0.60% of the productive land base. Other industrial activities disturb ~0.07% of the productive land base. Together, all human activities disturb circa 0.67% of the productive land base each year. Wildfire disturbs circa 0.66% of the Al-Pac productive land base each year. This figure assumes that all fires are stand-replacing and includes 'skipped' area within burn polygons if the unburned area is <~2 km^2. The burn estimate therefore overestimates the actual stand-replacing fire rate.

Together, human activities and wildfire disturb ~1.33% of the productive land base each year; this corresponds to a ~75.2 year rotation. Human activities disturb roughly the same amount of productive forest each year as does wildfire, as a rule of thumb. Schneider et al. (2003) estimate that, as of 2002, there were ~155,162 ha of the Al-Pac forest land base in a non-forest state due to industrial disturbances (principally due to seismic lines, pipelines, roads, pasture grass, and wellsites, but exclusive of areas not forested due to cutting and wildfire).

Roughly 18% of Alberta's Boreal Forest Natural Region was burned by Class E fires (>200 ha) in the 66 years from 1931 to 1996 (roughly 0.27% / year). The proportion of the forest land base burned in northeastern Alberta, within the Central Mixedwood (21.4%), Subarctic (27.3%), and Boreal Highlands (26.6%) was higher than the overall boreal mean (see Thomas 1998, Table 40). Since 1980, wildfire has burned ~0.65% / year of northern Alberta, and the fire rate appears to be rising (Schneider et al. 2003). Cumming (2000b) concluded that "the allocation of softwood to Quota holders is not sustainable under the existing arrangements of divided land bases and overlapping tenures, even without losses due to wildfire. When a realistic risk of fire is incorporated into the harvest schedule simulator, the situation becomes much worse... [and furthermore] alienation of productive forest land by the energy sector is not considered in this analysis."

For northeastern Alberta, B. Stelfox (cited in Anielski and Wilson 2001) applied a cumulative impacts model of fire and land use on the Alberta-Pacific forest management area. He estimated that the 'overmature' timber supply would be liquidated in 40 to 60 years (i.e., ca. 2040-2060). The 40-year estimate assumed no effective fire suppression and the 60-year estimate assumed full fire suppression and rapid recovery from oil and gas disturbances. The increasing demand for forest fibre is pushing the boreal forest on a course of dramatic change in which there may be little forest remaining free of human impacts (Spence et al. 1997).

If the findings of Cumming et al. (2000) are generally applicable, forests in the FMA area may be considerably older than the inventory data indicate, which has implications both for biodiversity conservation and for timber supply. Regarding the latter, the use of 70 year rotations for deciduous stands and 110 year rotations for white spruce stands depend primarily on the reliability of volume-age curves which in turn depend on estimated stand ages, which may not be reliable. The justification for these rotation ages depends, secondarily, upon a belief that 'natural' rates of wildfire disturbance are accurately estimated, are statistically characterizable rather than stochastic, have a stable mean rate, and are under management control. None of these assumptions may be true.

Cumming et al. (1996) concluded that forest age and size structures in the Al-Pac FMA area could not be replicated at any scale smaller than the study area; in other words, at no spatial scale did they observe a stable temporal structure. Cumming (2000a), tentatively concluded that, after correcting for (presumed) fire suppression, fire activity may be increasing in NE Alberta. Armstrong (1998) concluded that the annual area burned of an 8.6 million ha study area in northeastern Alberta was best characterized as a serially independent random draw from a lognormal distribution. For

northeastern Alberta, over the period 1961-1996, Armstrong (1999) found no trend in annual area burned. Prairie Province (AB, SK, MB) annual area burned from 1970-99 showed no linear trend, despite record expenditures on fire suppression and increased fragmentation (Timoney 2003). These studies corroborate the view of Johnson et al. (1998) that there is little evidence of successful fire suppression in the western Canadian boreal forest. Wildfire in the western boreal forest remains 'wild'-- i.e., outside human control, and thus its effects on timber supply and the ecosystem remain difficult to predict.

The most recent assessment of cumulative impacts within the FMA area is that of Schneider et al. (2003). Under a business as usual model scenario, those authors concluded that:

conifer old-growth will be eliminated in ~20 years, and deciduous old-growth eliminated in ~65 years;

available woodland caribou habitat declined rapidly from 43% of the land base to 6% of the land base;

a shortfall of harvestable conifer timber was predicted to occur in ~ 60 years;

the density of human-origin edge will increase from 1.8 km/km^2 to a maximum of 8.0 km/km^2;

Overall, there will be a progressive reduction in the forest land base, the remaining forest will become progressively younger and more fragmented, there will be a marked increase in human access, and the industrial footprint will quadruple over the next 20=30 years, then moderate.

Projections of future age-class distributions, in particular those of old-growth forests, under assumptions that do not include wildfire and its great variability, oil and gas activities, and climatic change are not supportable (see e.g., Figure 7 in Al-Pac 2000).

If climate continues to change, the years to old-growth liquidation predictions of Stelfox, Schneider, and other authors may prove optimistic. Under a 2xCO_2 climate, it is predicted that mean May-September temperature will rise over the Prairie Provinces by 3-5 C (Flannigan et al. 2001), and that fire weather index and fire activity will increase over the core of the subhumid boreal (Flannigan et al. 1998, 2001). Modeling studies predict unprecedented increases in boreal temperature and fire activity, with a resulting greatly reduced extent of boreal forest and a corresponding increase in fragmentation (Weber and Flannigan 1997). It is critical to convey the sense of urgency felt by the scientific community that the boreal ecosystem is about to undergo fundamental change (Weber and Flannigan 1997). Increases in fire activity may be taking place already: from 1961 to 1993, the average burn rate in the FMA area was 12,586 ha/yr, while from 1993 to 2000, the average burn rate was 38,000 ha/yr (data from Al-Pac 2000). In 2002, the House River fire in the FMA area (apparently started by humans) burned over 248,000 ha, an area 6.5 times the average wildfire burn rate from 1993 to 2000.

Interactions among stressors may bring about unexpected responses. For example, the southern half of the western Canadian boreal forest would be exposed, under a 2xCO_2 climate, to conditions like those of present aspen parkland, where conifers are absent and aspen restricted to groves; forest edges exposed to warm, dry conditions might suffer stresses leading to decline of productivity (Hogg and Hurdle 1995). Furthermore, growth and yield estimates are based on natural, not post-harvest, forests, and thus estimates of future timber supply may be optimistic.

Increased fire activity may liberate increased amounts of sequestered carbon resulting in a

positive feedback with greenhouse-gas induced global warming (Weber and Stocks 1998). Mild winters, or drier and warmer summers in the boreal zone may mean increased fire activity and increased probability of insect outbreaks (Holling 1992). Warm, dry springs without frost favor forest tent caterpillar survival, and mild winters favor bark beetle survival (D. Williams, pers. comm., Forestry Canada, Edmonton). Forest tent caterpillar outbreaks may become more severe as a result of forest fragmentation and climate warming (Fleming and Volney 1995; Roland et al. 1998).

If high conservation values are to be maintained, management will have to be improved. The impacts of the non-renewable resource industry (primarily oil, gas, tar sands) are significant and represent a serious threat to the maintenance of ecological integrity of northeastern Alberta.

A shift to 'best practices' would help to minimize fragmentation, human access, and loss of caribou habitat, and provide economic benefits to the petroleum industry. It is sobering, however, that even under 'best practices', the proportion of conifer old-growth may decline from ~13% down to 2% in about 75 years while deciduous old-growth may increase from ~13% up to ~25% after about 40 years, then decline to ~ 1% in about 80 years (Schneider et al. 2003).

Table 21. Estimated annual land disturbances within the Al-Pac FMA area based on most recent data.

Land Use / Disturbance	Ha/Yr on 5.8 million ha total land base	Ha/Yr on 2.1million ha Productive Land base	% of Annual Disturbance/ Yr	% of Productive Land base/Yr	Comments
Al-Pac deciduous harvest*	6324#	6324#	22.64	0.30	1993-2000
non-Al-Pac deciduous 'incidental' harvest*	2753#	2753#	9.86	0.13	1993-2000
coniferous harvest, including Al-Pac and coniferous quota holders^	3468 **	3468 **	12.41	0.17	1993-2000
wildfire* ##	38,000 ^^	13759 ^^	49.26	0.66	1993-2000, Al-Pac 2000: 19 and Figure 9
other industrial developments &	4,503	1630$ ^^	5.84	0.07	average disturbance rate 1994-2002 &
Total Annual Disturbance Rate@	55048	27934	100.01	1.33	

* Al-Pac 2000

annual disturbance rate 1993-2000 interpolated from Figure 1 of Al-Pac (2000);
~44,271 ha in 7 years = 6324 ha/yr; during that time, Al-Pac (2000, Figure 8) harvested 1,515,971.4 m^3/yr, for an estimated average volume of 239.7 m^3; this empirical average is in keeping with average stand volumes reported for aspen in Peterson and Peterson (1994: Figure 21) for other FMA deciduous dispositions (Al-Pac 2000, Figure 8): 4,618,700 m^3 in 7 years = 659814.3 m^3/yr; annual hectarage = volume m^3/yr / 239.7 m^3/ha = 2753 ha/yr;

^ Simon Dyer, pers. comm., March 2003

@ average annual deciduous and conifer harvest, 1993-2000 is circa 12545 ha/yr which may be an underestimate as Schneider et al. (2003) estimate the annual harvest at 16,000 ha/yr

^^adjusted to productive forest area by assuming that wildfire and anthropogenic disturbance rates in the productive forest land base are proportional to those in the total FMA area: for wildfire, as (2.1 million ha/5.8 million ha)*38,000 ha/yr

and for 'other industrial developments' as (2.1 million ha/5.8 million ha)* 4503 ha/yr; the 1961-1993 average annual burn rate was 12,586 ha; burn rates can vary orders of magnitude over time and space, and some forest types are more flammable than others; these average figures are intended to provide the reader with an overview of burn rates

salvage of burned timber was traditionally additive to AAC (i.e., it was not included within the AAC calculation); presently, salvage is "AAC chargeable", making harvest and fire partially compensatory; in this table, I assume they are additive

$ Simon Dyer, pers. comm., October 2003, annual disturbance rate 1994-2002

** converted to ha/yr by assuming harvest volume of 250 m^3/ha at rotation age of 105 years based on Peterson and Peterson (1992:38 and Figure 21)

& includes settlements, wells, processing plants, seismic lines, pipelines, highways, seasonal roads, railways, power lines, and peat mines; Schneider et al. (2003) estimate a total 155,162 ha (~2.6%) in a non-forest state as of 2002, exclusive of cutblocks and recent burns, in their total 5.9 million ha study area; the 4503 ha/year FMA-average (S. Dyer, pers. comm. October 2003) does not include an additional 31,676 ha which Al-Pac has removed from its AAC calculation in anticipation of future oil sands projects

High Priority Conservation Areas

Consultation with non-governmental organizations during preparation of this report indicated three areas of high concern: the southern fringe of the FMA area, the Lakeland area, and the McClelland Lake area. The reasons that conservation organizations place high values on these areas are provided below.

The Southern Fringe

Anthropogenic disturbance of the boreal ecoregion in general follows a north to south gradient of increasing intensity. Disturbance, habitat loss, and fragmentation of the Dry Mixedwood subregion is advanced. Agricultural clearing of forest lands is a primary stressor, with forestry and oil and gas activities also significant. About 80% of the Dry Mixedwood Subregion has been lost to agriculture and settlement.

As the area of intensive industrial and agricultural pressure expands northward, the area adjacent to the Dry Mixedwood comes under increasing pressure. The fringe is also a natural tension zone where many species and communities reach their range limits and where range-edge ecotypic and genetic diversity will prove important as ecosystems cope with climate change.

Conservation groups place a high conservation value on the southern boreal fringe and are committed to achieving better protection and management there. For these reasons, I have identified the Dry Mixedwood subregion with a 50 km wide buffer as a high conservation value (Figure 16).

The Lakeland Area

Lakeland Provincial Park and the adjoining Provincial Recreation Area (PRA) have high conservation value.

Lakeland is Alberta's first boreal provincial park. Conflicts between protection and human use are ongoing. Human uses of the area include forestry, oil and gas exploration, cattle grazing, off-road vehicle use, hunting, trapping, and fishing. The park covers 147 km^2 while the PRA covers 441 km^2. Much of the conflict, and conservation concern, derives from logging within the PRA, and from overfishing.

The area is renowned for its old-growth forests (Nordstrom 1994), and for its high diversity of birds. Wallis et al. (1994) documented 153 species of birds in the area. The area supports 20 species of warblers, 19 of which are breeders (Thomas 2000), nesting Bald Eagles and Ospreys, and Great Blue Heron and Common Tern colonies (Westworth and Associates 1991).

The area is a stronghold for the old-growth dependent and declining Blackburnian Warbler (Nordstrom 1994).

As of 1994, the park contained ~28% of area's old-growth, while the PRA contained ~72%. (Nordstrom 1994). Old-growth white spruce, mixedwood, and deciduous forests are an outstanding feature of the PRA north of the park (Map 6).

Other significant features of the area include 18 species of orchids (Alberta Environmental Protection 1998b), a diversity of landforms and soils, rare species such as the pitcher plant (*Sarracenia purpurea*), excellent warm water fish habitat, the only provincial occurrences of crayfish in the Sand and Beaver River drainages, and possible occurrences of log perch and river shiner (Westworth and Associates 1991).

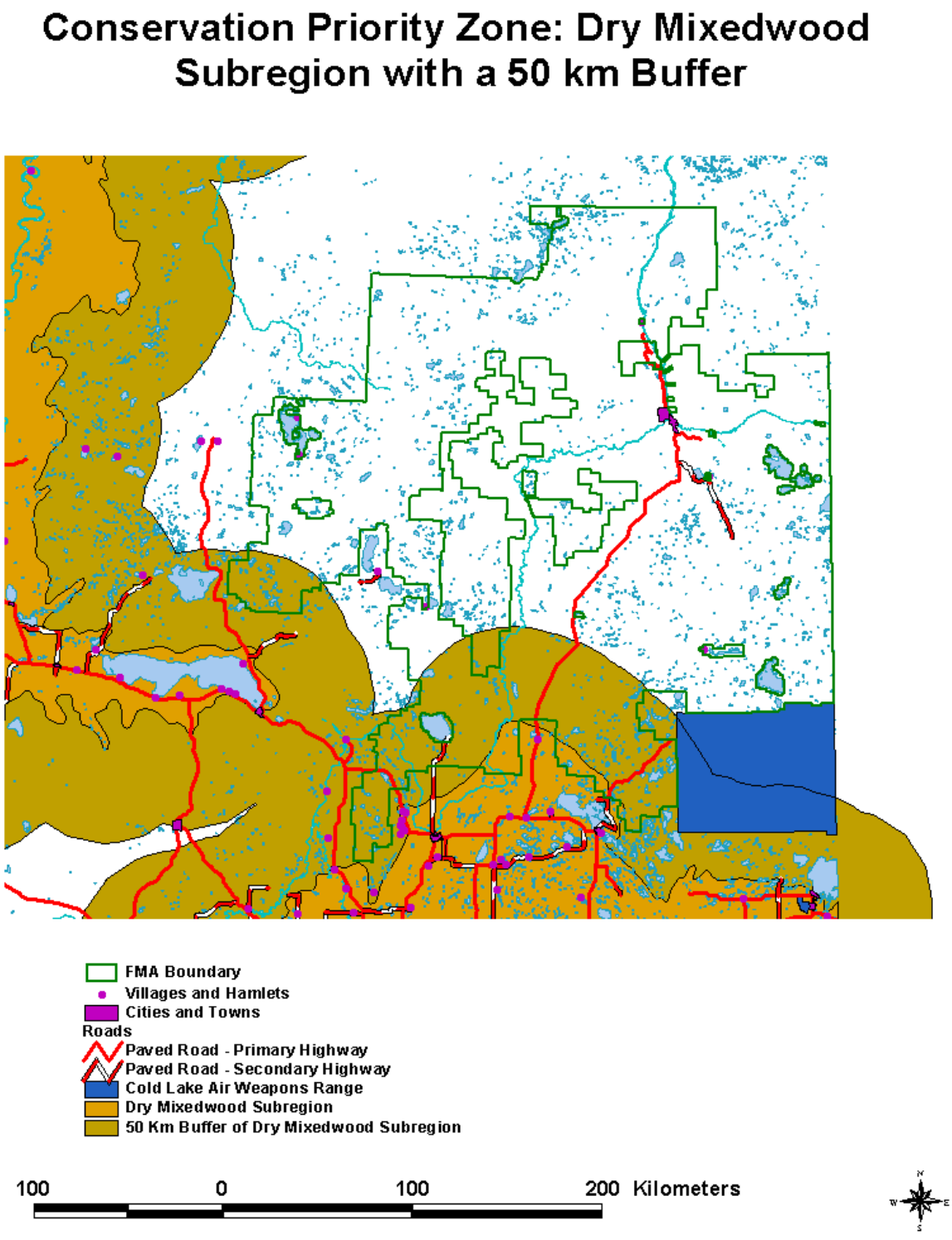


Figure 16. The southern boreal fringe: a zone of high conservation priority for Alberta conservation groups.

With such a wealth of conservation values, the Lakeland area will remain a priority of non-governmental organizations. Lee (1994) noted that "The diversity underpins Lakeland's status as one of Alberta's largest protected areas possessing regional, national and international significance for nature conservation."

Al-Pac could create much goodwill within the conservation community should the company choose to defer logging in the Lakeland area.

The McClelland Lake Area

The McClelland Lake area north of Ft. McMurray has high conservation value. It is also in the center of a controversy regarding development of an open pit oil sands mine in the wetland on the west side of the lake.

The Fort Hills Oil Sands Project, currently on hold for economic reasons, would, according to its proponents, produce an estimated 195,000 barrels per day of bitumen (Vitt et al. 2002). The proposed project would destroy circa 50% of the McClelland Lake Wetland Complex, and 40% of the patterned fen (Horton 2002). A study undertaken on behalf of the Canadian Wildlife Service (Francis and Lumbis 1979) stated that: "Important lakes such as McClelland Lake should not be tampered with." Doubt and Belland (2001) concluded that: "Water drainage associated with the mine would affect the entire wetland."

Conservation groups are committed to protecting the area from both mining and forestry operations. Their commitment stems from documented conservation values, some of which are:

The area is used by endangered Whooping Cranes during migration (Thomas 2002).

The lake is an important fall staging area for waterfowl, and is a significant nesting area for Red-necked Grebes (Francis and Lumbis 1979).

To date, a total of 205 species of birds have been noted for the McClelland Lake Wetland Complex, 116 species (57%) of which breed there (R. Thomas, pers. comm., June 2003, Edmonton)

The wetland supports at least 18 species of provincially rare mosses and hepatics (Vitt et al. 2002), four species of provincially rare vascular plants, and contains 12 sinkhole lakes (Thomas 2002).

The wetland complex has been described as having the best-developed string and flark pattern in the province, and is one of 54 Alberta peatlands identified as a 'high priority for preservation' (Nicholson 1991; Westworth and Associates 1990).

The wetland is larger than 91% of all other wetlands in the province, and larger than 91% of all patterned peatlands in the province (Horton 2002).

The area has been identified as a provincially significant natural feature (Westworth and Associates 1990), was nominated under Special Places 2000, and was zoned for protection in the regional Integrated Resource Plan until recent lobbying resulted in its being rezoned to allow development (Thomas 2002).

The current hiatus in oil sands development of the area may afford Al-Pac and non-governmental organizations an opportunity to work together to secure protection for the area. The most immediate threat is summer logging in the area of the fen.

Other Outstanding Concerns Relating to Forest Certification and HCVF Assessment

High conservation value forest assessment is an evolving, new discipline. Because of the scarcity of HCV assessments, or their perceived sensitive or proprietary nature, HCV assessments are not readily available. This is troubling for the scientific approach as reproducibility of results and standard methods are cornerstones of the scientific method.

Those conducting HCV assessments may find themselves 're-inventing the wheel' devoting much time to accessing data and developing both approaches and methods. With no standard protocols, comparison of HCV assessments, if assessments became available, they might be hampered by incompatibility.

The use of the HCVF toolkit helps to structure the assessment and does provide unequivocal answers to the questions of type and occurrence of HCVs. The toolkit, however, is essentially non-spatial, yet management application of results requires a spatial component. For that reason, I have devoted much effort to mapping the high conservation values.

Following HCV assessment, companies wishing to achieve FSC certification are charged with maintaining or enhancing the HCV attributes. The suggested approach to date has been a representivity analysis in which enduring landscape features are identified and their occurrence in protected areas determined. Those enduring features which are not well-represented in protected areas are 'gaps' then recommended for conservation priority.

Currently the data layer used by World Wildlife Fund to assess enduring landscape features is Agriculture Canada's national 1:1 million scale Soil Landscape Maps of Canada (Agriculture Canada 1986). The data attributes include surface form, parent material, soil development, soil texture, slope gradient, and polygon number. Advantages of this dataset include its national coverage, the persistence of its features, and the fact that a representivity analysis approach has been developed to use the soil landscape data.

From a conservation planning standpoint, however, the soil landscape dataset has three obvious disadvantages. (1) The correlation between soil landscape polygons and HCV attributes has not been demonstrated and would likely be low. (2) The biotic and ecological character within a given soil polygon can vary widely since there is no historic/ecological process or disturbance component in the soil polygons. (3) The reliability of soil data can be low (e.g., for the FMA area, the map reliability is listed as 'low', meaning "compiled from soil survey maps produced from field traverses at wide intervals (up to six miles) and without the use of aerial photographs..."

I provide an example to illustrate difficulties with the proposed representivity analysis: A large portion of the FMA area is covered by a single enduring landscape theme "X/B16", namely Organic Fibrisols on bog material of blanket bog form. A typical polygon of this type in the FMA area has no other data; one polygon (# 768, near the Mikkwa River) is listed as very-poorly drained, non-calcareous, with water table from 0-1 m from the surface. There is little that can be done from a conservation planning standpoint with such generalized and sparse information, especially when the information lists 'bogs' as the predominant type when in reality the predominant wetland type in the "X/B16" polygons is fens (based on the Alberta Peatland Inventory), and the predominant Organic soil type is Mesisols, not Fibrisols (e.g, see Twardy 1978).

In light of the above deficiencies, I recommend that the representivity analysis not be based on the soil landscapes dataset. There are three alternative datasets that could be used. (1) The high conservation value maps produced in this report, either as single themes (e.g., intact blocks), or as multiple themes (e.g., conservation ranks by overlap). The disadvantage of these data is that the

detailed mapping is limited to the FMA area. (2) Ecodistricts of Alberta (Strong and Thompson 1995, Strong 1991) is a polygon database that offers more relevant ecological information than does the national soil landscapes dataset, such as dominant and subdominant vegetation cover, wetland types, and more detailed soil information. (3) Alberta Vegetation Inventory data. Both options 2 and 3 are essentially province-wide, an advantage that allows for representivity analysis, but both become mute at the Alberta border.

There is no single correct or standard way to conduct a representivity analysis, but it is clear that the national soil landscapes dataset is not an ideal platform on which to base conservation decisions.

Spatial Integration of High Conservation Value Themes

The structure of much of the report has been shaped by the 17 toolkit questions, many of which are non-spatial. The responses to the toolkit questions demonstrated that high conservation values exist in the study area. In order to assist managers toward certification, it is necessary to move beyond the toolkit questions to provide a spatially-explicit response that both locates and ranks conservation values in the FMA area.

In this final section, I integrate in a spatially-explicit manner eight high conservation attributes. Other attributes could have been chosen, but the eight used represent a spectrum of high conservation values for which spatially explicit data are available.

Simpler, more analytically tractable, approaches to ranking conservation values could have been used, such as single themes: environmentally significant areas, old-growth forests, or intact landscape blocks. However, linkages between such attributes and other attributes of conservation value, such as waterfowl production, rare or threatened species and communities, diversity hotspots, and ecosystem services may not be clear in many instances.

There are no standard methods for mapping and ranking conservation values. The approach taken is a compromise between reliance on quantitative spatial data and consultation. I include species-specific data such as rare species / nesting colony occurrence, consultative/derivative data such as areas of conservation concern, and community and ecosystem data such as intact landscape blocks.

The attributes chosen are (a) environmentally significant areas at the national level (Map 2); (b) rare species and bird colonies (Figure 3); (c) woodland caribou zones (Map 7); (d) intact forest blocks >50,000 ha in size (Map 5); (e) old-growth forests (with old-growth black spruce excluded) (Map 6); (f) current protected areas (Map 1); (g) surface water as indicated by mapped water bodies, major rivers, and non-bog peatlands (Map 8); and (h) the dry mixedwood subregion of the boreal ecoregion with a 50 km wide buffer (Figure 16).

The ranking procedure is arbitrary but parsimonious: each attribute is given equal value. If an area supports none of the eight attributes, it is ranked zero. If an area supports one attribute, it is ranked 1. If there are coincident attributes, the area of overlap is ranked 2, etc. For example, an area that supports old-growth forests that are intact is ranked 2, while a woodland caribou zone coincident with a protected area would also be ranked 2.

Regarding caribou habitat, the spatial distribution of woodland caribou management zones and telemetry locations is presented in Map 7. Note that the location data are clustered in two areas (northeast and east of Wabasca, and south and southeast of Ft. McMurray), an artifact of data availability. Notwithstanding the artifactual clustering, the location data show a preference of caribou

for wetlands (indicated by the AVI wet soil polygons) and an avoidance of major river valleys (perhaps due to wolf avoidance). The fidelity of Alberta telemetry locations to caribou management zones is high (with the exception of the Cold Lake Air Weapons Range). For this reason, caribou management zones, while less quantitative than the detailed location data, are used to define high conservation areas for caribou.

The scarcity of surface water, the importance of aquatic and riparian habitat, and of surface water to migratory waterfowl, and the threats to surface and groundwater posed by humans, render high conservation value to surface waters in the study area. Riparian areas (rivers and their adjacent valleys) are well known for their linking function, facilitating both migration and movement of energy, water, organic and mineral matter, and biota across landscapes. They maintain water quality, provide flood and erosion protection, and often support old-growth forests (Timoney et al. 1997a). They are characterized by high diversity of communities, species, ecological structure and function, and physical processes (Naiman et al. 1993). Boreal lakes, rivers, and their valleys are under significant human pressures from water diversions and dams, oil and gas development, logging, transportation, agriculture and grazing, water and air pollution, weed invasion, fishing, recreation, stratospheric ozone depletion, acid precipitation, and climate change (Auble et al. 1994; Harper et al. 1992; Décamps 1993; Schindler 1998a). Clearly, boreal waters are both critically important and threatened: they have high conservation value.

Depicting the spatial extent of surface water is not straightforward at present as (1) small water bodies may be missing from surface hydrology data; and (2) the extent of small water bodies is exaggerated in plotting at the scale of the study area due to pen thickness. To produce an interim surface water extent, I merged the hydrology layers of major lakes and rivers with those of non-bog wetlands (Map 8). About 32% of the FMA area (using a 6.1 million ha area, including the 'donut holes') is covered by wetlands (Table 19a). By wetland type, about 23.5% of the FMA is covered by fens, compared to 8.6% for bogs, 0.05% for marshes, and 0.02% for swamps. Of the wetland extent in the study area, circa 73.1% are fens, while 26.7% are bogs.

Since bogs often lack surface water, I omitted bogs from Map 8 (which is limited to the FMA proper, 5.8 million ha). Surface water covers circa 26.4% of the FMA proper (Table 22), principally as fens. Fens are most abundant in a triangle formed by the Fort Hills, Thickwood Hills, and the Birch Mountains; in the area of Ft. McMurray; and as a discontinuous band extending ENE from Calling Lake to the Saskatchewan border.

The eight high conservation attributes cover a large proportion of the FMA area (Map 9, Table 22). This multiple-theme map is presented as an interpretation tool for the generalized polygons of Map 10. Overlap of multiple themes in Map 9 makes a confusing plot— the more complex the area, the higher the conservation rank. The map is useful chiefly as to means to determine what attributes are present in the ranked polygons of Map 10.

Assuming a study area of 5.816 million ha (Table 22), the two largest contributors to HCVF area are caribou zones and intact blocks. Old-growth (without the black spruce component) forests cover 9.4%, and national ESAs cover 4.6% of the area. The two smallest contributors to HCVF area are rare elements (species and breeding sites, in 78.5 ha buffers) and currently protected areas.

Table 22. Areal estimates of the eight high conservation value attributes in the FMA proper. Areas and proportions due not sum to 58156 km2 and 100% due to overlap in themes.

HCVF Attribute Areas within the FMA (km2) (FMA Area 58156 km2)	Km2	% of FMA area
Dry Mixedwood buffered by 50 km	10756.38	18.5
Caribou Zones	21260.95	36.6
National ESAs	2666.67	4.6
Intact Blocks	19548.97	33.6
Old-growth Forests (no black spruce)	5466 .43	9.4
Surface Water (non-bog)	15328.34	26.4
Rare elements	82.96	0.14
Protected Areas	557.38	0.96

Map 10 and Table 23 present the same data in a format that conveys a conservation rank according to overlap in attributes. In this depiction, the lowest value areas have none of the 8 attributes (20.3% of the FMA area). The highest ranked areas, supporting 4-6 overlapping attributes, are associated with the Athabasca River valley upstream of Ft. McMurray.

The highest ranked area overall lies northeast of Calling Lake in the McMillan Lake and Parallel Creek area of the Athabasca River. Attributes overlapping in this area include the Dry Mixedwood with 50 km buffer, old-growth forests, woodland caribou range, surface waters, national ESA, and intact forest (Figure 17). There is an extensive marsh bordering McMillan Lake (see Map 8). Note the nesting of the conservation ranks from white (0), through tan (1), gray (2), blue (3), green (4), orange (5), and red (6 attributes). The sharp transitions to lower ranks outside the FMA border are artifact due to absence of some datasets.

Other high-ranked areas include the Thickwood Hills, the area north of the Thickwood Hills, areas north and east of both Utikuma and Calling Lakes, the Athabasca, Clearwater, and Firebag Rivers, McClelland Lake and Fen, the area east of the Cold Lake Air Weapons Range, and areas along the Saskatchewan border. The Liege River, northeast of Peerless Lake, supports three high conservation value attributes (old-growth forest, intact block, and caribou range).

Circa 79.7% of the FMA area supports at least one HCVF attribute; 43.7% of the FMA area supports one attribute, 27.3% supports two attributes, 7.3% supports three attributes, 1.2% supports four attributes, 0.083% supports five attributes, and 0.003% supports six overlapping attributes. Many of the areas supporting high numbers of overlapping HCVs are associated with river valleys or wetlands.

Such a spatial description of HCVF status might inform Al-Pac and WWF in regards to protection of HCVF features. Protecting only 8.6% of the FMA could advance protection measurably in that the highest rated areas (areas supporting 3-6 overlapping attributes) could be protected. At a minimum, areas supporting 5 to 6 overlapping attributes should receive immediate deferment from human disturbances. With the assistance of GIS, all polygons supporting 5-6 attributes should be identified and protected; they cover only 49.6 km2, circa 0.086% of the FMA area.

Table 23. Areal estimates by conservation rank (overlap of the eight high conservation value

attributes) in the FMA proper. No areas supported 7 or 8 overlapping attributes (see Map 10).

Number of Overlapping Attributes	Km2	% of FMA area	Cumulative % of FMA area
0	11824.2	20.3	20.3
1	25439.1	43.7	64.1
2	15893.4	27.3	91.4
3	4223.4	7.3	98.7
4	726.1	1.2	99.9
5	48.1	0.083	100.0
6	1.5	0.003	100.0
Totals	58155.8	100.0	100.0

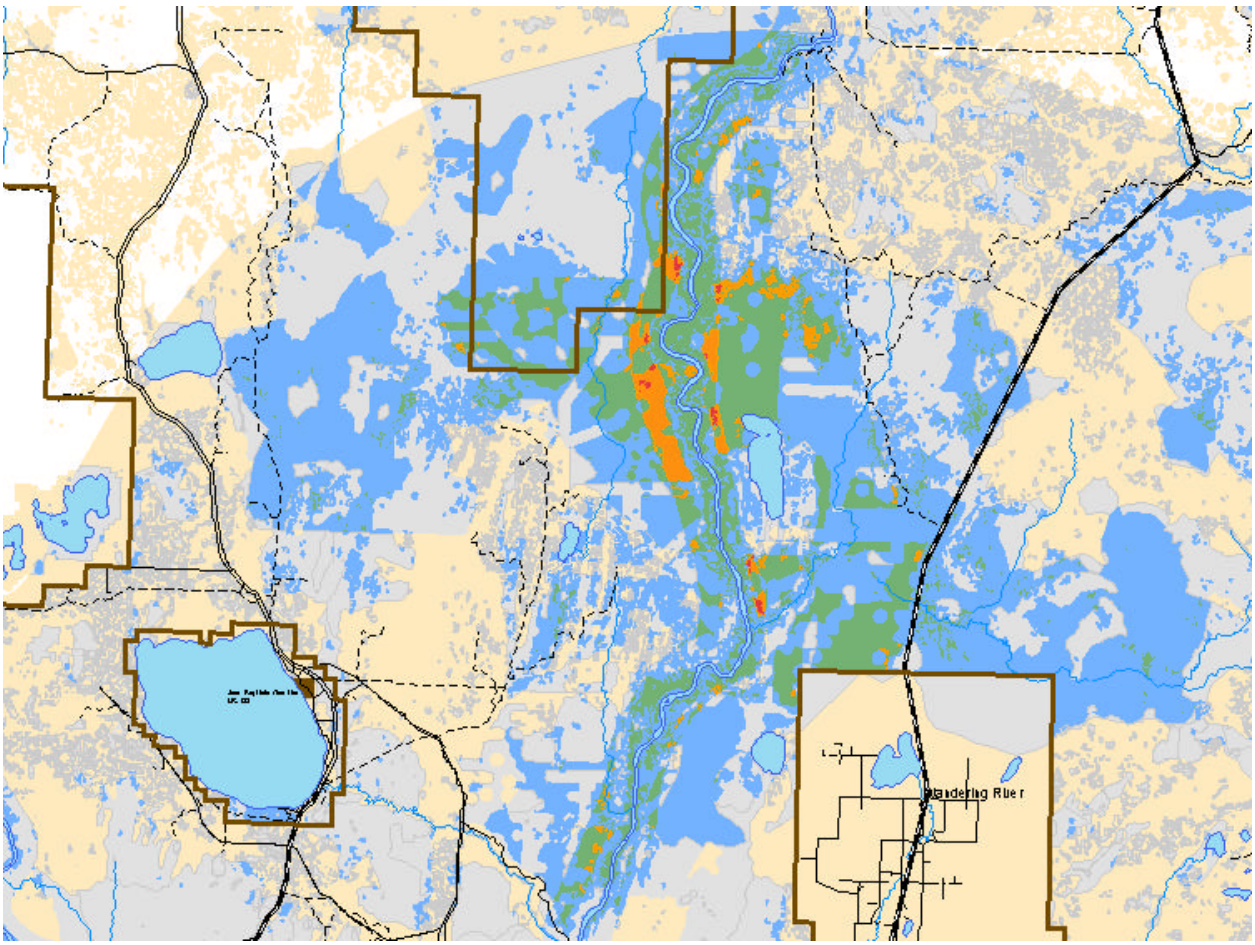


Figure 17. Detail of conservation ranks centered on the Athabasca River area northeast of Calling Lake. The elongate lake near plot center is McMillan Lake. Detail excerpted from Map 10.

Conclusions

This assessment confirms the existence of High Conservation Value Forests within the study region. The ecoregion supports species and communities at risk, supports endemic species, contains critical breeding areas and migration sites, supports species at the edges of their ranges, and supports both rare and declining species and communities.

The ecoregion supports features of international to regional significance.

The list of HCVs is long. Some of the highlights are:

Ecosystems and Landscapes: the Peace-Athabasca Delta, the Athabasca Dunes, Utikuma Lake, the Athabasca and Clearwater Rivers, and large intact forests and landscapes.

Communities and Habitats: old-growth forests, saline wetlands, large wetland complexes, rare forest types, dry grasslands, woodland caribou habitat.

Rare Species: Peregrine Falcon, Whooping Crane, Sprague's Pipit, Loggerhead Shrike, Woodland Caribou, Grizzly Bear, Cougar, Wolverine, and sand dune endemic plants.

Characteristic species that may be of conservation concern include Canadian and Western Toads; American White Pelican, Bay-breasted, Black-throated Green, Blackburnian, Canada, and Cape May Warblers, Black-backed and Pileated Woodpeckers, Sandhill Crane, Western Tanager; Fisher, Lynx, River Otter; several sedge species, and Pitcher Plant.

Maintenance of HCVFs will require more than science, technology, and good intentions. It will require original thinking and management systems and commitment. Meaningful stakeholder involvement, integrated planning, and an assessment of how current management decisions affect the future ecosystem are needed (Schneider et al. 2003).

The majority of the land disturbed annually on the Al-Pac FMA area lies outside the company's management authority. Two impediments to better management in Alberta are the present lack of a scientifically defensible protected areas network, and the inability of forest companies to control the activities of the petroleum industry (NGO 2001). This presents a serious challenge to management. Currently there is a wide gulf between the ecological understanding of boreal forests and the policies (characterized by short-term economics and resistance to change) that constrain boreal forest management (Burton and Kuuluvainen 2001).

If Al-Pac can change long-standing forestry and other land use practices, many of which the company is not directly responsible for, it will become a world leader in innovative ecosystem management. Its success will determine in large measure whether the high conservation values identified in this report will be lost, maintained, or enhanced in the coming years.

Distribution Note

The Al-Pac policy of scientific openness and public dialogue is praiseworthy. In keeping with the policy of openness, I suggest that this report be made publicly available, perhaps in online pdf format. At the very least, those people listed in Information Sources should be offered a copy of the report.

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Appendices

Notes on some file names.

The native document = *hcvf final report.wpd* (*.pdf).

The GIS project file = *hcvf2.apr*.

Table 12 source = *hcvf table 12.xls*.

Grizzly bear and fish information = *grizzly and fish re alpac.xls*

Alberta breeding birds survey data = *bl_recs1.xls*.

Alberta Natural Heritage Information Centre data = *ktimoney.zip*.

Saskatchewan Conservation Data Centre data = *wwfrequest.zip.*

Manitoba Conservation Data Centre data = *manitoba.zip*.

Note: rare element occurrence locations were transformed to a standard map projection by Matthew Smith.

Appendix 1. Definitions of element occurrence rank codes.

S1 designates element occurrences of </=5 occurrences in a provincial jurisdiction (e.g., Alberta).

S2 = 6-20 element occurrences.

S3 = 21-100 element occurrences.

S1S3, S2S3, S3S4 = ranks of uncertain occurrence frequency.

SU = rank uncertain.

S?= not yet ranked.

SH = historically known.

For ranks followed by a B, Z, or N, the suffixes apply to migratory birds: B is the breeding period, N is the non-breeding period. The Z rank means "zero features of conservation significance" (Jeff Keith, Saskatchewan CDC, pers. comm. January 2003).

Appendix 2. Tables 1 through 12, 16.

Appendix Table 1. Locations of rare Alberta plant and animal element occurrences in the study region. Colonial bird nesting colonies include those of American White Pelican, California Gull, Common Tern, Double-crested Cormorant, Franklin's Gull, Ring-billed Gull, and Western Grebe. Data provided courtesy of ANHIC, Edmonton, December, 2002. Tmeast and Tmnorth coordinates are based on a NAD83 10TM (Transverse Mercator) projection.

Tmeast	Tmnorth	Scientific Name	Common Name	Rank	Survey Date	Last Observ.
702187	6332101	Aloina brevirostris	short-beaked rigid screw	S2	1976-07-12	1976-07-12
464367	5996233	Aloina brevirostris	short-beaked rigid screw	S2	1964-09-20	1964-09-20
464367	5996233	Aloina rigida	aloe-like rigid screw moss	S2	1964-09-20	1964-09-20
797618	6292247	Anomodon minor	moss	S1	1987-07-28	1987-07-28
467647	5999139	Aongstroemia longipes	moss	S2	1976-05-16	1976-05-16
711468	6328438	Arabidopsis salsuginea	mouse-ear cress	S1	1991-07-28	1991-07-28
723653	6288023	Artemisia tilesii	Herriot's sagewort	S2	1979-07-30	1979-07-30
645393	6647456	Artemisia tilesii	Herriot's sagewort	S2	1972-07-21	1972-07-21
720988	6292476	Artemisia tilesii	Herriot's sagewort	S2	1935-09-10	1935-09-10
700980	6359479	Artemisia tilesii	Herriot's sagewort	S2	2000-08-28	2000-08-28
701175	6361268	Artemisia tilesii	Herriot's sagewort	S2	2000-08-24	2000-08-24
702989	6475547	Artemisia tilesii	Herriot's sagewort	S2	2000-08-25	2000-08-25
523609	6022847	Aster x maccallae	Maccalla's aster	S1S2	1997-08-24	1997-08-24
720582	6290849	Astragalus bodinii	Bodin's milk vetch	S1	1953-07-09	1953-07-09
537214	6307426	Astragalus bodinii	Bodin's milk vetch	S1	1977-07-27	1977-07-27
464283	6208267	Bacidia bagliettoana	lichen	S2	1968-08-18	1968-08-18
546512	6276663	Barbarea orthoceras	American winter cress	S2	1999-07-05	1999-07-05
641980	6367999	Bird colony	bird colony	S?	1998-06-09	1998-06-09
637518	6343001	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
610127	6182875	Bird colony	bird colony	S?	2000-07-05	2000-07-05
610127	6182875	Bird colony	bird colony	S?	1991-06-01	1991-06-01
592532	6135109	Bird colony	bird colony	S?	2000-07-05	2000-07-05
592532	6135109	Bird colony	bird colony	S?	2000-07-05	2000-07-05
729871	6046528	Bird colony	bird colony	S?	1998-06-05	1998-06-05
729871	6046528	Bird colony	bird colony	S?	1998-06-05	1998-06-05
610206	6185833	Bird colony	bird colony	S?	2000-07-05	2000-07-05
758046	6065275	Bird colony	bird colony	S?	1998-06-05	1998-06-05
701365	6065942	Bird colony	bird colony	S?	1988-XX-XX	1988-XX-
715355	6059527	Bird colony	bird colony	S?	1991-XX-XX	1980-XX-
710385	6060596	Bird colony	bird colony	S?	1991-XX-XX	1988-XX-
710385	6060596	Bird colony	bird colony	S?	1998-05-30	1998-05-30
578530	6038314	Bird colony	bird colony	S?	1995-XX-XX	1995-XX-
711298	6144345	Bird colony	bird colony	S?	1994-XX-XX	1994-XX-
780682	6160967	Bird colony	bird colony	S?	1997-08-12	1997-08-12
817633	6042604	Bird colony	bird colony	S?	1989-XX-XX	1989-XX-
801492	6049679	Bird colony	bird colony	S?	1989-XX-XX	1989-XX-
790568	6056699	Bird colony	bird colony	S?	1995-XX-XX	1995-XX-
797431	6060272	Bird colony	bird colony	S?	1980-XX-XX	1980-XX-
774312	6057928	Bird colony	bird colony	S?	1982-XX-XX	1982-XX-
774312	6057928	Bird colony	bird colony	S?	1982-XX-XX	1982-XX-
772379	6057116	Bird colony	bird colony	S?	1982-XX-XX	1982-XX-
758672	6064201	Bird colony	bird colony	S?	1998-06-05	1998-06-05
758672	6064201	Bird colony	bird colony	S?	1998-06-05	1998-06-05

763292	6067971	Bird colony	bird colony	S?	1982-XX-XX	1982-XX-
729595	6046964	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
724331	6054077	Bird colony	bird colony	S?	1985-XX-XX	1985-XX-
733379	6058801	Bird colony	bird colony	S?	1993-XX-XX	1993-XX-
722928	6047936	Bird colony	bird colony	S?	1981-XX-XX	1981-XX-
731793	6078698	Bird colony	bird colony	S?	1993-XX-XX	1993-XX-
592448	6066283	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
725201	6102867	Bird colony	bird colony	S?	1998-07-09	1998-07-09
732779	6142326	Bird colony	bird colony	S?	1986-XX-XX	1986-XX-
782527	6151552	Bird colony	bird colony	S?	1982-XX-XX	1982-XX-
781116	6152122	Bird colony	bird colony	S?	1981-XX-XX	1981-XX-
781116	6152122	Bird colony	bird colony	S?	1997-08-12	1997-08-12
758368	6169050	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
564424	6101238	Bird colony	bird colony	S?	1992-XX-XX	1992-XX-
603869	6149477	Bird colony	bird colony	S?	2000-07-05	2000-07-05
570860	6199723	Bird colony	bird colony	S?	2000-07-05	2000-07-05
784329	6256291	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
794447	6260689	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
774986	6269577	Bird colony	bird colony	S?	1991-XX-XX	1991-XX-
656747	6478816	Bird colony	bird colony	S?	1978-08-13	1978-08-13
731634	6486384	Bird colony	bird colony	S?	1975-XX-XX	1975-XX-
725604	6477858	Bird colony	bird colony	S?	1975-XX-XX	1975-XX-
725604	6477858	Bird colony	bird colony	S?	1975-XX-XX	1975-XX-
730407	6480073	Bird colony	bird colony	S?	1975-XX-XX	1975-XX-
552130	6041480	Bird colony	bird colony	S?	1992-XX-XX	1992-XX-
514509	6036852	Bird colony	bird colony	S?	1998-07-02	1998-07-02
478820	6190547	Bird colony	bird colony	S?	1980-XX-XX	1980-XX-
544807	6293607	Bird colony	bird colony	S?	1991-06-06	1991-06-06
460546	6396692	Bird colony	bird colony	S?	2000-07-20	2000-07-20
423463	6290107	Bird colony	bird colony	S?	1984-08-23	1984-08-23
592653	6092021	Bird colony	bird colony	S?	1979-XX-XX	1979-XX-
527028	6266784	Bird colony	bird colony	S?	1980-XX-XX	1980-XX-
758946	6287682	Blysmus rufus	Red Bulrush	S1	1983-06-28	1983-06-28
696500	6296229	Botrychium minganense	Mingan grape fern	S2S3	1996-08-03	1996-08-03
578942	6035435	Botrychium multifidum var in	leather grape fern	S2	1989-08-10	1989-08-10
679711	6195260	Botrychium multifidum var in	leather grape fern	S2	1996-08-05	1996-08-05
411160	6300316	Botrychium pinnatum	fern	S1	1999-07-18	1999-07-18
758224	6065027	Brachythecium rutabulum	moss	S2?	1977-07-06	1977-07-06
732407	6265089	Brachythecium rutabulum	moss	S2?	1975-08-25	1975-08-25
744811	6323730	Brachythecium rutabulum	moss	S2?	1976-07-05	1976-07-05
711264	6322515	Brachythecium rutabulum	moss	S2?	1976-06-25	1976-06-25
520655	6017382	Brachythecium rutabulum	moss	S2?	1997-08-22	1997-08-22
467647	5999139	Bryobrittonia longipes	moss	S3	1976-05-16	1976-05-16
703676	6334042	Bryoria nadvornikiana	old man’s beard	S2	1975-XX-XX	1975-XX-
704835	6329226	Bryoria simplicior	old man’s beard	S2S3	1974-05-16	1974-05-16
446515	5996138	Bryum algovicum	moss	S2	1961-08-28	1961-08-28
755829	6326381	Bryum cyclophyllum	moss	S1S2	1976-07-04	1976-07-04
709538	6326321	Bryum pallens	moss	S2	1976-07-29	1976-07-29
809340	6059723	Calopteryx aequabilis	River Jewelwing	S1	1979-07-04	1979-07-04
772131	6297021	Calopteryx aequabilis	River Jewelwing	S1	1996-07-06	1996-07-06
741845	6463844	Calopteryx aequabilis	River Jewelwing	S1	2000-06-21	2000-06-21
721838	6348934	Calypogeia muelleriana	liverwort	S?	1975-09-02	1975-09-02
490787	6186731	Calypogeia neesiana	liverwort	S1S2	1981-07-30	1981-07-30

788467	6153698	Campylium polygamum	moss	S3	1989-06-16	1989-06-16
731361	6284716	Campylium polygamum	moss	S3	1975-08-26	1975-08-26
520655	6017382	Campylium polygamum	moss	S3	1997-08-22	1997-08-22
522823	6016271	Campylium polygamum	moss	S3	1997-08-22	1997-08-22
525724	6028685	Campylium polygamum	moss	S3	1997-06-18	1997-06-18
529715	6023124	Campylium polygamum	moss	S3	1997-06-21	1997-06-21
519482	6016566	Campylium radicale	moss	S2	1997-08-23	1997-08-23
522823	6016271	Campylium radicale	moss	S2	1997-08-22	1997-08-22
524335	6016728	Campylium radicale	moss	S2	1997-08-22	1997-08-22
561548	6094791	Cardamine pratensis	meadow bitter cress	S1S2	1950-06-16	1950-06-16
726569	6080704	Cardamine pratensis	meadow bitter cress	S1S2	1993-06-19	1993-06-19
687599	6317383	Cardamine pratensis	meadow bitter cress	S1S2	1999-06-18	1999-06-18
455219	5998042	Carex adusta	browned sedge	S1	1960-07-07	1960-07-07
452234	6000326	Carex arcta	narrow sedge	S1	1962-07-05	1962-07-05
647891	6578246	Carex arcta	narrow sedge	S1	1928-07-14	1928-07-14
593963	6083562	Carex backii	Back’s sedge	S2	1998-06-11	1998-06-11
593752	6084626	Carex backii	Back’s sedge	S2	2000-06-25	2000-06-25
592560	6086282	Carex backii	Back’s sedge	S2	2002-08-16	2002-08-16
593184	6085435	Carex backii	Back’s sedge	S2	2002-08-16	2002-08-16
676426	6651087	Carex capitata	capitate sedge	S2	1950-07-19	1950-07-19
434482	6003827	Carex capitata	capitate sedge	S2	1963-06-30	1963-06-30
685990	6642049	Carex capitata	capitate sedge	S2	1950-07-24	1950-07-24
682362	6645711	Carex capitata	capitate sedge	S2	1950-06-18	1950-06-18
654665	6649820	Carex capitata	capitate sedge	S2	1965-07-14	1965-07-14
722101	6441679	Carex capitata	capitate sedge	S2	2000-06-22	2000-06-22
751902	6067823	Carex heleonastes	Hudson Bay sedge	S2	1982-06-22	1982-06-22
746947	6062029	Carex heleonastes	Hudson Bay sedge	S2	1982-06-22	1982-06-22
762584	6072040	Carex heleonastes	Hudson Bay sedge	S2	1981-06-22	1981-06-22
713722	6321607	Carex houghtoniana	sand sedge	S2	1968-06-21	1968-06-21
593410	6084907	Carex hystericina	porcupine sedge	S1	2000-09-08	2000-09-08
593875	6082031	Carex hystericina	porcupine sedge	S1	2000-09-08	2000-09-08
593875	6082031	Carex hystericina	porcupine sedge	S1	2000-09-08	2000-09-08
728616	6082574	Carex lacustris	lakeshore sedge	S2	1967-06-24	1967-06-24
593523	6083812	Carex lacustris	lakeshore sedge	S2	2002-08-15	2002-08-15
594125	6083346	Carex lacustris	lakeshore sedge	S2	1998-07-06	1998-07-06
521725	6020751	Carex lacustris	lakeshore sedge	S2	1997-08-23	1997-08-23
526116	6021351	Carex lacustris	lakeshore sedge	S2	1997-06-16	1997-06-16
593752	6084626	Carex lacustris	lakeshore sedge	S2	2000-08-04	2000-08-04
593752	6084626	Carex lacustris	lakeshore sedge	S2	2000-08-04	2000-08-04
593035	6083584	Carex lacustris	lakeshore sedge	S2	2000-08-04	2000-08-04
593035	6083584	Carex lacustris	lakeshore sedge	S2	2000-08-04	2000-08-04
591720	6086012	Carex lacustris	lakeshore sedge	S2	2000-08-04	2000-08-04
591720	6086012	Carex lacustris	lakeshore sedge	S2	2000-08-04	2000-08-04
593947	6085588	Carex lacustris	lakeshore sedge	S2	2002-08-15	2002-08-15
682567	6179650	Carex oligosperma	few-fruited sedge	S1S2	1983-07-22	1983-07-22
729070	6448358	Carex oligosperma	few-fruited sedge	S1S2	2000-08-22	2000-08-22
708665	6319007	Carex pseudocyperus	cyperus-like sedge	S2	1999-07-08	1999-07-08
593410	6084907	Carex pseudocyperus	cyperus-like sedge	S2	2002-08-15	2002-08-15
593035	6083584	Carex pseudocyperus	cyperus-like sedge	S2	2000-08-01	2000-08-01
593035	6083584	Carex pseudocyperus	cyperus-like sedge	S2	2000-08-01	2000-08-01
591720	6086012	Carex pseudocyperus	cyperus-like sedge	S2	2000-08-01	2000-08-01
593947	6085588	Carex pseudocyperus	cyperus-like sedge	S2	2002-08-15	2002-08-15
714329	6442311	Carex pseudocyperus	cyperus-like sedge	S2	2000-06-19	2000-06-19

754323	6068412	Carex retrorsa	turned sedge	S2S3	1977-07-20	1977-07-20
702957	6338608	Carex retrorsa	turned sedge	S2S3	1979-07-30	1979-07-30
566604	6505983	Carex retrorsa	turned sedge	S2S3	1930-07-31	1930-07-31
690467	6320544	Carex retrorsa	turned sedge	S2S3	1999-07-29	1999-07-29
703051	6363858	Carex retrorsa	turned sedge	S2S3	2000-08-26	2000-08-26
784783	6054398	Carex retrorsa	turned sedge	S2S3	2001-08-09	2001-08-09
787687	6052577	Carex retrorsa	turned sedge	S2S3	2001-08-11	2001-08-11
754393	6231650	Carex rostrata	beaked sedge	S2	1990-09-04	1990-09-04
741988	6452178	Carex rostrata	beaked sedge	S2	1975-08-01	1975-08-01
554170	6104199	Carex rostrata	beaked sedge	S2	1989-08-15	1989-08-15
553216	6104926	Carex rostrata	beaked sedge	S2	1989-08-15	1989-08-15
593752	6084626	Carex rostrata	beaked sedge	S2	2000-08-04	2000-08-04
703658	6360788	Carex rostrata	beaked sedge	S2	2000-08-XX	2000-08-XX
790945	6057122	Carex vulpinoidea	fox sedge	S2	1995-07-30	1995-07-30
790261	6057684	Carex vulpinoidea	fox sedge	S2	1995-07-06	1995-07-06
668470	6629419	Charadrius semipalmatus	Semipalmated Plover	SAB	2002-07-04	2002-07-04
493460	6327554	Cladina portentosa	lichen	S1	1990-08-19	1990-08-19
692938	6129591	Cladina stygia	lichen	S1	1988-09-12	1988-09-12
437948	6175878	Cladonia bacilliformis	lichen	S2S3	1981-07-29	1981-07-29
781271	6149876	Cladonia bellidiflora	lichen	S2S3	1989-06-19	1989-06-19
547694	6111082	Cladonia cyanipes	lichen	S2	1981-07-23	1981-07-23
566735	6370523	Cladonia cyanipes	lichen	S2	1978-08-03	1978-08-03
721109	6286973	Cladonia ramulosa	lichen	S1	1976-XX-XX	1976-XX-
788467	6153698	Cladonia squamosa	lichen	S2	1989-XX-XX	1989-XX-
673731	6641407	Coenonympha tullia ochracea	Ochre Ringlet	S1	1981-06-23	1981-06-23
684496	6643962	Coenonympha tullia ochracea	Ochre Ringlet	S1	1981-06-23	1981-06-23
701692	6589798	Coenonympha tullia ochracea	Ochre Ringlet	S1	2001-07-11	2001-07-11
758773	6063305	Conardia compacta	moss	S2	1980-04-26	1980-04-26
706715	6141728	Cynodontium tenellum	moss	S2S3	1978-06-06	1978-06-06
680074	6194179	Cyphelium tigillare	lichen	S2	1985-05-25	1985-05-25
699682	6600297	Dendroica tigrina	Cape May Warbler	S2B	1933-05-29	1933-05-29
712046	6326268	Dermatocarpon moulinsii	lichen	S2	1976-XX-XX	1976-XX-
684428	6182112	Diphasiastrum sitchense	ground-fir	S2	1983-06-23	1983-06-23
739058	6458977	Diphasiastrum sitchense	ground-fir	S2	2000-06-23	2000-06-23
715779	6371871	Drepanocladus sendtneri	brown moss	S2	1982-06-09	1982-06-09
562519	6107758	Drosera linearis	slender-leaved sundew	S2	1981-07-28	1981-07-28
741572	6062724	Drosera linearis	slender-leaved sundew	S2	1998-06-21	1998-06-21
714051	6370432	Drosera linearis	slender-leaved sundew	S2	2001-07-07	2001-07-07
701188	6347419	Dryopteris filix-mas	male fern	S1	1977-08-06	1977-08-06
774271	6401118	Eleocharis tenuis	slender spike-rush	SU	2000-08-23	2000-08-23
809007	6055896	Enodia anthedon	Northern Pearly-eye	S1	1990-07-01	1990-07-01
803424	6052721	Enodia anthedon	Northern Pearly-eye	S1	1990-07-04	1990-07-04
519745	6017033	Entodon schleicheri	moss	S1	1997-08-23	1997-08-23
520655	6017382	Entodon schleicheri	moss	S1	1997-08-22	1997-08-22
714808	6320168	Entodon schleicheri	moss	S1	1976-08-01	1976-08-01
700131	6353468	Entodon schleicheri	moss	S1	1976-07-10	1976-07-10
562519	6107758	Epilobium lactiflorum	Willowherb	S2	1941-07-29	1941-07-29
676616	6649195	Erigeron hyssopifolius	wild daisy fleabane	S1	1950-07-08	1950-07-08
803012	6292588	Eupatorium maculatum	spotted Joe-pye weed	S1S2	1985-08-08	1985-08-08
798011	6293248	Eupatorium maculatum	spotted Joe-pye weed	S1S2	1995-07-22	1995-07-22
774373	6295523	Eupatorium maculatum	spotted Joe-pye weed	S1S2	1986-08-09	1986-08-09
788411	6155549	Flavopunctelia soredica	lichen	S2	1991-05-29	1991-05-29
705071	6535196	Frullania inflata	liverwort	S1	1971-06-08	1971-06-08

675898	6649051	Gavia pacifica	Pacific Loon	SAB	1985-08-09	1985-08-09
711468	6328438	Gentianopsis detonsa ssp raupii	northern fringed gentian	S1	1991-07-28	1991-07-28
734559	6263411	Herzogiella turfacea	moss	S2	1975-09-01	1975-09-01
453318	5997996	Herzogiella turfacea	moss	S2	1965-09-12	1965-09-12
520655	6017382	Heterodermia speciosa	lichen	S2	1997-08-22	1997-08-22
521821	6021498	Heterodermia speciosa	lichen	S2	1997-08-21	1997-08-21
548192	6151055	Heterodermia speciosa	lichen	S2	1971-XX-XX	1971-XX-
474698	6000939	Heterodermia speciosa	lichen	S2	1964-XX-XX	1964-XX-
529578	6023577	Heterodermia speciosa	lichen	S2	1997-06-19	1997-06-19
747579	6467053	Huperzia selago	mountain club-moss	S1	2000-06-16	2000-06-16
646201	6260066	Hybognathus hankinsoni	brassy minnow	S2	1996-05-22	1996-05-22
731436	6361221	Hygroamblystegium noterophilum	moss	SU	1976-07-01	1976-07-01
801931	6291347	Hygroamblystegium tenax	moss	S2	1987-07-28	1987-07-28
755829	6326381	Hygroamblystegium tenax	moss	S2	1976-07-04	1976-07-04
437008	6004756	Hygroamblystegium tenax	moss	S2	1963-10-05	1963-10-05
691282	6112643	Hypericum majus	large Canada St. John's-	S2	1981-07-09	1981-07-09
741988	6452178	Hypericum majus	large Canada St. John's-	S2	1975-07-30	1975-07-30
706453	6366914	Hypericum majus	large Canada St. John's-	S2	2000-07-05	2000-07-05
706835	6366811	Hypericum majus	large Canada St. John's-	S2	2000-07-05	2000-07-05
773652	6401346	Hypericum majus	large Canada St. John's-	S2	2000-06-14	2000-06-14
771620	6411150	Hypericum majus	large Canada St. John's-	S2	2000-06-15	2000-06-15
747579	6467053	Hypericum majus	large Canada St. John's-	S2	2000-06-16	2000-06-16
722966	6452498	Hypericum majus	large Canada St. John's-	S2	2000-06-15	2000-06-15
733616	6460674	Hypericum majus	large Canada St. John's-	S2	2000-08-24	2000-08-24
718117	6295314	Hypnum callichroum	moss	S1	1975-08-25	1975-08-25
735120	6264095	Hypnum pallescens	moss	S1	1975-09-01	1975-09-01
694339	6131800	Imshaugia placorodia	American starburst lichen	S2	1978-06-09	1978-06-09
787421	6291351	Imshaugia placorodia	American starburst lichen	S2	1978-08-09	1978-08-09
729341	6250633	Isoetes echinospora	northern quillwort	S1	1996-08-30	1996-08-30
771442	6411520	Isoetes echinospora	northern quillwort	S1	2000-06-15	2000-06-15
707275	6142010	Juncus brevicaudatus	short-tail rush	S2	1968-07-25	1968-07-25
741901	6450269	Juncus brevicaudatus	short-tail rush	S2	1980-08-08	1980-08-08
771442	6411520	Juncus brevicaudatus	short-tail rush	S2	2000-06-15	2000-06-15
747579	6467053	Juncus brevicaudatus	short-tail rush	S2	2000-06-16	2000-06-16
741176	6452596	Juncus brevicaudatus	short-tail rush	S2	2000-06-19	2000-06-19
741352	6452887	Juncus brevicaudatus	short-tail rush	S2	2000-06-17	2000-06-17
733039	6260692	Juncus filiformis	thread rush	S2S3	1979-07-26	1979-07-26
780557	6292603	Juncus filiformis	thread rush	S2S3	1983-06-30	1983-06-30
761030	6291461	Juncus filiformis	thread rush	S2S3	1983-06-30	1983-06-30
682252	6181635	Juncus filiformis	thread rush	S2S3	1983-07-22	1983-07-22
678606	6184930	Juncus filiformis	thread rush	S2S3	1983-07-06	1983-07-06
442298	6004357	Juncus filiformis	thread rush	S2S3	1997-06-28	1997-06-28
628910	6595733	Juncus filiformis	thread rush	S2S3	1929-08-20	1929-08-20
686676	6323277	Juncus filiformis	thread rush	S2S3	1999-07-25	1999-07-25
729711	6250304	Juncus stygius var americanus	marsh rush	S2	1996-08-04	1996-08-04
733039	6260692	Lactuca biennis	tall blue lettuce	S2	1979-07-26	1979-07-26
451255	6001054	Lactuca biennis	tall blue lettuce	S2	1997-07-29	1997-07-29
674499	6532113	Lagopus lagopus	Willow Ptarmigan	S1B	1962-12-02	1962-12-02
699682	6600297	Lagopus lagopus	Willow Ptarmigan	S1B	1933-11-07	1933-11-07
645842	6553159	Lagopus lagopus	Willow Ptarmigan	S1B	1962-12-05	1962-12-05
599691	6566636	Lagopus lagopus	Willow Ptarmigan	S1B	1961-12-18	1961-12-18
619052	6620125	Lagopus lagopus	Willow Ptarmigan	S1B	1933-04-02	1933-04-02
678246	6652049	Lampetra japonica	Arctic lamprey	S1	1983-08-29	1983-08-29

701696	6586392	Larus canus	Mew Gull	S2B	2001-07-10	2001-07-10
439855	6004626	Lecania dubitans	lichen	S2	1965-03-07	1965-03-07
734559	6263411	Lecanora cateilea	lichen	S2	1990-08-07	1990-08-07
662731	6158025	Lecanora cateilea	lichen	S2	1978-06-15	1978-06-15
548333	6055583	Leucorrhinia glacialis	Crimson-ringed Whiteface	S1S3	1962-05-30	1962-05-30
672261	6617252	Lomatogonium rotatum	marsh felwort	S2S3	1928-08-20	1928-08-21
437008	6004756	Lophozia badensis	Liverwort	S1	1964-09-20	1964-09-20
424134	6423468	Luzula rufescens	reddish wood-rush	S1	1993-06-15	1993-06-15
741988	6452178	Lycopodiella inundata	bog club-moss	S1	1975-07-30	1975-07-30
747579	6467053	Lycopodiella inundata	bog club-moss	S1	2000-06-16	2000-06-16
741482	6463959	Lycopodiella inundata	bog club-moss	S1	2000-06-17	2000-06-17
519745	6017033	Malaxis monophylla	white adder’s-mouth	S2	1997-08-23	1997-08-23
520655	6017382	Malaxis monophylla	white adder’s-mouth	S2	1997-08-22	1997-08-22
717746	6071609	Malaxis monophylla	white adder’s-mouth	S2	1995-07-08	1995-07-08
730759	6284731	Malaxis monophylla	white adder’s-mouth	S2	1993-XX-XX	1993-XX-
594118	6084347	Malaxis monophylla	white adder’s-mouth	S2	2000-08-02	2000-08-02
593035	6083584	Malaxis monophylla	white adder’s-mouth	S2	2000-08-02	2000-08-02
592537	6084857	Malaxis monophylla	white adder’s-mouth	S2	2000-08-02	2000-08-02
591264	6086494	Malaxis monophylla	white adder’s-mouth	S2	2002-08-16	2002-08-16
591646	6086524	Malaxis monophylla	white adder’s-mouth	S2	2002-08-16	2002-08-16
592560	6086282	Malaxis monophylla	white adder’s-mouth	S2	2002-08-16	2002-08-16
594036	6085309	Malaxis monophylla	white adder’s-mouth	S2	2002-08-15	2002-08-15
594118	6084347	Malaxis paludosa	bog adder’s-mouth	S1	2002-08-15	2002-08-15
594206	6084034	Malaxis paludosa	bog adder’s-mouth	S1	2002-08-15	2002-08-15
685276	6291590	Meesia longiseta	moss	S1	1982-05-23	1982-05-23
502744	6030063	Melanelia multispora	lichen	S2?	1968-XX-XX	1968-XX-
558274	6114877	Melanelia multispora	lichen	S2?	1989-08-17	1989-08-17
528802	6026149	Melanelia olivacea	lichen	S1	1997-06-16	1997-06-16
527922	6023325	Melanelia olivacea	lichen	S1	1997-06-21	1997-06-21
527458	6022838	Melanelia olivacea	lichen	S1	1997-06-22	1997-06-22
521595	6024104	Melanelia olivacea	lichen	S1	1997-08-21	1997-08-21
675603	6652690	Microtus xanthognathus	Taiga Vole	SH	1941-XX-XX	1901-07-19
641300	6149330	Microtus xanthognathus	Taiga Vole	SH	1904-08-29	1904-08-29
648210	6242758	Microtus xanthognathus	Taiga Vole	SH	1903-08-20	1903-08-20
678035	6270633	Microtus xanthognathus	Taiga Vole	SH	1901-08-15	1901-08-15
691890	6275248	Microtus xanthognathus	Taiga Vole	SH	1901-08-15	1901-08-15
699271	6277507	Microtus xanthognathus	Taiga Vole	SH	1901-08-14	1901-08-14
423020	6008752	Monotropa hypopithys	pinesap	S2	1997-08-01	1997-08-01
801931	6291347	Neckera pennata	moss	S2	1987-07-21	1987-07-21
797618	6292247	Neckera pennata	moss	S2	1983-06-30	1983-06-30
716803	6320335	Neckera pennata	moss	S2	1976-08-01	1976-08-01
705071	6535196	Neckera pennata	moss	S2	1971-06-08	1971-06-08
528723	6141517	Nephroma bellum	moss	S2	1971-XX-XX	1971-XX-
706453	6366914	Nymphaea leibergii	pygmy water-lily	S1	2000-07-05	2000-07-05
706835	6366811	Nymphaea leibergii	pygmy water-lily	S1	2000-07-05	2000-07-05
707341	6366716	Nymphaea leibergii	pygmy water-lily	S1	2001-07-07	2001-07-07
703279	6368079	Nymphaea leibergii	pygmy water-lily	S1	2000-07-05	2000-07-05
713878	6369997	Nymphaea leibergii	pygmy water-lily	S1	2001-08-31	2001-08-31
713143	6334898	Oeneis chryxus caryi	Cary’s Arctic	S1S2	1975-06-11	1975-06-11
706734	6328010	Oeneis chryxus caryi	Cary’s Arctic	S1S2	1979-06-10	1979-06-10
721366	6442402	Panicum acuminatum	hot-springs millet	SU	2000-06-22	2000-06-22
743315	6455028	Panicum acuminatum	hot-springs millet	SU	2000-08-24	2000-08-24
722966	6452498	Panicum acuminatum	hot-springs millet	SU	2000-06-15	2000-06-15

729495	6446375	Panicum acuminatum	hot-springs millet	SU	2000-06-15	2000-06-15
747001	6466983	Panicum acuminatum	hot-springs millet	SU	2000-06-16	2000-06-16
715757	6335602	Pannaria conoplea	lichen	S?	1976-XX-XX	1976-XX-
681121	6650069	Pelecanus erythrorhynchos	American White Pelican	S2B	1995-XX-XX	1995-XX-
645999	6386888	Pelecanus erythrorhynchos	American White Pelican	S2B	1998-06-09	1998-06-09
537181	6196459	Pelecanus erythrorhynchos	American White Pelican	S2B	1990-XX-XX	1990-XX-
795609	6292330	Pellaea glabella ssp simplex	Smooth cliff brake fern	S2	1983-06-28	1983-06-28
519786	6016707	Peltigera collina	lichen	S1	1997-08-23	1997-08-23
519745	6017033	Peltigera evansiana	lichen	S2S3	1997-08-23	1997-08-23
519786	6016707	Peltigera evansiana	lichen	S2S3	1997-08-23	1997-08-23
519745	6017033	Peltigera horizontalis	lichen	S1S2	2002-08-23	2002-08-23
521821	6021498	Peltigera horizontalis	lichen	S1S2	1997-08-21	1997-08-21
810731	6059051	Percina caprodes	logperch	S1	1971-08-04	1971-08-04
809007	6055896	Percina caprodes	logperch	S1	1979-07-19	1979-07-19
806234	6063205	Percina caprodes	logperch	S1	1997-08-12	1997-08-12
734559	6263411	Phaeophyscia nigricans	lichen	S2	1985-XX-XX	1985-XX-
519745	6017033	Physcia dimidiata	lichen	S1	1997-08-23	1997-08-23
520655	6017382	Physcia dimidiata	lichen	S1	1997-08-22	1997-08-22
524335	6016728	Physcia dimidiata	lichen	S1	1997-08-22	1997-08-22
474698	6000939	Physcia tenella	lichen	S2	1964-07-26	1964-07-26
711400	6523201	Physcomitrium hookeri	bladder-cap moss	S1	1971-06-08	1971-06-08
521821	6021498	Physconia enteroxantha	lichen	S1?	1997-08-21	1997-08-21
710981	6496675	Physostegia ledinghamii	false dragonhead	S2	1930-08-07	1930-08-07
711400	6523201	Physostegia ledinghamii	false dragonhead	S2	1970-08-21	1970-08-21
695160	6568466	Physostegia ledinghamii	false dragonhead	S2	1928-07-26	1928-07-26
758946	6287682	Plantago maritima	sea-side plantain	S1	1983-06-28	1983-06-28
711468	6328438	Plantago maritima	sea-side plantain	S1	1991-08-01	1991-08-01
816414	6044640	Poanes hobomok	Hobomok Skipper	S2	1976-06-05	1976-06-05
467647	5999139	Pohlia atropurpurea	moss	S1	1976-05-16	1976-05-16
711313	6366048	Pohlia sphagnicola	moss	S2	1982-06-09	1982-06-09
685931	6201580	Pohlia sphagnicola	moss	S2	1985-05-25	1985-05-25
714608	6316750	Polygala paucifolia	fringed milkwort	S1	1977-05-19	1977-05-19
713182	6322277	Polygala paucifolia	fringed milkwort	S1	1976-05-30	1976-05-30
715476	6313044	Polygala paucifolia	fringed milkwort	S1	1996-05-XX	1996-05-XX
715907	6310815	Polygala paucifolia	fringed milkwort	S1	1972-XX-XX	1972-XX-
715499	6309238	Polygala paucifolia	fringed milkwort	S1	1974-05-07	1972-XX-
763358	6411950	Polypodium sibiricum	fern	S2S3	2000-06-13	2000-06-13
777543	6403573	Polypodium sibiricum	fern	S2S3	2000-08-23	2000-08-23
628910	6595733	Potamogeton foliosus	leafy pondweed	S2	1929-08-20	1929-08-20
709454	6328621	Potamogeton foliosus	leafy pondweed	S2	1991-08-01	1991-08-01
734913	6261628	Potamogeton natans	floating-leaf pondweed	S2	1972-08-27	1972-08-27
741988	6452178	Potamogeton obtusifolius	blunt-leaved pondweed	S2	1975-07-31	1975-07-31
594172	6086026	Potamogeton praelongus	white-stem pondweed	S2	2000-12-31	2000-12-31
755685	6400182	Potamogeton praelongus	white-stem pondweed	S2	2000-06-12	2000-06-12
707275	6142010	Potamogeton strictifolius	linear-leaved pondweed	S2	1968-07-25	1968-07-25
453788	5997832	Potamogeton strictifolius	linear-leaved pondweed	S2	1969-07-20	1969-07-20
702185	6361743	Potentilla multifida	branched cinquefoil	S1	2000-06-11	2000-06-11
712283	6454676	Potentilla multifida	branched cinquefoil	S1	2000-06-23	2000-06-23
734607	6420014	Potentilla multifida	branched cinquefoil	S1	2000-06-11	2000-06-11
730867	6282884	Potentilla multifida	branched cinquefoil	S1	2001-07-27	2001-07-27
451003	5997461	Prosopium coulteri	pygmy whitefish	S1	1995-06-09	1995-06-09
700435	6587794	Prosopium cylindraceum	round whitefish	SU	1992-05-29	1992-05-29
685931	6201580	Pseudobryum cinclidioides	moss	S1	1985-05-25	1985-05-25

727239	6059302	Pseudoleskeella sibirica	moss	S2	1978-06-06	1978-06-06
676426	6651087	Pyrola grandiflora	Arctic wintergreen	S2	1950-06-23	1950-06-23
676616	6649195	Pyrola grandiflora	Arctic wintergreen	S2	1950-07-19	1950-07-19
702105	6518637	Pyrola grandiflora	Arctic wintergreen	S2	1969-06-20	1969-06-20
713706	6501797	Pyrola grandiflora	Arctic wintergreen	S2	1969-06-26	1969-06-26
788467	6153698	Ramalina dilacerata	lichen	S2	1989-06-15	1989-06-15
512948	6014427	Ramalina dilacerata	lichen	S2	1986-10-03	1986-10-03
505253	6026018	Ramalina dilacerata	lichen	S2	1972-10-09	1972-10-09
474561	5997844	Ramalina obtusata	lichen	S2	1964-07-26	1964-07-26
502744	6030063	Ramalina sinensis	lichen	SU	1968-XX-XX	1968-XX-
690054	6637385	Rana pipiens	Leopard frog	S2S3	1903-XX-XX	1903-XX-
531023	6368992	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
616610	6252334	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
735253	6236850	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
762979	6111546	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
529013	6128112	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
755398	6396703	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
748236	6348181	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
787952	6354526	Rangifer tarandus pop 14	Woodland Caribou –	S2	2001-XX-XX	2001-XX-
801931	6291347	Rhodobryum ontariense	moss	S2	1987-07-21	1987-07-21
797618	6292247	Rhodobryum ontariense	moss	S2	1983-06-30	1983-06-30
692396	6128133	Riccia cavernosa	liverwort	S1	1981-07-09	1981-07-09
721525	6291005	Sagittaria latifolia	broad-leaved arrowhead	S1	1989-08-06	1989-08-06
452917	5997957	Salix sitchensis	Sitka willow	S1	1968-05-19	1968-05-19
724037	6461376	Salix tyrrellii	Tyrrell’s willow	S1	2000-06-21	2000-06-21
741176	6452596	Salix tyrrellii	Tyrrell’s willow	S1	2000-06-19	2000-06-19
740961	6451506	Salix tyrrellii	Tyrrell’s willow	S1	2000-06-19	2000-06-19
740466	6451475	Salix tyrrellii	Tyrrell’s willow	S1	2000-06-17	2000-06-17
723617	6462057	Salix tyrrellii	Tyrrell’s willow	S1	2000-06-21	2000-06-21
741352	6452887	Salix tyrrellii	Tyrrell’s willow	S1	2000-06-19	2000-06-19
733043	6458511	Sarracenia purpurea	pitcher-plant	S2	1977-07-XX	1977-07-XX
558943	6108560	Sarracenia purpurea	pitcher-plant	S2	1980-07-08	1980-07-08
555324	6104365	Sarracenia purpurea	pitcher-plant	S2	1974-08-09	1974-08-09
741801	6252611	Sarracenia purpurea	pitcher-plant	S2	1951-08-27	1951-08-27
721010	6316925	Sarracenia purpurea	pitcher-plant	S2	1968-09-01	1968-09-01
554114	6104000	Sarracenia purpurea	pitcher-plant	S2	1987-07-10	1987-07-10
712399	6369719	Sarracenia purpurea	pitcher-plant	S2	2001-07-09	2001-07-09
782984	6102595	Sarracenia purpurea	pitcher-plant	S2	1999-06-03	1999-06-03
783236	6110001	Sarracenia purpurea	pitcher-plant	S2	1999-08-09	1999-08-09
783428	6101843	Sarracenia purpurea	pitcher-plant	S2	1999-06-03	1999-06-03
756005	6400461	Sarracenia purpurea	pitcher-plant	S2	2000-06-12	2000-06-12
755685	6400182	Sarracenia purpurea	pitcher-plant	S2	2000-06-12	2000-06-12
771604	6411970	Sarracenia purpurea	pitcher-plant	S2	2000-06-15	2000-06-15
741882	6455377	Sarracenia purpurea	pitcher-plant	S2	2000-06-18	2000-06-18
719285	6080187	Scapania apiculata	liverwort	S1	1992-05-13	1992-05-13
738482	6306876	Schistidium agassizii	elf bloom moss	S1	1976-07-11	1976-07-11
677056	6181410	Scirpus pallidus	pale bulrush	S1	1983-06-07	1983-06-07
702187	6332101	Seligeria calcarea	chalk brittle moss	S1	1976-07-12	1976-07-12
648275	6183778	Sisyrinchium septentrionale	pale blue-eyed grass	S2S3	1914-10-06	1914-10-06
673647	6652722	Somatochlora kennedyi	Kennedy’s Emerald	S1S2	1950-06-19	1950-06-19
720582	6290849	Spartina pectinata	prairie cord grass	S1	1935-09-10	1935-09-10
711468	6328438	Spartina pectinata	prairie cord grass	S1	1991-07-28	1991-07-28
711468	6328438	Spergularia salina	salt-marsh sand spurry	S2	1996-09-12	1996-09-12

698738	6605149	Spergularia salina	salt-marsh sand spurry	S2	1965-08-11	1965-08-11
538942	6445789	Spergularia salina	salt-marsh sand spurry	S2	1992-07-19	1992-07-19
766607	6294643	Spergularia salina	salt-marsh sand spurry	S2	1984-07-31	1984-07-31
684618	6290851	Sphagnum contortum	twisted bog moss	S1	1982-05-23	1982-05-23
715588	6227842	Sphagnum fallax	peat moss	S2	1984-07-21	1984-07-21
685276	6291590	Sphagnum fallax	peat moss	S2	1982-05-23	1982-05-23
749437	6343091	Sphagnum fallax	peat moss	S2	1982-05-24	1982-05-24
681002	6197188	Sphagnum fallax	peat moss	S2	1985-07-XX	1985-07-XX
685276	6291590	Sphagnum fimbriatum	fringed bog moss	S2S3	1982-05-23	1982-05-23
725835	6351673	Sphagnum fimbriatum	fringed bog moss	S2S3	1976-06-30	1976-06-30
625474	6364298	Sphagnum fimbriatum	fringed bog moss	S2S3	1991-06-19	1991-06-19
593837	6084881	Sphagnum fimbriatum	fringed bog moss	S2S3	2000-07-14	2000-07-14
749437	6343091	Sphagnum lindbergii	Lindberg’s bog moss	S2S3	1982-05-24	1982-05-24
711587	6293480	Spiranthes lacera	northern slender ladies’-tr	S1	1995-XX-XX	1995-XX-
705114	6316344	Splachnum ampullaceum	flagon-fruited splachnum	S2	1976-08-02	1976-08-02
735699	6282916	Splachnum rubrum	red collar moss	S2	1997-06-30	1997-06-30
593837	6084881	Splachnum sphaericum	globe-fruited splachnum	S2	2002-08-15	2002-08-15
741988	6452178	Stellaria arenicola	sand-dune chickweed	S1	1975-08-01	1975-08-01
724037	6461376	Stellaria arenicola	sand-dune chickweed	S1	2000-06-21	2000-06-21
723617	6462057	Stellaria arenicola	sand-dune chickweed	S1	2000-06-21	2000-06-21
741882	6455377	Stellaria arenicola	sand-dune chickweed	S1	2000-06-18	2000-06-18
741550	6454916	Stellaria arenicola	sand-dune chickweed	S1	2000-06-18	2000-06-18
740726	6455741	Stellaria arenicola	sand-dune chickweed	S1	2000-08-24	2000-08-24
742083	6450749	Stellaria arenicola	sand-dune chickweed	S1	2000-06-21	2000-06-21
742273	6451594	Stereocaulon condensatum	lichen	S1	1975-07-31	1975-07-31
548333	6055583	Sympetrum corruptum	Variegated Meadowhawk	S2S3	1962-XX-XX	1962-XX-
739099	6455263	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	1971-05-XX	1971-05-XX
742273	6451594	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	1980-08-08	1980-08-08
741176	6452596	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-06-19	2000-06-19
741352	6452887	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-06-19	2000-06-19
741882	6455377	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-06-18	2000-06-18
742162	6454371	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-06-18	2000-06-18
740887	6450236	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-06-19	2000-06-19
741234	6451519	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-06-19	2000-06-19
740726	6455741	Tanacetum bipinnatum ssp huronense	Indian tansy	S2	2000-08-24	2000-08-24
689739	6113356	Tayloria serrata	slender splachnum	S2	1978-06-09	1978-06-09
664119	6175631	Tayloria serrata	slender splachnum	S2	1978-06-13	1978-06-13
739099	6455263	Utricularia cornuta	horned bladderwort	S1	1971-06-XX	1971-06-XX
732765	6457292	Utricularia cornuta	horned bladderwort	S1	1971-07-XX	1971-07-XX
773652	6401346	Viola pallens	Macloskey’s violet	S1S2	2000-06-14	2000-06-14
771620	6411150	Viola pallens	Macloskey’s violet	S1S2	2000-06-15	2000-06-15
747579	6467053	Viola pallens	Macloskey’s violet	S1S2	2000-06-16	2000-06-16
722966	6452498	Viola pallens	Macloskey’s violet	S1S2	2000-06-15	2000-06-15
692411	6286047	Warnstorfia pseudostraminea	brown moss	S1	1976-06-17	1976-06-17
685276	6291590	Warnstorfia tundrae	brown moss	S2	1982-05-23	1982-05-23
785217	6159224	Warnstorfia tundrae	brown moss	S2	1989-06-16	1989-06-16
520655	6017382	Zygodon viridissimus	moss	S1	1997-08-22	1997-08-22

Appendix Table 2. Locations of rare Saskatchewan plant and animal element occurrences in the study region (Mid-Boreal Upland (with the exception of the Bronson/Whitewood Upland and the Duck Mountain Upland, both island forests) as well as all of the Mid-Boreal Lowland regions based on the work by Omernik with CEC-NAFTA). GRANK is the global rarity rank; followed by the CITES and IUCN rankings (if applicable), and SRANK is the Saskatchewan CDC rank. Data provided courtesy of Jeff Keith, Saskatchewan Conservation Data Centre, Fish and Wildlife Branch, Saskatchewan Environment, December, 2002. UTMEAST and UTMNORTH coordinates are based on a NAD27 Extended Zone 13 UTM projection.

UTM East	UTM North	Scientific Name	Common Name	GRANK	CITES	IUCN	SRank
715968	5840395	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
709912	5776869	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
716932	5837264	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
593800	5825500	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
690300	5939400	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
636700	5816400	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
476730	5948578	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
415330	5980177	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
661700	5805400	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
604300	5819500	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
699900	5865700	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
655700	5887200	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
482630	5946278	ADOXA MOSCHATELLINA	MUSK-ROOT	G5			S3
492400	5986700	ALLIUM SCHOENOPRASUM VAR SIBIRICUM	SIBERIAN OR WILD CHIVES	G5T5			S2
693200	6009600	ALLIUM SCHOENOPRASUM VAR SIBIRICUM	SIBERIAN OR WILD CHIVES	G5T5			S2
241359	6308498	ANEMONE RICHARDSONII	YELLOW OR RICHARDSON'S ANEMONE	G5			S1
238825	6300284	ANEMONE RICHARDSONII	YELLOW OR RICHARDSON'S ANEMONE	G5			S1
715874	5850100	ARCEUTHOBIUM PUSILLUM	DWARF MISTLETOE	G5			S1
694123	5921520	ARCEUTHOBIUM PUSILLUM	DWARF MISTLETOE	G5			S1
237461	6299846	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
241215	6304841	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
655000	5886500	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
350900	5939300	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
655700	5887200	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
472129	5973378	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
685400	5888400	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
692400	5899800	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
575700	6039200	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
673000	5898700	ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	G5			S3
198322	6100411	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
290510	6202464	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
288505	6164337	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
228953	6045849	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
372581	5974177	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
448850	6014800	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
642050	5782750	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
672900	5815000	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
438030	5954378	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
358900	6003850	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
695300	5804900	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
596400	5817400	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
617750	5801800	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
398850	6017500	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
641900	6025200	ARDEA HERODIAS	GREAT BLUE HERON	G5			S3B,SZN
716804	5874789	ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID	G4	2		S1
320900	6115000	ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID	G4	2		S1

443900	5983850	ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID			G4	2	S1
349400	6049000	ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID			G4	2	S1
671500	5903400	ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID			G4	2	S1
608600	6060700	ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID			G4	2	S1
245578	6312192	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
239074	6299906	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
242814	6309321	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
515300	6001700	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
690000	5939500	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
685500	6047200	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
684000	6035500	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
689200	5934300	ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA			G4T4		S2S3
334062	6119981	ASTER MODESTUS	LARGE NORTHERN ASTER			G5		S2
264457	6035353	ASTER MODESTUS	LARGE NORTHERN ASTER			G5		S2
335883	5966259	ASTER MODESTUS	LARGE NORTHERN ASTER			G5		S2
716932	5837264	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
716068	5840403	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
715470	5836740	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
716932	5837264	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
719333	5834955	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
239074	6299906	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
245578	6312192	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
603900	5824500	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
544600	6085600	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
690800	5937000	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
685300	5928000	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
672400	5902900	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
692000	5935700	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
684000	5928200	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
693500	5909000	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
655700	5887200	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
692000	5935700	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
546300	6082200	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
319100	6079100	ATHYRIUM FILIX-FEMINA	LADY-FERN			G5		S3
716625	5837338	BOTRYCHIUM HESPERIUM	WESTERN MOONWORT OR CHAMOMILE-LEAVED GRAPE-FERN			G3		S1
685300	6047000	BOTRYCHIUM HESPERIUM	WESTERN MOONWORT OR CHAMOMILE-LEAVED GRAPE-FERN			G3		S1
685300	6046950	BOTRYCHIUM PEDUNCULOSUM	STALKED MOONWORT			G2?		S1
237657	6299648	CALAMAGROSTIS PURPURASCENS	PURPLE REED-GRASS			G5?		S2
722315	5819647	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
483530	5964778	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
493429	5970128	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
554531	5947178	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
472280	5963778	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
581800	5941300	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
694200	5899100	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
444730	5938278	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
693300	6009700	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
681400	5810400	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
655600	5887300	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
442700	5981100	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
441930	5935878	CALYPSO BULBOSA	FAIRY SLIPPER			G5	2	S3
724275	5817803	CAREX ARCTA	BEAR SEDGE			G5		S1
494900	5987750	CAREX ARCTA	BEAR SEDGE			G5		S1
685800	6044900	CAREX ARCTA	BEAR SEDGE			G5		S1
257960	6060257	CAREX CRYPTOLEPIS	YELLOW SEDGE			G4		S1

710728	5861996	CAREX CRYPTOLEPIS	YELLOW SEDGE	G4	S1
428562	5974769	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
686947	6046449	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
481085	6106127	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
246151	6251683	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
494040	5965051	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
524166	5963021	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
292329	6085123	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
671584	5903428	CAREX HELEONASTES	HUDSON BAY SEDGE	G4	S2
666365	5936804	CAREX HYSTERICINA	PORCUPINE SEDGE	G5	S2
477375	6105566	CAREX HYSTERICINA	PORCUPINE SEDGE	G5	S2
655723	5889730	CAREX HYSTERICINA	PORCUPINE SEDGE	G5	S2
717227	5837338	CAREX LAXIFLORA VAR VARIANS	PLEASING SEDGE	G5T?Q	S1
187840	6047304	CAREX LAXIFLORA VAR VARIANS	PLEASING SEDGE	G5T?Q	S1
263542	6057501	CAREX LAXIFLORA VAR VARIANS	PLEASING SEDGE	G5T?Q	S1
685300	5928000	CAREX LAXIFLORA VAR VARIANS	PLEASING SEDGE	G5T?Q	S1
684000	5941500	CAREX MACKENZIEI	MACKENZIE SEDGE	G4?	S1
679230	5983119	CAREX PEDUNCULATA	LONG-STALKED SEDGE	G5	S1
715185	5845415	CAREX PEDUNCULATA	LONG-STALKED SEDGE	G5	S1
691900	5935400	CAREX PROJECTA	NECKLACE SEDGE	G5	S1
711861	5958482	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
365600	5966800	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
691700	5943200	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
666600	5936900	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
691500	5900800	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
553300	6038000	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
691600	5935600	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
681000	5968300	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
433277	5980978	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
423230	5982277	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
689100	5935200	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
668500	5965100	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
669800	5975100	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
690850	5939700	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
622800	5822900	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
317900	6052200	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
692350	6016700	CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	G5	S2S3
715861	5836873	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
673300	5900100	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
676300	5858800	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
470300	6062400	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
657900	5812400	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
483000	6093300	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
345500	6054800	CAREX TRISPERMA	THREE-FRUITED SEDGE	G5	S2
283172	6181566	CAREX VULPINOIDEA	FOX SEDGE	G5	S2
449700	5989800	CAREX VULPINOIDEA	FOX SEDGE	G5	S2
317600	6017000	CAREX VULPINOIDEA	FOX SEDGE	G5	S2
492530	5968077	CAREX VULPINOIDEA	FOX SEDGE	G5	S2
315800	6147800	CAREX VULPINOIDEA	FOX SEDGE	G5	S2
429530	5947077	CAREX VULPINOIDEA	FOX SEDGE	G5	S2
714180	5873766	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
718951	5831109	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
690500	5939000	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
434300	6145300	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
432800	6128600	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
340350	6116000	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
676200	5934900	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
534700	6080400	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
322500	6141800	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3
650800	5887400	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5	S2S3

481211	6106900	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5			S2S3
314300	6139700	CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	G5T5			S2S3
188729	6047128	CIRSIUM DRUMMONDII	SHORT-STEMMED THISTLE	G5			S3
574500	5938400	CIRSIUM DRUMMONDII	SHORT-STEMMED THISTLE	G5			S3
438500	5992300	CIRSIUM DRUMMONDII	SHORT-STEMMED THISTLE	G5			S3
636700	5816700	CIRSIUM DRUMMONDII	SHORT-STEMMED THISTLE	G5			S3
598536	5822583	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
645037	5795784	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
630187	5789834	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
683138	5787784	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
695338	5831883	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
669037	5809034	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
683138	5787784	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
673300	5807800	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
685850	5793350	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
620886	5801184	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
630737	5799584	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
625536	5812384	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
686438	5790784	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
653637	5799884	CYGNUS BUCCINATOR	TRUMPETER SWAN	G4		nt	S1B,SZN
676900	5855700	CYPRIPEDIUM ARIETINUM	RAM'S-HEAD LADY'S-SLIPPER	G3	2		S1
685200	6045600	DICHANTHELIUM ACUMINATUM	HAIRY OR WOOLLY PANIC-GRASS	G5			S2
723142	5853640	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
716226	5837305	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
714523	5840876	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
725995	5823667	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
672000	5902900	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
672900	5902000	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
690300	5927200	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
604900	5819100	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
655000	5886500	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
688700	5819750	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
636200	5815700	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
693900	5922600	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
671900	5887200	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
693000	5904100	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
635300	5815300	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
676900	5815500	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
649500	5813399	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
694100	5899100	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
688100	5904600	DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	G5			S3
443402	5982590	ELATINE TRIANDRA	MUD PURSLANE	G5			S2
659100	5876500	ELEOCHARIS NITIDA	NEAT SPIKE-RUSH	G3G4			S2
643000	5947700	ELYMUS GLAUCUS	SMOOTH OR BLUE WILD-RYE	G5			S2
229023	6266631	EUPHRASIA SUBARCTICA	ARCTIC EYEBRIGHT	G5Q			S1S2
232291	6259213	EUPHRASIA SUBARCTICA	ARCTIC EYEBRIGHT	G5Q			S1S2
281888	6196838	EUPHRASIA SUBARCTICA	ARCTIC EYEBRIGHT	G5Q			S1S2
708339	5938411	FELIS CONCOLOR	COUGAR	G5	2		S2S3
708339	5938411	FELIS CONCOLOR	COUGAR	G5	2		S2S3
716816	5832637	FELIS CONCOLOR	COUGAR	G5	2		S2S3
704612	5939752	FELIS CONCOLOR	COUGAR	G5	2		S2S3
716816	5832637	FELIS CONCOLOR	COUGAR	G5	2		S2S3
704617	5939702	FELIS CONCOLOR	COUGAR	G5	2		S2S3
722297	5780002	FELIS CONCOLOR	COUGAR	G5	2		S2S3
266345	6060926	FELIS CONCOLOR	COUGAR	G5	2		S2S3
681500	5914500	FELIS CONCOLOR	COUGAR	G5	2		S2S3
601500	5818800	FELIS CONCOLOR	COUGAR	G5	2		S2S3
681500	5914500	FELIS CONCOLOR	COUGAR	G5	2		S2S3
681500	5914500	FELIS CONCOLOR	COUGAR	G5	2		S2S3
601500	5818800	FELIS CONCOLOR	COUGAR	G5	2		S2S3

681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
436200	5970300	FELIS CONCOLOR	COUGAR		G5	2	S2S3
545500	6075500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
436830	5950077	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
555200	5974600	FELIS CONCOLOR	COUGAR		G5	2	S2S3
605400	5806300	FELIS CONCOLOR	COUGAR		G5	2	S2S3
417530	5969277	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
682300	5860400	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
436200	5970300	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
430030	5975578	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
417530	5969277	FELIS CONCOLOR	COUGAR		G5	2	S2S3
522500	6014500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
449531	5929378	FELIS CONCOLOR	COUGAR		G5	2	S2S3
404500	5989400	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601700	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
679200	5981200	FELIS CONCOLOR	COUGAR		G5	2	S2S3
545500	6075500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
688400	5933000	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681400	5919600	FELIS CONCOLOR	COUGAR		G5	2	S2S3
417530	5969277	FELIS CONCOLOR	COUGAR		G5	2	S2S3
675200	5860500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
464900	6039800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
447330	5932578	FELIS CONCOLOR	COUGAR		G5	2	S2S3
436200	5970300	FELIS CONCOLOR	COUGAR		G5	2	S2S3
430500	6032500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
681500	5914500	FELIS CONCOLOR	COUGAR		G5	2	S2S3
601500	5818800	FELIS CONCOLOR	COUGAR		G5	2	S2S3
404500	5989400	FELIS CONCOLOR	COUGAR		G5	2	S2S3
404500	5989400	FELIS CONCOLOR	COUGAR		G5	2	S2S3
679500	5938900	FELIS CONCOLOR	COUGAR		G5	2	S2S3
605400	5806300	FELIS CONCOLOR	COUGAR		G5	2	S2S3
436200	5970300	FELIS CONCOLOR	COUGAR		G5	2	S2S3
642300	5928700	FELIS CONCOLOR	COUGAR		G5	2	S2S3
604400	5823300	FESTUCA HALLII FA	PLAINS ROUGH FESCUE FA				
357400	6002500	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE		G4	1	S4B,SZN
506600	5972100	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY		G3?		S2
671000	5932400	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY		G3?		S2

513700	5975200	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	G3?	S2
677600	5854200	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	G3?	S2
657800	5925500	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	G3?	S2
690000	5939500	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	G3?	S2
690100	5934000	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	G3?	S2
523800	5975300	LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	G3?	S2
438500	5992350	MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	G4G5T4	S1S2
669800	5982100	MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	G4G5T4	S1S2
660900	5961500	MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	G4G5T4	S1S2
688000	5821100	MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	G4G5T4	S1S2
679200	5814400	MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	G4G5T4	S1S2
321000	6118200	MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	G4G5T4	S1S2
229377	6045511	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
286827	6024540	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
299102	6015464	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
176347	6048036	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
289680	6162829	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
198663	6097367	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
291233	6203857	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
640000	5932000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
377300	6005000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
662000	5971000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
601000	5820000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
399100	6017000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
350100	6074900	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
676000	5974000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
668000	5960000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
693000	5879000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
603000	5814000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
458000	6026000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
406000	5994000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
680500	5971500	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
366000	5943000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
659050	5949100	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
645000	6027000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
650000	5937000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
683000	5968000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
691000	5969000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
639000	5941000	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
331600	6109800	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
670400	5975450	MIGRATORY BIRD CONCENTRATION SITE	MIGRATORY BIRD CONCENTRATION SITE	G3	S1
717514	5837513	MILIUM EFFUSUM VAR CISATLANTICUM	TALL MILLET-GRASS	G5T?	S1
436930	5939577	MUHLENBERGIA ANDINA	FOXTAIL MUHLY	G4	S1
716350	5869432	NAJAS FLEXILIS	FLEXIBLE NAIAD	G5	S2
553200	6038000	NAJAS FLEXILIS	FLEXIBLE NAIAD	G5	S2
506000	6011500	NAJAS FLEXILIS	FLEXIBLE NAIAD	G5	S2
483430	5964778	NAJAS FLEXILIS	FLEXIBLE NAIAD	G5	S2
422700	5987300	NAJAS FLEXILIS	FLEXIBLE NAIAD	G5	S2
406000	5984450	NAJAS FLEXILIS	FLEXIBLE NAIAD	G5	S2
632700	5815900	ORYZOPSIS CANADENSIS	CANADA MOUNTAIN-RICEGRASS	G5	S2
483130	5955278	ORYZOPSIS CANADENSIS	CANADA MOUNTAIN-RICEGRASS	G5	S2
438330	5940678	ORYZOPSIS CANADENSIS	CANADA MOUNTAIN-RICEGRASS	G5	S2
336200	5966100	PEDICULARIS GROENLANDICA	ELEPHANT-HEAD OR LITTLE RED ELEPHANT	G4G5	S1S2
345700	5939700	PEDICULARIS GROENLANDICA	ELEPHANT-HEAD OR LITTLE RED ELEPHANT	G4G5	S1S2

276443	6202912	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
480100	5963100	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
656750	5887200	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
674300	5899450	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
349450	6049000	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
483530	5964778	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
479030	5955778	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
554225	6038675	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
671500	5903500	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
433280	5958777	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
489500	5993750	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
655600	5887250	PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	G4Q	S2
198769	6099770	PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	G3	S3B,SZN
288813	6164410	PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	G3	S3B,SZN
398800	6017500	PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	G3	S3B,SZN
641900	6025100	PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	G3	S3B,SZN
454900	6014800	PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	G3	S3B,SZN
337500	6067100	PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	G3	S3B,SZN
685600	6047000	PELLAEA GLABELLA SSP OCCIDENTALIS	WESTERN SMOOTH CLIFF-BRAKE	G5T?	S2
686300	6046300	PELLAEA GLABELLA SSP OCCIDENTALIS	WESTERN SMOOTH CLIFF-BRAKE	G5T?	S2
597250	6052900	PELLAEA GLABELLA SSP OCCIDENTALIS	WESTERN SMOOTH CLIFF-BRAKE	G5T?	S2
685500	6045100	PELLAEA GLABELLA SSP OCCIDENTALIS	WESTERN SMOOTH CLIFF-BRAKE	G5T?	S2
616900	6061250	PELLAEA GLABELLA SSP OCCIDENTALIS	WESTERN SMOOTH CLIFF-BRAKE	G5T?	S2
288813	6164410	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
286554	6196232	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
256919	6224920	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
198769	6099770	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
398800	6017500	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
358900	6003900	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
641900	6025100	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
673000	5984000	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
337500	6067100	PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	G5	S4B,SZN
692000	5935700	PHEGOPTERIS CONNECTILIS	LONG OR NARROW BEECH-BERN	G5	S2
669800	5902800	PINGUICULA VILLOSA	HAIRY BUTTERWORT	G4	S2S3
403231	5967927	POTAMOGETON AMPLIFOLIUS	LARGE-LEAVED PONDWEED	G5	S1
258980	6059348	POTAMOGETON EPIHYDRUS	RIBBON-LEAF PONDWEED	G5	S2S3
233942	6258566	POTAMOGETON EPIHYDRUS	RIBBON-LEAF PONDWEED	G5	S2S3
604300	5818800	POTAMOGETON STRICTIFOLIUS	UPRIGHT NARROW-LEAVED PONDWEED	G5	S2
483530	5964778	POTAMOGETON STRICTIFOLIUS	UPRIGHT NARROW-LEAVED PONDWEED	G5	S2
423530	5973577	POTAMOGETON STRICTIFOLIUS	UPRIGHT NARROW-LEAVED PONDWEED	G5	S2
678700	5981500	POTAMOGETON STRICTIFOLIUS	UPRIGHT NARROW-LEAVED PONDWEED	G5	S2
523200	5988900	POTENTILLA MULTIFIDA	CUT-LEAVED CINQUEFOIL	G5	S2
726267	5799504	PRENANTHES ALBA	WHITE LETTUCE	G5	S2
715478	5851277	PRENANTHES ALBA	WHITE LETTUCE	G5	S2
684087	5940989	PRENANTHES ALBA	WHITE LETTUCE	G5	S2
662536	5802501	PRENANTHES ALBA	WHITE LETTUCE	G5	S2
676000	5860300	PRIMULA MISTASSINICA	BIRD'S-EYE PRIMROSE	G5	S3
638500	5816900	PRIMULA MISTASSINICA	BIRD'S-EYE PRIMROSE	G5	S3
335600	5963900	PRIMULA MISTASSINICA	BIRD'S-EYE PRIMROSE	G5	S3
665300	5867100	PRIMULA MISTASSINICA	BIRD'S-EYE PRIMROSE	G5	S3
658500	5976900	PRIMULA MISTASSINICA	BIRD'S-EYE PRIMROSE	G5	S3
706978	6019495	RHINANTHUS MINOR	YELLOW-RATTLE	G4	S2S3
281910	6195933	RHINANTHUS MINOR	YELLOW-RATTLE	G4	S2S3
693300	6009700	RHINANTHUS MINOR	YELLOW-RATTLE	G4	S2S3
318900	6138500	RHINANTHUS MINOR	YELLOW-RATTLE	G4	S2S3
717244	5837741	SALIX PLANIFOLIA SSP TYRRELLII	TYRRELL'S WILLOW	G5T2	S2
294654	6177357	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5	S3
319200	6131700	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5	S3
483050	5965000	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5	S3
444200	5983500	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5	S3

434230	5950477	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5		S3
421530	5974477	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5		S3
322600	6112900	SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	G5T5		S3
683900	5941600	SCIRPUS RUFUS VAR NEOGAEUS	RED CLUB-RUSH OR BULRUSH	G5T?		S2
707211	6019113	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
727746	5807453	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
281901	6195833	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
270863	6264977	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
228329	6041483	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
231050	6264545	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
273500	6213533	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
463300	6037900	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
483530	5964778	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
490430	5960678	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
440600	5986500	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
516000	5998700	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
318300	6055700	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
449500	5989200	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
597400	6052900	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
428930	5974477	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
439030	5940078	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
693200	6009700	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
491230	5963078	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
440800	5980800	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
496600	5992600	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
493530	5964778	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
446430	5933478	SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	G5		S3S4
257504	6062035	SPARGANIUM FLUCTUANS	FLOATING BUR-REED	G5		S2
353200	6070800	SPARGANIUM FLUCTUANS	FLOATING BUR-REED	G5		S2
281819	6194886	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
264309	6035949	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
272061	6057324	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
241000	6040501	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
273500	6213533	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
318800	6080900	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
672200	5908400	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
323100	6102100	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
447200	6042800	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
343900	6050900	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
320900	6116500	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
336700	6114800	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
548600	6037900	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
466230	5946878	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
692400	5899800	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
676300	5858700	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
428930	5974477	SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	G5	2	S2S3
342620	6043612	STERNA FORSTERI	FORSTER'S TERN	G5		S4B,SZN
672600	5972000	TRIADENUM FRASERI	MARSH ST. JOHN'S-WORT	G4G5		S1
242354	6234125	TRIENTALIS EUROPAEA SSP ARCTICA	ARCTIC STARWORT	G4G5T4		S1
241264	6304100	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
676891	5854864	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
483467	5964873	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
657311	5925802	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
188762	6048188	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
564632	6042737	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
269953	6217227	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
444450	5983937	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
716392	5837380	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
255795	6312539	TRIMORPHA ELATA	TALL WHITE FLEABANE	G4?		S2
712084	5862852	UTRICULARIA MINOR	LESSER BLADDERWORT	G5		S2S3

247762	6252335	UTRICULARIA MINOR	LESSER BLADDERWORT	G5	S2S3
523600	5987900	UTRICULARIA MINOR	LESSER BLADDERWORT	G5	S2S3
435230	5940777	UTRICULARIA MINOR	LESSER BLADDERWORT	G5	S2S3
716459	5836923	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
716110	5839905	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
684400	5905900	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
593800	5825500	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
688100	5940700	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
689100	5935200	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
655700	5887200	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
604300	5819500	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
672250	5902950	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
690900	5938400	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
683500	5905900	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
686100	5815800	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
687500	5903300	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
636500	5816100	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
676200	5978200	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
683900	6033400	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
670400	5927200	VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	G5?	S2S3
661800	5792900	VIOLA SEPTENTRIONALIS		G5	S?
684400	5905900	VIOLA SORORIA	DOWNY BLUE VIOLET	G5	S?
661500	5793000	VIOLA SORORIA	DOWNY BLUE VIOLET	G5	S?
240293	6301205	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
238848	6299624	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
614600	6061900	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
597350	6052900	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
685200	6046100	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
692350	6016700	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
685500	6045100	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
685600	6047000	WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2

Appendix Table 3. Rare Manitoba plant and animal element occurrences in the study region. GRANK is the global rarity rank and SRANK is the Manitoba CDC rank. Data provided courtesy of Nicole Firlotte, Biodiversity Conservation Section, Wildlife and Ecosystem Protection Branch, Manitoba Conservation, Winnipeg, MB, February 2003. There is one plant community listed (*Distichlis stricta - Hordeum jubatum - Puccinellia nuttalliana*).

Scientific Name	Common Name	GRANK	SRANK
ADOXA MOSCHATELLINA	MOSCHATEL	G5	S1?
ADOXA MOSCHATELLINA	MOSCHATEL	G5	S1?
AGROPYRON VIOLACEUM	PURPLISH WHEAT GRASS	G?	S2
BOS BISON	AMERICAN BISON	G4	SXS1
CAREX FLAVA	YELLOW SEDGE	G5	S2S3
CAREX FLAVA	YELLOW SEDGE	G5	S2S3
CAREX GARBERI	ELK SEDGE	G4	S1?
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2B,SZN
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2B,SZN
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2B,SZN
CHRYSOSPLENIUM TETRANDRUM	NORTHERN GOLDEN-CARPET	G5	S2S3
CHRYSOSPLENIUM TETRANDRUM	NORTHERN GOLDEN-CARPET	G5	S2S3
CYPRIPEDIUM ARIETINUM	RAM'S HEAD LADY'S-SLIPPER	G3	S2?
CYPRIPEDIUM ARIETINUM	RAM'S HEAD LADY'S-SLIPPER	G3	S2?
DISTICHLIS STRICTA-HORDEUM JUBATUM-PUCCINELLIA NUTTALLIANA	ALKALI GRASS-WILD BARLEY-NUTTALL'S SALT MEADOW GRASS-SEASIDE		S2
DROSERA LINEARIS	SLENDER-LEAVED SUNDEW	G4	S2
DROSERA LINEARIS	SLENDER-LEAVED SUNDEW	G4	S2
ERIOPHORUM CALLITRIX	BEAUTIFUL COTTON-GRASS	G5	S2
GALIUM APARINE	CLEAVERS, GOOSEGRASS	G5	S2
GYMNOCARPIUM ROBERTIANUM	LIMESTONE OAK FERN	G5	S1
GYMNOCARPIUM ROBERTIANUM	LIMESTONE OAK FERN	G5	S1
LISTERA AURICULATA	AURICLED TWAYBLADE	G3	S1
MALAXIS BRACHYPODA	WHITE ADDER'S-MOUTH	G4Q	S2?
MALAXIS BRACHYPODA	WHITE ADDER'S-MOUTH	G4Q	S2?
MYOTIS LUCIFUGUS	LITTLE BROWN MYOTIS	G5	S2N,S5B
MYOTIS LUCIFUGUS	LITTLE BROWN MYOTIS	G5	S2N,S5B
MYOTIS LUCIFUGUS	LITTLE BROWN MYOTIS	G5	S2N,S5B
NYMPHAEA ODORATA	FRAGRANT WATER-LILY	G5	S2
PELLAEA GLABELLA SSP OCCIDENTALIS	CLIFF-BRAKE	G5T4	S2
PELLAEA GLABELLA SSP OCCIDENTALIS	CLIFF-BRAKE	G5T4	S2
PELLAEA GLABELLA SSP OCCIDENTALIS	CLIFF-BRAKE	G5T4	S2
PLANTAGO MARITIMA	SEASIDE PLANTAIN	G5	S2
RHYNCHOSPORA CAPILLACEA	HORNED BEAKRUSH	G4G5	S2
THALICTRUM SPARSIFLORUM	FEW-FLOWERED MEADOW-RUE	G5	S2S3
THALICTRUM SPARSIFLORUM	FEW-FLOWERED MEADOW-RUE	G5	S2S3
THELYPTERIS PHEGOPTERIS	NORTHERN BEECH FERN	G5	S2
VACCINIUM CAESPITOSUM	DWARF BILBERRY	G5	S2
VACCINIUM CAESPITOSUM	DWARF BILBERRY	G5	S2
VIOLA SELKIRKII	LONG-SPURRED VIOLET	G5?	S2
VIOLA SELKIRKII	LONG-SPURRED VIOLET	G5?	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	G5	S2

Appendix Table 4. General location of Alberta Peregrine Falcon and Whooping Crane nesting sites. Data provided courtesy of ANHIC, Edmonton, December, 2002.

AREA sq m	PERIMETER m	MER	RGE	TWP
96567361	39309	4	15	126
96350839	39273	4	17	126
94776283	38941	4	12	125
94759416	38938	4	14	125
95294305	39046	4	9	123
94803471	38947	4	14	117
94799934	38946	4	15	117
94789559	38943	4	16	117
94844129	38955	4	9	113
95370249	39062	4	7	111
95375521	39063	4	8	111
94939730	38975	5	9	80
95452705	39080	5	9	79
94683837	38923	5	9	78
94942279	38974	5	12	60
95192380	39025	5	12	59

Appendix Table 5. Rare Alberta species occurring in the study region (derived from Appendix Table 1) with Alberta provincial rarity rank.

Scientific Name	Common Name	Rank	Notes
Aloina brevirostris	short-beaked rigid screw moss	S2	
Aloina rigida	aloe-like rigid screw moss	S2	
Anomodon minor		S1	
Aongstroemia longipes		S2	
Arabidopsis salsuginea	mouse-ear cress	S1	Thelungiella salsuginea
Artemisia tilesii	Herriot's sagewort	S2	
Aster x maccallae		S1S2	
Astragalus bodinii	Bodin's milk vetch	S1	
Bacidia bagliettoana		S2	
Barbarea orthoceras	American winter cress	S2	
Blysmus rufus	Red Bulrush	S1	Scirpus rufus
Botrychium minganense	Mingan grape fern	S2S3	
Botrychium multifidum var intermedium	leather grape fern	S2	
Botrychium pinnatum		S1	
Brachythecium rutabulum		S2?	
Bryobrittonia longipes		S3	
Bryoria nadvornikiana	old man's beard	S2	
Bryoria simplicior	old man's beard	S2S3	
Bryum algovicum		S2	
Bryum cyclophyllum		S1S2	
Bryum pallens		S2	
Calopteryx aequabilis	River Jewelwing	S1	
Calypogeia muelleriana	Liverwort	S?	
Calypogeia neesiana	Liverwort	S1S2	
Campylium polygamum		S3	
Campylium radicale		S2	
Cardamine pratensis	meadow bitter cress	S1S2	
Carex adusta	browned sedge	S1	
Carex arcta	narrow sedge	S1	
Carex backii	Back's sedge	S2	
Carex capitata	capitate sedge	S2	
Carex heleonastes	Hudson Bay sedge	S2	
Carex houghtoniana	sand sedge	S2	
Carex hystericina	porcupine sedge	S1	
Carex lacustris	lakeshore sedge	S2	
Carex oligosperma	few-fruited sedge	S1S2	
Carex pseudocyperus	cyperus-like sedge	S2	
Carex retrorsa	turned sedge	S2S3	
Carex rostrata	beaked sedge	S2	
Carex vulpinoidea	fox sedge	S2	
Charadrius semipalmatus	Semipalmated Plover	SAB	breeding area
Cladina portentosa		S1	
Cladina stygia		S1	
Cladonia bacilliformis		S2S3	
Cladonia bellidiflora		S2S3	
Cladonia cyanipes		S2	
Cladonia ramulosa		S1	
Cladonia squamosa		S2	

Coenonympha tullia ochracea	Ochre Ringlet	S1	
Conardia compacta		S2	
Cynodontium tenellum		S2S3	
Cyphelium tigillare		S2	
Dendroica tigrina	Cape May Warbler	S2B	
Dermatocarpon moulinsii		S2	
Diphasiastrum sitchense	ground-fir	S2	
Drepanocladus sendtneri	brown moss	S2	
Drosera linearis	slender-leaved sundew	S2	
Dryopteris filix-mas	male fern	S1	
Eleocharis tenuis	slender spike-rush	SU	
Enodia anthedon	Northern Pearly-eye	S1	
Entodon schleicheri		S1	
Epilobium lactiflorum	willowherb	S2	
Erigeron hyssopifolius	wild daisy fleabane	S1	
Eupatorium maculatum	spotted Joe-pye weed	S1S2	
Flavopunctelia soredica		S2	
Frullania inflata	liverwort	S1	
Gavia pacifica	Pacific Loon	SAB	breeding site
Gentianopsis detonsa ssp raupii	northern fringed gentian	S1	Gentiana detonsa, Gentianella detonsa
Herzogiella turfacea		S2	
Heterodermia speciosa		S2	
Huperzia selago	mountain club-moss	S1	Lycopodium selago
Hybognathus hankinsoni	brassy minnow	S2	
Hygroamblystegium noterophilum		SU	
Hygroamblystegium tenax		S2	
Hypericum majus	large Canada St. John's-wort	S2	
Hypnum callichroum		S1	
Hypnum pallescens		S1	
Imshaugia placorodia		S2	
Isoetes echinospora	northern quillwort	S1	
Juncus brevicaudatus	short-tail rush	S2	
Juncus filiformis	thread rush	S2S3	
Juncus stygius var americanus	marsh rush	S2	
Lactuca biennis	tall blue lettuce	S2	
Lagopus lagopus	Willow Ptarmigan	S1B	
Lampetra japonica	Arctic lamprey	S1	
Larus canus	Mew Gull	S2B	breeding area
Lecania dubitans		S2	
Lecanora cateilea		S2	
Leucorrhinia glacialis	Crimson-ringed Whiteface	S1S3	
Lomatogonium rotatum	marsh felwort	S2S3	
Lophozia badensis	liverwort	S1	
Luzula rufescens	reddish wood-rush	S1	
Lycopodiella inundata	bog club-moss	S1	
Malaxis monophylla	white adder's-mouth	S2	
Malaxis paludosa	bog adder's-mouth	S1	
Meesia longiseta		S1	
Melanelia multispora		S2?	
Melanelia olivacea		S1	
Microtus xanthognathus	Taiga Vole	SH	
Monotropa hypopithys	pinesap	S2	

Neckera pennata		S2	
Nephroma bellum		S2	
Nymphaea leibergii	pygmy water-lily	S1	
Oeneis chryxus caryi	Cary's Arctic	S1S2	
Panicum acuminatum	hot-springs millet	SU	
Pannaria conoplea		S?	
Pelecanus erythrorhynchos	American White Pelican	S2B	breeding area
Pellaea glabella ssp simplex		S2	
Peltigera collina		S1	
Peltigera evansiana		S2S3	
Peltigera horizontalis		S1S2	
Percina caprodes	logperch	S1	
Phaeophyscia nigricans		S2	
Physcia dimidiata		S1	
Physcia tenella		S2	
Physcomitrium hookeri	bladder-cap moss	S1	
Physconia enteroxantha		S1?	
Physostegia ledinghamii	false dragonhead	S2	
Plantago maritima	sea-side plantain	S1	
Poanes hobomok	Hobomok Skipper	S2	
Pohlia atropurpurea		S1	
Pohlia sphagnicola		S2	
Polygala paucifolia	fringed milkwort	S1	
Polypodium sibiricum		S2S3	
Potamogeton foliosus	leafy pondweed	S2	
Potamogeton natans	floating-leaf pondweed	S2	
Potamogeton obtusifolius	blunt-leaved pondweed	S2	
Potamogeton praelongus	white-stem pondweed	S2	
Potamogeton strictifolius	linear-leaved pondweed	S2	
Potentilla multifida	branched cinquefoil	S1	
Prosopium coulteri	pygmy whitefish	S1	
Prosopium cylindraceum	round whitefish	SU	
Pseudobryum cinclidioides		S1	
Pseudoleskeella sibirica		S2	
Pyrola grandiflora	Arctic wintergreen	S2	
Ramalina dilacerata		S2	
Ramalina obtusata		S2	
Ramalina sinensis		SU	
Rana pipiens	leopard frog	S2S3	breeding area?
Rangifer tarandus pop 14	Woodland Caribou -- boreal	S2	caribou range
Rhodobryum ontariense		S2	
Riccia cavernosa	liverwort	S1	
Sagittaria latifolia	broad-leaved arrowhead	S1	
Salix sitchensis	Sitka willow	S1	
Salix tyrrellii	Tyrrell's willow	S1	
Sarracenia purpurea	pitcher-plant	S2	
Scapania apiculata	liverwort	S1	
Schistidium agassizii	elf bloom moss	S1	
Scirpus pallidus	pale bulrush	S1	
Seligeria calcarea	chalk brittle moss	S1	
Sisyrinchium septentrionale	pale blue-eyed grass	S2S3	
Somatochlora kennedyi	Kennedy's Emerald	S1S2	
Spartina pectinata	prairie cord grass	S1	

Spergularia salina	salt-marsh sand spurry	S2
Sphagnum contortum	twisted bog moss	S1
Sphagnum fallax	peat moss	S2
Sphagnum fimbriatum	fringed bog moss	S2S3
Sphagnum lindbergii	Lindberg's bog moss	S2S3
Spiranthes lacera	northern slender ladies'-tresses	S1
Splachnum ampullaceum	flagon-fruited splachnum	S2
Splachnum rubrum	red collar moss	S2
Splachnum sphaericum	globe-fruited splachnum	S2
Stellaria arenicola	sand-dune chickweed	S1
Stereocaulon condensatum		S1
Sympetrum corruptum	Variegated Meadowhawk	S2S3
Tanacetum bipinnatum ssp huronense	Indian tansy	S2
Tayloria serrata	slender splachnum	S2
Utricularia cornuta	horned bladderwort	S1
Viola pallens	Macloskey's violet	S1S2
Warnstorfia pseudostraminea	brown moss	S1
Warnstorfia tundrae	brown moss	S2
Zygodon viridissimus		S1

Appendix Table 6. Rare Saskatchewan species occurring in the study region (derived from Appendix Table 2) with Saskatchewan provincial rarity rank.

Scientific Name	Common Name	Rank
ADOXA MOSCHATELLINA	MUSK-ROOT	S3
ALLIUM SCHOENOPRASUM VAR SIBIRICUM	SIBERIAN OR WILD CHIVES	S2
ANEMONE RICHARDSONII	YELLOW OR RICHARDSON'S ANEMONE	S1
ARCEUTHOBIUM PUSILLUM	DWARF MISTLETOE	S1
ARCTOSTAPHYLOS RUBRA	RED ALPINE BEARBERRY	S3
ARDEA HERODIAS	GREAT BLUE HERON	S3B,SZN
ARETHUSA BULBOSA	SWAMP-PINK OR DRAGON'S-MOUTH ORCHID	S1
ARNICA LONCHOPHYLLA SSP LONCHOPHYLLA	SPEAR-LEAVED ARNICA	S2S3
ASTER MODESTUS	LARGE NORTHERN ASTER	S2
ATHYRIUM FILIX-FEMINA	LADY-FERN	S3
BOTRYCHIUM HESPERIUM	WESTERN MOONWORT OR CHAMOMILE-LEAVED GRAPE-FERN	S1
BOTRYCHIUM PEDUNCULOSUM	STALKED MOONWORT	S1
CALAMAGROSTIS PURPURASCENS	PURPLE REED-GRASS	S2
CALYPSO BULBOSA	FAIRY SLIPPER	S3
CAREX ARCTA	BEAR SEDGE	S1
CAREX CRYPTOLEPIS	YELLOW SEDGE	S1
CAREX HELEONASTES	HUDSON BAY SEDGE	S2
CAREX HYSTERICINA	PORCUPINE SEDGE	S2
CAREX LAXIFLORA VAR VARIANS	PLEASING SEDGE	S1
CAREX MACKENZIEI	MACKENZIE SEDGE	S1
CAREX PEDUNCULATA	LONG-STALKED SEDGE	S1
CAREX PROJECTA	NECKLACE SEDGE	S1
CAREX PSEUDOCYPERUS	CYPERUS-LIKE SEDGE	S2S3
CAREX TRISPERMA	THREE-FRUITED SEDGE	S2
CAREX VULPINOIDEA	FOX SEDGE	S2
CHIMAPHILA UMBELLATA SSP OCCIDENTALIS	WESTERN PRINCE'S-PINE	S2S3
CIRSIUM DRUMMONDII	SHORT-STEMMED THISTLE	S3
CYGNUS BUCCINATOR	TRUMPETER SWAN	S1B,SZN
CYPRIPEDIUM ARIETINUM	RAM'S-HEAD LADY'S-SLIPPER	S1
DICHANTHELIUM ACUMINATUM	HAIRY OR WOOLLY PANIC-GRASS	S2
DIERVILLA LONICERA	NORTHERN BUSH-HONEYSUCKLE	S3
ELATINE TRIANDRA	MUD PURSLANE	S2
ELEOCHARIS NITIDA	NEAT SPIKE-RUSH	S2
ELYMUS GLAUCUS	SMOOTH OR BLUE WILD-RYE	S2
EUPHRASIA SUBARCTICA	ARCTIC EYEBRIGHT	S1S2
FELIS CONCOLOR	COUGAR	S2S3
FESTUCA HALLII FA	PLAINS ROUGH FESCUE FA	
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	S4B,SZN
LEUCOPHYSALIS GRANDIFLORA	LARGE WHITE-FLOWERED GROUND-CHERRY	S2
MEGALODONTA BECKII VAR BECKII	WATER MARIGOLD	S1S2
MILIUM EFFUSUM VAR CISATLANTICUM	TALL MILLET-GRASS	S1
MUHLENBERGIA ANDINA	FOXTAIL MUHLY	S1

NAJAS FLEXILIS	FLEXIBLE NAIAD	S2
ORYZOPSIS CANADENSIS	CANADA MOUNTAIN-RICEGRASS	S2
PEDICULARIS GROENLANDICA	ELEPHANT-HEAD OR LITTLE RED ELEPHANT	S1S2
PEDICULARIS MACRODONTA	PURPLE OR SWAMP LOUSEWORT	S2
PELECANUS ERYTHRORHYNCHOS	AMERICAN WHITE PELICAN	S3B,SZN
PELLAEA GLABELLA SSP OCCIDENTALIS	WESTERN SMOOTH CLIFF-BRAKE	S2
PHALACROCORAX AURITUS	DOUBLE-CRESTED CORMORANT	S4B,SZN
PHEGOPTERIS CONNECTILIS	LONG OR NARROW BEECH-FERN	S2
PINGUICULA VILLOSA	HAIRY BUTTERWORT	S2S3
POTAMOGETON AMPLIFOLIUS	LARGE-LEAVED PONDWEED	S1
POTAMOGETON EPIHYDRUS	RIBBON-LEAF PONDWEED	S2S3
POTAMOGETON STRICTIFOLIUS	UPRIGHT NARROW-LEAVED PONDWEED	S2
POTENTILLA MULTIFIDA	CUT-LEAVED CINQUEFOIL	S2
PRENANTHES ALBA	WHITE LETTUCE	S2
PRIMULA MISTASSINICA	BIRD'S-EYE PRIMROSE	S3
RHINANTHUS MINOR	YELLOW-RATTLE	S2S3
SALIX PLANIFOLIA SSP TYRRELLII	TYRRELL'S WILLOW	S2
SCHEUCHZERIA PALUSTRIS VAR AMERICANA	AMERICAN SCHEUCHZERIA	S3
SCIRPUS RUFUS VAR NEOGAEUS	RED CLUB-RUSH OR BULRUSH	S2
SENECIO PLATTENSIS	PRAIRIE RAGWORT OR GROUNDSEL	S3S4
SPARGANIUM FLUCTUANS	FLOATING BUR-REED	S2
SPIRANTHES LACERA	NORTHERN SLENDER LADIES'-TRESSES	S2S3
STERNA FORSTERI	FORSTER'S TERN	S4B,SZN
TRIADENUM FRASERI	MARSH ST. JOHN'S-WORT	S1
TRIENTALIS EUROPAEA SSP ARCTICA	ARCTIC STARWORT	S1
TRIMORPHA ELATA	TALL WHITE FLEABANE	S2
UTRICULARIA MINOR	LESSER BLADDERWORT	S2S3
VIOLA SELKIRKII	GREAT-SPURRED OR SELKIRK'S VIOLET	S2S3
VIOLA SEPTENTRIONALIS		S?
VIOLA SORORIA	DOWNY BLUE VIOLET	S?
WOODSIA GLABELLA	SMOOTH WOODSIA	S2

Appendix Table 7. Rare Manitoba species occurring in the study region (derived from Appendix Table 3) with Manitoba provincial rarity rank.

Scientific Name	Common Name	SRANK
ADOXA MOSCHATELLINA	MOSCHATEL	S1?
AGROPYRON VIOLACEUM	PURPLISH WHEAT GRASS	S2
BOS BISON	AMERICAN BISON	SXS1
CAREX FLAVA	YELLOW SEDGE	S2S3
CHARADRIUS MELODUS	PIPING PLOVER	S2B,SZN
CHRYSOSPLENIUM TETRANDRUM	NORTHERN GOLDEN-CARPET	S2S3
CYPRIPEDIUM ARIETINUM	RAM'S HEAD LADY'S-SLIPPER	S2?
DISTICHLIS STRICTA-HORDEUM JUBATUM-PUCCINELLIA NUTTALLIANA	ALKALI GRASS-WILD BARLEY-NUTTALL'S SALT MEADOW GRASS-SEASIDE	S2
DROSERA LINEARIS	SLENDER-LEAVED SUNDEW	S2
ERIOPHORUM CALLITRIX	BEAUTIFUL COTTON-GRASS	S2
GALIUM APARINE	CLEAVERS, GOOSEGRASS	S2
GYMNOCARPIUM ROBERTIANUM	LIMESTONE OAK FERN	S1
LISTERA AURICULATA	AURICLED TWAYBLADE	S1
MALAXIS BRACHYPODA	WHITE ADDER'S-MOUTH	S2?
MYOTIS LUCIFUGUS	LITTLE BROWN MYOTIS	S2N,S5B
NYMPHAEA ODORATA	FRAGRANT WATER-LILY	S2
PELLAEA GLABELLA SSP OCCIDENTALIS	CLIFF-BRAKE	S2
PLANTAGO MARITIMA	SEASIDE PLANTAIN	S2
RHYNCHOSPORA CAPILLACEA	HORNED BEAKRUSH	S2
THALICTRUM SPARSIFLORUM	FEW-FLOWERED MEADOW-RUE	S2S3
THELYPTERIS PHEGOPTERIS	NORTHERN BEECH FERN	S2
VACCINIUM CAESPITOSUM	DWARF BILBERRY	S2
VIOLA SELKIRKII	LONG-SPURRED VIOLET	S2
WOODSIA GLABELLA	SMOOTH WOODSIA	S2

Appendix Table 8. Alberta Boreal Forest Natural Region significant plant communities. Top portion of table provided courtesy of Lorna Allen, Alberta Natural Heritage Information Centre, Edmonton, AB, 3 December 2002 (communities that have been identified to date as provincially rare by an expert committee). The bottom portion of the table lists suggested additions based on the sources listed. The list is a work in progress and will be augmented in the future.

*Primary source reference for each occurrence is given; otherwise, refer to Allen (2002) for details.

CODE/ Source*	SCIENTIFIC NAME	COMMON NAME	RANK	GROUP
CEAB000029 Willoughby et al. (1997)	*Amelanchier alnifolia / Arctostaphylos uva-ursi / Oryzopsis pungens*	saskatoon / common bearberry / northern rice grass	S2S3	Shrubland
CEAB000031 Allen (2002)	*Carex limosa - Scheuchzeria palustris / Sphagnum teres - S. subsecundum*	mud sedge - scheuchzeria / peat moss	S1	Herbaceous
CEAB000037 Lewis et al. (1928)	*Carex pseudocyperus - Calla palustris*	cypress-like sedge - water arum	S1S2	Herbaceous
CEAB000148 Schwarz (1994)	*Elymus trachycaulus - Distichlis stricta*	slender wheat grass - salt grass	S1	Herbaceous
CEAB000149 Fairbarns (1990)	*Elymus trachycaulus - Hierochloe odorata*	slender wheat grass – sweet grass	SU	Herbaceous
CEAB000150 (Raup 1935)	*Elymus trachycaulus - Koeleria macrantha*	slender wheat grass - June grass	SU	Herbaceous
CEAB000036 Allen (2002)	*Isoetes echinospora*	northern quillwort	S1	Herbaceous
CEAB000038 Allen (2002)	*Larix laricina / Carex prairea*	tamarack / prairie sedge	S1	Forest/ Woodland
CEAB000040 Timoney (1996)	*Picea glauca / Alnus tenuifolia – Betula neoalaskana / Equisetum pratense / Hylocomium splendens*	white spruce / river alder - Alaska birch / meadow horsetail / stair-step moss	S3	Forest/ Woodland
CEAB000041 Raup (1935)	*Picea glauca / Cetraria islandica*	white spruce / lichen	S1?	Forest/ Woodland
CEAB000042 Timoney (1996)	*Populus balsamifera / Alnus tenuifolia / Cornus stolonifera / Equisetum pratense*	balsam poplar / river alder / red-osier dogwood / meadow horsetail	S3	Forest/ Woodland
CEAB000114 Allen (2002)	*Populus balsamifera / Rhamnus alnifolia / Equisetum arvense*	balsam poplar / alder-leaved buckthorn	S1	Forest/ Woodland
CEAB000043 Allen (2002)	*Populus balsamifera / Viburnum opulus / Matteuccia struthiopteris*	balsam poplar / high-bush cranberry / ostrich fern	S1S2	Forest/ Woodland
CEAB000044 Alberta Energy and Natural Resources (1984)	*Populus tremuloides / Rubus parviflorus / Aralia nudicaulis*	aspen / thimbleberry / wild sarsaparilla	S2S3	Forest/ Woodland
CEAB000045 Timoney and Robinson (1998a)	*Populus tremuloides / Salix bebbiana-Corylus cornuta / Calamagrostis canadensis – Matteuccia struthiopteris*	aspen / Bebb's willow – beaked hazelnut / bluejoint – ostrich fern	S1	Forest/ Woodland
CEAB000046 Timoney and Robinson (1991)	*Puccinellia nuttalliana – Suaeda calceoliformis – Spergularia marina barren*	Nuttall's salt-meadow grass - western sea-blite - salt-marsh sand spurry barren	S2	Sparsely Vegetated
CEAB000047 Allen (2002)	*Salicornia europaea*	Samphire	S2	Sparsely Vegetated
CEAB000048 Timoney (1997)	*Salix athabascensis string shrubland*	Athabasca willow string shrubland	SP	Shrubland
CEAB000049 Timoney and Robinson (1998b)	*Salix drummondiana / Scirpus microcarpus – Calamagrostis canadensis*	Drummond's willow / small-fruited bulrush – bluejoint	S1	Shrubland
Recently Noted Communities Not Yet Added to Tracking List				
----- Timoney et al. (1997b)	Some dominants include: *Nitzschia amphibia, Cymbella pusilla, Mastogloia smithii*	Diatom Pond [Shallow open water] of Whooping Crane Nesting Area	S1?	Herbaceous

-----Timoney (2001b)	Strings of *+/- Atriplex subspicata, Calamagrostis stricta, Plantago maritima, Puccinellia nuttalliana, Triglochin palustris, T. maritima;* flarks of Cyanophytes and Bacillariophyceae	Interior Patterned Saline Marsh [strings of halophytes, flarks of blue-green algae and diatoms]	S1?	Herbaceous
	Related, Vulnerable Boreal Grasslands and Savannahs			
---- Timoney and Robinson (1998b)	*Stipa curtiseta – Symphoricarpos albus / Tortula ruralis* with *Calamovilfa longifolia, Arctostaphylos uva-ursi*	Western Porcupine Grass – Snowberry / Tortula ruralis grassland	SU?	Herbaceous
---- Timoney and Robinsion (1992, 1998b); allied to CEAB000029?	*Pinus banksiana / Oryzopsis pungens* with *Amelanchier alnifolia, Festuca saximontana, Schizachne purpurascens, Carex siccata, Prunus virgianiana, Galium boreale, Elymus trachycaulus, Apocynum androsaemifolium,* and *Cladonia*	Jack Pine / Northern Rice Grass savannah and grassland	S2S3?	Shrubland, Herbaceous
---- Timoney and Robinson (1998b)	*Elymus trachycaulus – Arctostaphylos uva-ursi* with *Galium boreale, Oryzopsis pungens*	Slender Wheatgrass – Bearberry grassland	SU?	Herbaceous

** These types tend to succeed to jack pine or aspen in the absence of fire unless the site is xeric, unstable, and/or steeply south-facing. In Alberta's boreal forest, they tend to be found on sandy Dystric Brunisols along river bluffs and on eolian dunes. They are related to the jack pine – heath facies and to the *Agropyron – Stipa* Peace River Prairie association of Moss (1955).

Appendix Table 9. Overview of Alberta boreal old-growth forest types (modified after Timoney 2001a).

Type	Alberta Natural Region Distribution	Landform / Parent Materials	Soil Orders	Ecological Moisture Regime	Drainage	Dominant Plant Species
Aspen Forest	Boreal NR Rocky Mtn NR Foothills NR	Rolling to Level / Morainal, Lacustrine	Luvisols Gleysols	Submesic to Subhygric	Well to Mod-Well	May incl. *Picea glauca, Populus balsamifera; Amelanchier alnifolia, Corylus cornuta, Viburnum edule, Rosa acicularis, Cornus stolonifera, C. canadensis, Aralia, Rubus pubescens, R. idaeus, Lathyrus ochroleucus, Lonicera involucrata, Pyrola asarifolia, Ribes oxyacanthoides, Linnaea borealis, Calamagrostis canadensis*
Upland Balsam Poplar	Boreal NR Foothills NR Central Parkland SR Montane SR	Undulating to Depressional / Morainal, Lacustrine	Luvisols Gleysols	Mesic to Hygric	Well to Poorly	May incl. *Picea glauca, Populus tremuloides; Viburnum edule, Alnus tenuifolia, Rosa acicularis, Cornus stolonifera, Lonicera involucrata, Rubus idaeus, Aralia nudicaulis, Mertensia paniculata, Calamagrostis canadensis*
Upland Populus - White Spruce	Boreal NR Foothills NR	Undulating to Depressional / Morainal, Lacustrine	Luvisols Gleysols Brunisols	Mesic to Hygric	Well to Poorly	*Viburnum edule, Rosa acicularis, Cornus stolonifera, C. canadensis, Rubus idaeus, R. pubescens, Shepherdia, Aralia nudicaulis, Linnaea borealis, Calamagrostis canadensis, Pleurozium schreberi, Hylocomium splendens*
White Spruce / Shrub / Herb	Boreal NR Foothills NR	Undulating to Depressional / Morainal, Lacustrine, Residual	Luvisols Gleysols Brunisols	Mesic to Hygric	Well to Poorly	May incl. *Populus tremuloides, P. balsamifera, Betula papyrifera, Abies balsamea, Pinus contorta; Alnus crispa, Cornus stolonifera, Viburnum edule, Rosa acicularis, Aralia nudicaulis, Rubus pubescens, Cornus canadensis, Linnaea borealis, Mertensia paniculata, Mitella nuda, Calamagrostis canadensis, Fragaria virginiana, Maianthemum canadense*
White Spruce / Horsetail / Feather Moss	Boreal NR Foothills NR	Undulating to Depressional / Morainal, Lacustrine (to Organic)	Luvisols Gleysols Brunisols (to Organic)	Mesic to Hygric	Mod-Well to Poorly (to Very Poorly)	May incl. *Populus tremuloides, Populus balsamifera, Betula papyrifera, Abies balsamea; Rosa acicularis, Cornus stolonifera, Viburnum edule, Mitella nuda, Rubus pubescens, Cornus canadensis, Linnaea borealis, Equisetum arvense, E. pratense, Calamagrostis canadensis, Pleurozium schreberi, Hylocomium splendens, Ptilium crista-castrensis*
Riparian White Spruce	Boreal NR Foothills NR	Terraced / Alluvial	Regosols	Subhygric to Hygric	Imperf.	*Betula neoalaskana, Alnus tenuifolia, Cornus stolonifera, Rosa acicularis, Rubus pubescens, Aralia nudicaulis, Equisetum pratense, Hylocomium splendens, Pleurozium schreberi*

Riparian Balsam Poplar	Boreal NR Foothills NR	Terraced / Alluvial	Regosols	Mesic to Hygric	Mod-Well to Imperf.	Alnus tenuifolia, Cornus stolonifera, Viburnum edule, Rubus pubescens, Equisetum pratense
Riparian Mixedwood	Boreal NR Foothills NR	Terraced / Alluvial	Regosols	Mesic to Hygric	Mod-Well to Imperf.	Alnus tenuifolia, Cornus stolonifera, Rosa acicularis, Rubus pubescens, Equisetum pratense
Jack Pine / Heath	Boreal NR Central Parkland SR	Level to Rolling / Eolian, Glaciofluvial	Brunisols	Subxeric to Submesic	Rapidly to Well	May include *Populus tremuloides*; may be savannah or park-like; *Vaccinium vitis-idaea, V. myrtilloides, Alnus crispa, Arctostaphylos uva-ursi, Cornus canadensis, Cladina mitis, C. rangiferina, C. stellaris*
Jack Pine / Moss	Boreal NR Central Parkland SR	Level to Rolling / Eolian, Glaciofluvial	Brunisols	Subxeric to Mesic	Rapidly to Well	May include *Picea glauca, Picea mariana, Populus tremuloides; Hylocomium splendens, Pleurozium schreberi*
Black Spruce / Heath	Boreal NR Canadian Shield NR	Undulating / Fluvial, Eolian, Glaciofluvial	Luvisols Brunisols Podzols	Mesic to Hygric	Rapidly to Imperf.	May include *Pinus banksiana, Pinus contorta, Populus tremuloides, Betula papyrifera; Vaccinium vitis-idaea, V. myrtilloides, Alnus crispa, Arctostaphylos uva-ursi, Empetrum nigrum, Cornus canadensis, Hylocomium splendens, Pleurozium schreberi, Cladina mitis, C. rangiferina, C. stellaris, Cetraria nivalis*
Black Spruce / Labrador Tea / (Feather Moss)	Boreal NR Canadian Shield NR	Undulating to Level / Morainal, Lacustrine, Morainal/Fluvial, Glaciofluvial	Luvisols Brunisols Podzols Gleysols	Mesic to Subhydric	Mod-Well to Poorly	May include *Pinus banksiana, Pinus contorta; Vaccinium vitis-idaea, Equisetum arvense, E. sylvaticum, Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*
Black Spruce Bog	Boreal NR Canadian Shield NR Foothills NR	Level to Depressional (to Lower Slope) / Organic over Lacustrine	Organic Cryosols	Hygric to Hydric	Imperf. to Very Poorly	*Ledum groenlandicum, Rubus chamaemorus, Vaccinium vitis-idaea, Chamaedaphne calyculata, Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis, Sphagnum angustifolium, S. fuscum, S. magellanicum, Polytrichum strictum, Cladonia* spp.
Tamarack Fen	Boreal NR	Level to Depressional (to Lower Slope) / Organic over Lacustrine	Organic Cryosols Gleysols	Hygric to Hydric	Imperf. to Very Poorly	*Picea mariana, Betula pumila, Carex spp., Salix* spp., *Aulacomnium and Drepanocladus* spp., *Pleurozium schreberi, Tomenthypnum nitens, Scorpidium scorpioides, Sphagnum angustifolium, S. fallax, S. jensenii, S. riparium, S. warnstorfii*

Appendix Table 10. Overview of Alberta boreal old-growth forest type structural attributes.

Type	Canopy Ht	Canopy Cover %	Multi-layered Canopy?	Stand Age Min / Max	Gap Dynamics	Pit and Mound Micro-topography?	Snags	Logs	Moss Cover %
Aspen Forest	22.5-29	56 mean inclusive, mature	Moderately Developed	85-130 / >130	Important source of gap-scale diversity	No. Populus break off above ground	Yes. While relatively small, they are used by wildlife	Create microbial habitat diversity and add structure and organic matter; do not function as nursery logs	<2, to <20 at moist end of gradient
Upland Balsam Poplar	22-29.5	55 mean inclusive, mature	Moderately Developed	80 / >120	Important source of gap-scale diversity	No. Populus break off above ground	Yes. While relatively small, they are used by wildlife	Create microbial habitat diversity and add structure and organic matter; do not function as nursery logs	<2, to <20 at moist end of gradient
Upland Populus - White Spruce	22-31.5 [d]	52 mean inclusive, to ~70% in mature to OG	Well Developed	85-130 / >130	Important in accelerating succession to *Picea glauca* dominance	? Microtopo-graphy increases with stand age	See above. 50-75/ha	Create non-vascular plant and microbial habitat diversity and add structure and organic matter; wood in various stages of decay important; do not function as nursery logs; 0.663 logs/5m transect	~17% mean (varies widely)
White Spruce / Shrub / Herb	28.5->35 (19-28 at 200 years)	~41 mean inclusive, mature	Well Developed	128 / >250	Important	Potentially important seedbed and source of small-scale diversity	Important, but probably less so than *Populus* snags	Important as nursery logs, microbial, insect, and small mammal habitat, sources of N-fixation, and organic matter	<5-95 (varies widely)

White Spruce / Horsetail / Feather Moss	28.5->35 (19-28 at 200 years)	~51 mean inclusive, mature	Well Developed	128 / >250	Important	Potentially important seedbed and source of small-scale diversity	Important, but probably less so than *Populus* snags	Important as nursery logs, microbial, insect, and small mammal habitat, sources of N-fixation, and organic matter	~<5->80 (varies widely)
Riparian White Spruce	26->33 [46] (32 median)	45 mean inclusive (34 median exclusive) [7]	Very Well Developed 18 m (25-75th ht. tiles)	160 / >330	Very important in generating diversity	Yes. Large hummock-hollows may form	50/ha median (see riparian mixedwood)	See *Picea glauca* forest (above). Probably more important in riparian forests than elsewhere (due to log size and long fire return). 416/ha median (see riparian mixedwood)	56% median (incl. lichens)
Riparian Balsam Poplar	17->27 (25 median)	37 median exclusive	Well Developed 13 m (25-75th ht. tile)	80 / >290	Important in generating diversity	No. *Populus* break off above ground	183/ha median (see riparian mixedwood)	See *Picea glauca* forest (above). Large, persistent logs. 284/ha (see riparian mixedwood)	0% median (incl. lichens)
Riparian Mixedwood	17->27 (~25-32 median)	54 mean inclusive (~34-37 median exclusive)	Very Well Developed ~13-18 m (25-75th ht. tiles)	80 / >330	Very important in generating diversity	Yes. Large hummock-hollows may form (*Picea glauca* only)	flood origin: density ~30-70/ha (higher in mature); median diam ~10-58 cm; median ht. 3-10m	See *Picea glauca* forest (above). Probably more important in riparian forests than elsewhere (due to log size and long fire return). Flood origin type: density ~100-500/ha; median diam 25-45 cm; median length 5-17m [c]	Varies widely
Jack Pine / Heath	391	40 mean inclusive, mature	Weakly Developed	~80 / >190	Plays role in maintaining forest and forest/grass mosaic	Rare. *Pinus banksiana* too short?	Potentially important habitat (study needed)	Create microbial habitat diversity and add structure and organic matter; do not function as nursery logs	usually <2

Jack Pine / Moss	14-26	37 mean inclusive, mature	Weakly Developed	~80 / > 190	?	Rare. *Pinus banksiana* too short?	Potentially important habitat (study needed)	Create microbial habitat diversity and add structure and organic matter; do not function as nursery logs	~20-70
Black Spruce / Heath	10.5->28	26 mean inclusive, mature	Weakly Developed	~85 / >263	?	No? *Picea mariana* too short	Potentially important habitat (study needed)	Create microbial habitat diversity and add structure and organic matter; do not function as nursery logs	<20
Black Spruce / Labrador Tea / (Feather Moss)	10.5->22	53 mean inclusive, mature	Weakly Developed	~85 / >263	?	No. *Picea mariana* too short	Potentially important habitat (study needed)	Create non-vascular plant and microbial habitat diversity and add structure and organic matter; wood in various stages of decay important	~15-75
Black Spruce Bog	12-20.5 [g] (~6-15 at 200 years)	41 mean inclusive, mature	Very Weakly Developed	~85 / >200	Probably unimportant	No. *Picea mariana* too short	Potentially important habitat (study needed)	Create non-vascular plant and microbial habitat diversity and add structure and organic matter; wood in various stages of decay important	15->90
Tamarack Fen	no ht./ site for *Larix laricina* (~9-18 at 200 years)	18 mean inclusive, mature	Very Weakly Developed	~85 / >200	Probably unimportant	No. *Larix laricina* too short	Potentially important habitat (study needed)	Create non-vascular plant and microbial habitat diversity and add structure and organic matter; wood in various stages of decay important	15-60

Appendix Table 11. Overview of Alberta boreal old-growth forest type site indices and other old-growth attributes.

Type	Site Index at 50 Yrs (Species, Mean, Range of Means, N Trees)	Average Tree DBH (cm)	Average Tree Stems/Ha	Basal Area/Ha (m^2)	Typical Birds and Mammals	Conservation Status
Aspen Forest	*Populus tremuloides* 18,16-18,459; (16,10-18,93 Foothills)	~18-29?	519-1020 [0-1500 @85 yrs; 50-800 @130 yrs]	~30? (11-30)	pileated woodpecker, least flycatcher, red-eyed vireo, warbling vireo, house wren, Baltimore oriole, rose-breasted grosbeak	Declining; old-growth under strong logging pressure; also lost to agriculture
Upland Balsam Poplar	*Populus balsamifera* 18,17-20,85; (15, n/a,3 Foothills)	like Aspen?	like Aspen?	like Aspen?	pileated woodpecker, least flycatcher, red-eyed vireo, warbling vireo, house wren, Baltimore oriole, rose-breasted grosbeak	Declining; old-growth under logging pressure
Upland Populus - White Spruce	*Picea glauca* 17,15-18,727 *P. balsamifera* 18,17-20,85 *P. tremuloides* 18.5,17-21,499	~37	~800	>35?	brown creeper, black-throated green warbler, red-breasted nuthatch, western tanager, winter wren, American redstart, yellow-rumped warbler, yellow warbler	Declining; old-growth under strong logging pressure; also lost to agriculture
White Spruce / Shrub / Herb	*Picea glauca* 17,15-18,233	21-30	530-905 [0-1000 @128 yrs; 50-600 @260 yrs]	38-50	three-toed woodpecker, red-breasted nuthatch, brown creeper, winter wren, golden-crowned kinglet, pine grosbeak, various woodpeckers, red-breasted nuthatch, saw-whet owl, boreal owl	Threatened; old-growth under strong logging pressure
White Spruce / Horsetail / Feather Moss	*Picea glauca* 16,13-16.5,216	21-30	</=1015 [0-1000 @128 yrs; 50-600 @260 yrs]	39-72	three-toed woodpecker, red-breasted nuthatch, brown creeper, winter wren, golden-crowned kinglet, pine grosbeak	Threatened; old-growth under strong logging pressure
Riparian White Spruce	*Picea glauca* 16,10-16.5,187	37 median	333 median	24 median [17] ; </=40 maximum	brown creeper, winter wren, blackpoll warbler, black-throated green warbler, rub-crowned kinglet, various woodpeckers, red-breasted nuthatch	Severely threatened; old-growth under strong logging pressure
Riparian Balsam Poplar	*Populus balsamifera* 16,12-18,10	28 median	467 median	16 median ; </=40 maximum	black and white warbler, American redstart, yellow-bellied sapsucker, cavity-nesting bufflehead and common goldeneye ducks	Declining due to logging?; also lost to agriculture (e.g., along Athabasca River)

Riparian Mixedwood	*Picea glauca* 16,10-16.5,187 *P. balsamifera* 16,12-18,10 *P. tremuloides* 20,n/a,12	~28-37 median	~333-467 median	~16-24 median; </=40 maximum	see riparian white spruce forests above	Severely threatened; old-growth under strong logging pressure
Jack Pine / Heath	*Pinus banksiana* 12,9-15,102	<30?	<500? (<1000?)	~25? (5-40)	black-capped chickadee, gray jay, slate-colored junco, American robin, pine siskin, ruby-crowned kinglet	Probably secure
Jack Pine / Moss	*Pinus banksiana* 13.5,10-15,155	<30?	<750? (<1000?)	~25? (5-40)	black-capped chickadee, gray jay, dark-eyed junco, American robin, pine siskin, ruby-crowned kinglet	Probably secure
Black Spruce / Heath	*Picea mariana* 11,7-16,71	<20?	<500? (variable: 1000-12000)	~27? (9-45)	gray jay, common raven, yellow-rumped warbler, blackpoll warbler, dark-eyed junco, red squirrel, snowshoe hare, black bear	Declining due to logging
Black Spruce / Labrador Tea / (Feather Moss)	*Picea mariana* 9,7-11,26	<20?	<750? (variable: 1000-12000)	~27? (9-45)	gray jay, common raven, yellow-rumped warbler, blackpoll warbler, dark-eyed junco, red squirrel, snowshoe hare, black bear	Declining due to logging
Black Spruce Bog	*Picea mariana* 10,8-10,45 (5,n/a,3 Foothills)	<15	Highly variable	<15?	palm warbler, olive-sided flycatcher, alder flycatcher, rusty blackbird, gray jay, sandhill crane, moose	Presently secure but may decline due to wetland drainage, future use of peat for fuel, climatic change
Tamarack Fen	*L. laricina* 8,7-9,19 (*P. mariana* 7,6-7,13 Foothills)	<15	Variable	<15?	palm warbler, olive-sided flycatcher, alder flycatcher, rusty blackbird, gray jay, sandhill crane, moose	May decline due to wetland drainage and climatic change

Appendix Table 12. An assessment of focal species and communities within the Alberta portion of Ecoregion 92. Regarding the numeric ratings in each of the vulnerability categories, the most vulnerability species in each category is rated 1, the second most vulnerable is rated 2, etc.

Notes Rare ANHIC plant and animal ranks from ANHIC, December 2002

Rare ANHIC community ranks from Allen (2002)

'Other Species' Alberta provincial ranks from Alberta Environment (2001)

COSEWIC ranks from COSEWIC (2002)

^ Alberta old-growth forest ranks and old-growth stand age minima and maxima after Timoney (2001a)

$ Keystone Status is tentative and is afforded to only those species or communities whose removal might engender dramatic changes in the structure and function of the community (De Leo and Levin 1997); these species and communities have a large influence on landscape vegetation pattern and succession and upon energy flow and nutrient cycling (Khanina 1998); for more on boreal keystone species, see Table 13

Global and National Ranks after Argus and Pryer (1990) for Vascular Plants, CITES ranks after CITES (2000), and IUCN ranks after IUCN (2002)

* Vulnerability categories based on Lambeck (1997), with addition of Range Edge category; Area-limited species are limited by the amount of habitat available to them (for communities or ecosystems, it refers to the areal extent of the type); Dispersal-limited species are limited by their ability to move across the landscape; Resource-limited species are limited by the availability of resources within their habitats; Process-limited species are limited by processes such as fire, exotics, domestic grazing, and pesticides; and Range Edge species are vulnerable due to the fact that they are at their range edge.

Vulnerability ranks based on reference to literature and discussion and are tentative; 1 = highest

** Vulnerability Categories codes: A = area, D = dispersal, E = range edge, P = process, R = resource

Vulnerability Category *						Vulnerable Element								
Category	Ratings by Category**					*Scientific Name*	Common Name	Keystone? $	Global / National Rank #	ANHIC Rank (Alberta Environment (2001) rank), [COSEWIC (2002) rank]	Habitat / Comments	ANHIC n (for Rare Species Query)	Further Habitat Notes
	A	D	E	P	R	Rare Species from ANHIC query							
A	34					*Artemisia tilesii*	Herriot's sagewort	No		S2	Open woods and river flats (Kershaw et al. 2001)	6	
A	35					*Brachythecium rutabulum*	moss	No		S2?	On soil, soil over rock, sometimes on roots or logs, in moist places, usually in lowlands (Lawton 1971)	5	
A	36					*Campyliu m polygamum*	moss	No		S3	Fens, meadows, and on rock beside creeks (Ireland 1982)	6	
A	33					*Carex capitata*	capitate sedge	No		S2	Wet sites, often in calcareous fens (Kershaw et al. 2001)	6	

P				40		*Carex lacustris*	lakeshore sedge	No		S2	Marshes and 'swampy woods' with constant water levels; scarcity of marshes with constant water levels limits this species' distribution (Kershaw et al. 2001); 'old-growth' wetlands (D. Johnson, pers. comm. Dec. 2002)	12	
P				41		*Carex pseudocyperus*	cyperus-like sedge	No		S2	Marshes that are relatively stable for lengthy periods, with perhaps some dependence on shade and mucky soils (Kershaw et al. 2001); 'old-growth' wetlands (D. Johnson, pers. comm. Dec. 2002)	7	
E			17			*Carex retrorsa*	turned sedge	No		S2S3	Swampy woods' and wet meadows (Kershaw et al. 2001)	7	
E			16			*Carex rostrata*	beaked sedge	No		S2	Floating fens at the edges of ponds and lakes (Kershaw et al. 2001)	6	
P, R				1	1	*Falco peregrinus anatum*	Peregrine Falcon	No	App I CITES	S1 (At Risk) [Threatened]	"Cliffs near water for nesting, and open fields, swamps and marshes for hunting" (McGillivray and Semenchuk 1998)	?	Occurrence data generalized t protect species
A, P, R	1			2	2	*Grus americana*	Whooping Crane	No	IUCN Red List Endangered; App I CITES	S1 (At Risk) [Endangered]	Diatom ponds, bulrush marshes, bulrush/cattail mixed marshes with aquatic macrophytes, and shrubby mixed marshes with water sedge and cattail (Timoney 1999)	?	Occurrence data generalized t protect species; the species ha been sighted in the study are outside of Wood Buffalo NP (se Semenchuk 1992)
A	13					*Heterodermia speciosa*	lichen	No		S2	Mainly muscicolous and occurs on sheltered, steep rocks or boulders facing north or northeast in boreal dieciduous woodlands (46 localities); (Threatened macrolichen project. 1996. http://www.toyen.uio.no/botanisk/bot-mus/lav/factshts/hetespec.htm)	5	
E			15			*Hypericum majus*	large Canada St. John's-wort	No		S2	Wet sites in plains, foothills, and boreal forest (Kershaw et al. 2001)	9	
E			13			*Lagopus lagopus*	Willow Ptarmigan	No		S1B	Willow-dwarf birch meadows and willow-covered stream banks near timberline; in winter, they move into timbered areas along water courses where food is available (McGillivray and Semenchuk 1998); five old occurrences in the study area	5	

A	12					*Malaxis monophylla (Malaxis monophyllos)*	white adder's-mouth	No		S2	Damp woods, thickets, and drier parts of bogs and fens in drier and less acidic sites than those of Malaxis paludosa (Kershaw et al. 2001)	11	
A, D	6	5				*Microtus xanthognathus*	Taiga Vole (Yellow-cheeked Vole)	No		SH	"Upland areas along river near stands of horsetail (Equisetum)" (Smith 1993)	6	Rare, possibly extirpated. Non collected in Alberta since 190 (Smith 1993). Allison (1973 stated they are 'known o believed to be inhabitants' of th Peace-Athabasca Delta region
E			12			*Nymphaea leibergii*	pygmy water-lily	No		S1	Quiet streams, ponds, and lakes, usually in deep water (Kershaw et al. 2001)	5	
A	32					*Panicum acuminatum**	hot-springs millet*	No		SU	* Sandy soils with jack pine; The species is in taxonomic confusion; true Panicum acuminatum (=Dicanthelium acuminatum, P. thermale) is a plant of marshy places around hot springs (Kershaw et al. 2001); the boreal Panicum, while referred to as Panicum acuminatum is actually P. lanuginosum var. fasciculatum (Torr.) Fern., a plant of sandy soils with jack pine (D. Johnson, pers. comm. 2002)	5	
E			11			*Polygala paucifolia*	fringed milkwort	No		S1	Moist conifer and mixedwood forests (Kershaw et al. 2001)	5	
D, P		1		3		*Rangifer tarandus caribou* population 14	Woodland Caribou -- boreal ecotype	No		S2 (at risk) [Threatened]	Mature conifer and mixedwood forests (Smith 1993); sensitive to disturbance (Dzus 2001); prefer open peatlands in the study area	8	declines in several borea populations have bee documented by Dzus (2001
A	29					*Salix tyrrellii*	Tyrrell's willow	? (Within the dune ecosystem)	G5T2 / N5T2, Endemic	S1 [Not at Risk]	Rare, restricted endemic of shifting sand dunes along south shore of Lake Athabasca (Porsild and Cody 1980); six occurrences in study area, all from June 2000	6	
E			14			*Sarracenia purpurea*	pitcher-plant	No		S2	Wetlands, usually with Sphagnum moss (Kershaw et al. 2001)	14	
A	30					*Stellaria arenicola*	sand-dune chickweed	No	G2 / N2, Endemic	S1 [Not at Risk]	Shifting sand dunes (Kershaw et al. 2001)	7	
A	31					*Tanacetum bipinnatum* ssp *huronensis (T. huronense var. floccosum)*	Indian tansy	No	G3QT1Q / N?T1, Endemic	S2	Sandy or gravelly shores, sand dunes and gravel bars (Kershaw et al. 2001)	9	

						Other Species						
						Mammals				Alberta Environment (2001) rank [COSEWIC (2002) rank]	Habitat / Comments	Further Habitat Note
A	4					*Myotis septentrionalis*	Northern Long-eared Bat	No		May be at Risk	Forest and glades along rivers (Banfield 1974)	
P				24		*Canis lupus occidentalis*	Gray Wolf	No		Secure [Not at Risk]	Variety of habitats (Smith 1993); area-demanding, sensitive, keystone specie	
P				23		*Felis concolor (Puma concolor)*	Mountain Lion (Cougar)	No (Too uncommon to be keystone?)	IUCN Red List Near Threatened	Sensitive	Top level predator of a variety of habitats from "swamps and wooded rive valleys to dense coniferous forests" (Banfield 1974); decline due t persecution (pest control), and degradation of habitat and prey base (IUCN 2002)	
P				25		*Lynx canadensis*	Lynx	No		Sensitive [Not at Risk]	In central Alberta, they use spruce, aspen, and balsam poplar forests, and in Manitoba, they use aspen forests; in western mountains, lynx use early-successional forests for foraging and older forests that provide CWD for thermal and security cover and denning; mid-successional forest stages may be used as travel corridors; high quality habitat consists of a mosaic of forest ages (particularly old and young stages) (Koehler and Aubry 1994)	Natural disturbance patterns du to fire, disease, and insec disturbances are expected t provide optimal lynx habita (Koehler and Aubry 1994)
D, P		2		5		*Ursus arctos*	Grizzly Bear	No (Too uncommon to be keystone?)		May be at risk [Special Concern]	Variety of habitats, but prefer tundra, shrublands, grasslands, open forests and river valleys; sensitive to disturbance (Kansas 2002; Smith 1993); area-demanding	Bears from Alberta Bea Management Areas (BMA) (much of NW AB), 2a, 2b, 3a and 13 would reside in, ma wander into, or reside adjacen to the study region; note als that grizzlies have been noted i NE AB outside of any BMA
P				4		*Bos bison (Bison bison athabascae)*	American Bison (Wood Bison)	Yes (Within WBNP)	IUCN Red List Lower Risk, Conservation Dependent; App II CITES	At risk [Threatened]	Marshes, meadows, willow savannahs and thickets and open forests with preference for drier ground in summer; favorite foods are *Carex atherodes* an *Salix* shoots	
P				52		*Alces alces*	Moose	Yes		Secure	Boreal keystone species of marshes, meadows, peatlands, carrs, lakeshores river valleys and most forests	

P				51		*Castor canadensis*	Beaver	Yes		Secure	Boreal keystone species of ponds, lakes, and valleys wherever preferred food (aspen, willows, alders) exist near water		
A, R	9			12		*Martes americana*	Marten	No		Secure	Prefers late successional mesic conifer forest with complex physical structures near the ground; use clearcuts less than expected from availability; use largest diameter trees as resting sites; in n. Rockies, prefer mesic subalpine fir, Douglas fir, and lodgepole pine; show preference for riparian zones (Buskirk and Ruggiero 1994)	Complex physical structure nea ground provides protection fron predators, access to prey, an thermal protection in winter structure near ground provide by coarse woody debri recruitment by gradual tre death and fall, en mass recruitment of CWD followin fire, the lower branches of livin trees, rock fields in forests, talu fields, shrubs, herbaceous plants and squirrel middens (Buskir and Ruggiero 1994)
A, P	8			11		*Martes pennanti*	Fisher	No		Sensitive	Late successional conifer forests and use riparian areas disproportionately; strong preference for habitats with overhead tree cover (Powell and Zielinski 1994)	Unlikely that early and mid successional forest, especiall those resulting from timbe harvest, provide the same prey rest sites, and den sites as mor mature forests; open, hardwood dominated forests are frequentl avoided throughout the fisher' range (Powell and Zielinsk 1994)
D, P		3		6		*Gulo gulo*	Wolverine	No	IUCN Red List Vulnerable	May be at risk [Special Concern]	Habitat is probably best-defined as areas that provide adequate year-round food supplies in extensive, sparsely-inhabited wilderness areas; highest densities in areas of highest habitat diversity and highest prey abundance (Banci 1994)	Seem most affected by activitie that fragment and supplan habitat, such as huma settlement, extensive logging, oi and gas development, mining recreational developments, an access roads (Banci 1994)
A	27					*Lutra canadensis*	Northern River Otter	No		Secure	Boreal rivers, creeks, lakes, and ponds (Smith 1993); prefers deep clear waters in lakes, rivers, and large marshes (Banfield 1974)	NE Alberta may be a stronghol for otters in Alberta (Smit 1993)

						Birds				Alberta Environment (2001) rank [COSEWIC (2002) rank]	Habitat / Comments		Further Habitat Note

R					4	*Pelecanus erythrorhynchos*	American White Pelican	No			Sensitive	Shallow, turbid lakes remote from human activity with extensive shallows nea shore and good fish populations; occasionally use deep, clear lakes and rivers nest on low, flat islands that are generally treeless, protected from wave actio and devoid of mammalian predators; susceptible to fluctuating water levels an human disturbance (Semenchuk 1992)
A, P	21			20		*Botaurus lentiginosus*	American Bittern	No			Sensitive	Breeds in marshes, 'swamps', moist meadows, and wet alder and willo thickets where there is dense emergent vegetation or tall graminoids; suspecte to be in decline (McGillivray and Semenchuk 1998); easy to monitor due t male breeding calls
A, P	18			9		*Cygnus buccinator*	Trumpeter Swan	No			At risk [Not at Risk]	Small to medium-sized shallow, isolated lakes that have well establishe emergent and submergent vegetation; small breeding populations at Elinor L Fawcett L, Otter L (McGillivray and Semenchuk 1998)
P				44		*Grus canadensis tabida*	Greater Sandhill Crane	No			Sensitive [Not at Risk]	Marshes, bogs adjacent to ponds, and large marshes with some open wate and tall graminoids; area must be secluded and undisturbed; little is known o distribution in Alberta (McGillivray and Semenchuk 1998); species is highl visible and vocal; much is known of ecology due to international conservatio efforts
A	28					*Chilidonias niger*	Black Tern	No			Sensitive [Not at Risk]	Shallow lakes, marshes, sloughs, ponds, and wet meadows where there ar extensive open shallows and moderate amounts of emergent vegetation; i decline in Alberta due to habitat loss (McGillivray and Semenchuk 1998);
E			2			*Asio flammeus*	Short-eared Owl	No			May be at risk [Special Concern]	Relatively open country such as grasslands, marshes, shrubby meadows an previously forested areas that have been cleared; suspected to be in declin (McGillivray and Semenchuk 1998);
R					3	*Picoides arcticus*	Black-backed Woodpecker	No			Sensitive	Dependent on old-growth and recent conifer burns (McGillivray an Semenchuk 1998); impacted by fire suppression and salvage logging
A, P	17			18		*Dryocopus pileatus*	Pileated Woodpecker	No			Sensitive	Old-growth forest dependent; old and mature dense canopy mixed an deciduous forests where there are large dead or dying trees; rarely found i areas of downed timber and burns (McGillivray and Semenchuk 1998)
A, P	20			21		*Certhia americana*	Brown Creeper	No			Undetermined	Prefers mature conifer and mixedwood forest (McGillivray and Semenchu 1998);
E			1			*Lanius ludovicianus*	Loggerhead Shrike	No			Sensitive [Threatened]	Declining; prefers lightly wooded river valleys; mostly found in grassland region, it extends sporadically into the parkland and southern borea (Semenchuk 1992)
A, E, P	1.5		3.5	3.5		*Anthus spragueii*	Sprague's Pipit	No	IUCN Red List Vulnerable		Sensitive [Threatened]	Bushy grassland including dry lake beds, moderately grazed areas, and grasslands in sandhills; intolerant of heavy grazing (Semenchuk 1992); does not use tame pasture (IUCN 2002, Species Information) ; has undergone large and continuing population declines Habitat loss/degradation due t agriculture, invasive alie species, and changes in nativ species dynamics (IUCN 2002 Species Information); found o Cold Lake Air Weapons Rang (Thomas 1998)
A	22					*Dendroica tigrina*	Cape May Warbler	No			Sensitive	Open, mature white spruce and mixedwood forests with spruce emergent (Semenchuk 1992)

A	23					*Dendroica virens*	Black-throated Green Warbler	No		Sensitive	Mature boreal spruce and fir forests and riparian Populus with spruc (McGillivray and Semenchuk 1998; Semenchuk 1992)	
A, P	16			19		*Dendroica fusca*	Blackburnian Warbler	No		Sensitive	Mature boreal spruce and fir and mixedwood forests; intolerant of fores disturbance (McGillivray and Semenchuk 1998; Semenchuk 1992)	
A	24					*Dendroica castanea*	Bay-breasted Warbler	No		Sensitive	Mature boreal mixedwood forests of spruce, fir, and balsam poplar, generall near water (McGillivray and Semenchuk 1998)	
A	25					*Wilsonia canadensis*	Canada Warbler	No		Sensitive	Forest borders along streams in mature boreal forests with heavy undergrowt (McGillivray and Semenchuk 1998)	
A	26					*Piranga ludoviciana*	Western Tanager	No		Sensitive	Open conifer and mixedwood forests	
						Reptiles						
D, P, R		7		16	11	*Thamnophis sirtalis*	Red-sided Garter Snake	No		Sensitive	Wide range of habitats near ponds, marshes, dugouts, ditches, and streams chiefly resident of boreal forest and aspen parkland (Russell and Bauer 1993	
						Amphibians						
D, P		4		10		*Rana pipiens*	Northern Leopard Frog	No		At risk [Special Concern]	One known locality in study region, but distribution in northern Alberta is poorly known; springs, streams, marshes, and other permanent water bodies, usually those with abundant aquatic vegetation; uses water as a safe refuge if threatened (Russell and Bauer 1993); in Rocky Mountains, preferred habitat includes cattail marshes, beaver ponds, and other permanent water bodies with aquatic vegetation (Finch 1992)	Declined in Alberta markedl since 1978, which may be linke to climate (drought and winte freezing of overwintering areas) and to pesticides and herbicide (Russell and Bauer 1993) extirpated from N Saskatchewan drainage protection of breeding area essential (Alberta Environmen 2001)
D, P		8		17		*Bufo hemiophrys*	Canadian Toad	No		May be at risk	Near lakes, ponds, ditches, marshes, and temporary water bodies; when threatened, may swim far from shore; in Elk Island NP, numbers declined between 1971 and mid-1980s (Russell and Bauer 1993)	Range of overlap betwee Canadian and Western Toads i the Slave Lake to Lac la Bich region (Russell and Bauer 1993

D, E, P		6	5	15		*Bufo boreas*	Western Toad	No	IUCN Red List Endangered	Sensitive	Near ponds, streams, rivers, and lakes; congregate in spring to breed in pools and small ponds (Russell and Bauer 1993)	Range of overlap betwee Canadian and Western Toads i the Slave Lake to Lac la Bich region (Russell and Baue 1993); population trend i Alberta is unknown, but ha declined in other parts of range pollution identified threat i other parts of range (Albert Environment 2001)
						Fishes						
A	10					*Cottus ricei*	Spoonhead Sculpin	No		May be at risk [Not at Risk]	Small, swift streams, turbid rivers, and inshore shallows and deeper waters o lakes; in northern Alberta, known from N. Saskatchewan, Athabasca, Peac drainages, Lesser Slave Lake, and in northern Saskatchewan, known fron Saskatchewan River, and Lakes Wollaston and Athabasca (Scott an Crossman 1979)	
A, E	5		3			*Coregonus zenithicus*	Shortjaw Cisco	No		May be at risk [Threatened]	In Alberta, known only from extreme NE; deep waters of lakes (Scott an Crossman 1979)	
A, E	7		4			*Prosopium coulteri*	Pygmy Whitefish	No		May be at risk	In Alberta, one record from study area; in western lakes, usually found a depths greater than 6 m; spawning assumed to take place in shallows o streams and lakes; in Canada, main distribution is in BC (Russell and Baue 1979)	
A, P	14			13		*Salvelinus namaycush*	Lake Trout	Yes		Sensitive	Spawns usually in large lakes with boulder or rubble bottom at depths of less than 12 m; most typically found in clear, cold waters of large lakes; range is principally boreal, subarctic, and arctic; in north, may inhabit rivers and shallow lakes (Scott and Crossman 1979)	Generally inhabit deeper waters especially in mid-summer where they prefer wate temperatures of about 10C (Scot and Crossman 1979)
A, P	15			14		*Thymallus arcticus*	Arctic Grayling	No		Sensitive	Spawns in gravel and rock-bottomed small streams, sometimes in appropriat habitat in main rivers; prefer clear waters of large, cold rivers, rocky creeks and lakes (Scott and Crossman 1979)	
A	19					*Hybognathus hankinsoni*	Brassy Minnow	No		Undetermined	Typically found in small lakes, slow-moving streams, beaver ponds and drainage ditches, usually associated with mud bottoms and dense vegetation (UBC, undated); last seen in Athabasca River in early 1980s (Larry Rhude, Alberta Fish and Wildlife, pers. comm. 2002)	Disjunct? Main range in Canad is in southern Prairie Province and s. Ontario; remainder o range is in north central US (UBC, undated)

A	19.5					*Phoxinus (Chrosomus) neogaeus*	Finescale Dace, Bronze Minnow	No		Undetermined	Cool bog ponds, streams, and larger lakes; in northern Alberta, known from West Pierre Greys Lake, Horne Lake, and East Hawk Hills Lake (Scott and Crossman 1979);	Disjunct? Main range in Canad is in Ontario (Scott an Crossman 1979);
E			6			*Percina caprodes*	Logperch	No		Undetermined	Three occurrences in study area; sand, gravel, or rocky shores in lakes an larger rivers, sometimes in swift water; usually found in water deeper than m, so may be missed in seine sampling (Scott and Crossman 1979)	
						Reverse Focal Species						
P				53		*Canis latrans*	Coyote	No		Secure	Broad habitat tolerance from grasslands, to parklands and dense northern forests (Smith 1993); tolerant of human activities	
P				55		*Mephitis mephitis*	Striped Skunk	No		Secure	Variety of habitats from grasslands to northern uplands; prefer uplands wher their burrows cannot be flooded; shelter belts around farms, old buildings, an rock outcrops are suitable (Smith 1993)	
P				54		*Procyon lotor*	Common Raccoon	No		Secure	Open wooded areas associated with riparian areas (Smith 1993)	
P				57		*Bos taurus*	Domestic Cattle	Yes		---	Anthropogenic pastures and open forests, grasslands, wetlands, and riparia areas	
P				56		*Molothrus ater*	Brown-headed Cowbird	No		Secure	Open county with suitable perches, including burns, cutlines, and roadsides; prefers to be near cattle; follow cattle when foraging; use perches to scan for hosts to parasitize; migrating northward; only unusable habitat is dense forest (McGillivray and Semenchuk 1998)	Social parasite with strong negative impacts on smalle passerines; "… by opening th boreal forest, we are expandin the range of cowbirds an putting added pressure o already habitat-stressed warble populations" (McGillivray an Semenchuk 1998)
						Communities						
						Boreal Old-Growth Forests				Assessment after Timoney (2001a) / ANHIC Rank	Comments / Age range (minimum - maximum ages reported) ^	
P				36		*Populus tremuloides*	Aspen Forest	Yes		Declining	/ 85->130	
P				37		*Populus balsamifera*	Upland Balsam Poplar	Yes		Declining	/ 80->120	
P				35		*Populus balsamifera / Picea glauca*	Upland Populus - White Spruce	Yes		Declining	/ 85->130	

P				34		*Picea glauca / Alnus / Cornus - Rosa*	White Spruce / Shrub / Herb	Yes		Threatened	/ 128 - >250		
P				33		*Picea glauca / Equisetum / Hylocomium*	White Spruce / Horsetail / Feather Moss	Yes		Threatened	/ 128 - >250		
A, P	2			7		*Picea glauca / Alnus - Betula / Equisetum*	Riparian White Spruce	Yes		Severely Threatened / S3	=ANHIC CEAB000040 / 160 - >330		
A, P	11			22		*Populus balsamifera / Alnus / Cornus*	Riparian Balsam Poplar	Yes		Declining / S3	=ANHIC CEAB000042 / 80 - >290		
A, P	3			8		*Picea glauca - Populus balsamifera*	Riparian Mixedwood	Yes		Severely Threatened	/ 80 - >330		
P, R				48	20	*Pinus banksiana / Vaccinium*	Jack Pine / Heath	Yes		Probably Secure	/ ~80 - >190		
P, R				47	19	*Pinus banksiana / Hylocomium*	Jack Pine / Moss	Yes		Probably Secure	/ ~80 - >190		
P, R				42	12	*Picea mariana / Vaccinium*	Black Spruce / Heath	Yes		Declining	/ ~85 - >263		
P, R				43	13	*Picea mariana / Ledum / FM*	Black Spruce / Labrador Tea / (Feather Moss)	Yes		Declining	/ ~85 - >263		
P, R				49	21	*Picea mariana / Sphagnum*	Black Spruce Bog	Yes		Presently Secure	/ ~85 - >200		
P, R				50	22	*Larix laricina*	Tamarack Fen	Yes		Presently Secure	/ ~85 - >200		

						Other Rare Community Types				ANHIC Rank	Habitat / Comments
P				38		*Amelanchier / Arctostaphylos / Oryzopsis*	saskatoon / common bearberry / northern rice grass	No		S2S3	
P				45		*Carex limosa / Sphagnum*	mud sedge - scheuchzeria / peat moss	No		S1	depends on nutrient-rich groundwater and peat accumulation
P				39		*Carex pseudocyperus - Calla palustris*	cypress-like sedge - water arum	No		S1S2	depends on fairly constant water levels

R					15	*Elymus trachycaulus - Distichlis stricta*	slender wheat grass - salt grass	No		S1	requires saline conditions
R					16	*Elymus trachycaulus - Hierochloe odorata*	slender wheat grass – sweet grass	No		SU	requires slightly saline, wet conditions
P, R				31	10	*Elymus trachycaulus - Koeleria macrantha*	slender wheat grass - June grass	No		SU	may be somewhat salt- or fire-dependent
R					14	*Isoetes echinospora*	northern quillwort	No		S1	tends to be found on sandy bottom, in shallow (clear?) water about 30 cm (D Johnson, pers. comm. 2002)
E			8			*Larix laricina / Carex prairea*	tamarack / prairie sedge	No		S1?	
E			7			*Picea glauca / Cetraria islandica*	white spruce / lichen	No		S1?	
E			9			*Populus balsamifera / Rhamnus*	balsam poplar / buckthorn	No		S1	
P				47		*Populus balsamifera / Viburnum opulus*	balsam poplar / high-bush cranberry	No		S1S2	depends on seepage on hillsides and in depressions
P						*Populus tremuloides / Rubus parviflorus / Aralia*	aspen / thimbleberry / sarsaparilla	No		S2S3	associated with seepage sites
P				46		*Populus tremuloides / Matteuccia*	aspen / ostrich fern	No		S1	associated with widely-fluctuating water table due to riparian processes an beaver
R					17	*Puccinellia – Suaeda – Spergularia*	salt-meadow grass - sea-blite - sand spurry	No		S2	salt-dependent
R					18	*Salicornia europaea*	samphire	No		S2	salt-dependent
P, R				28	7	*Salix athabascensis*	Athabasca willow string shrubland	No		SP	associated with gypsum-rich groundwater and peat accumulation (Timoney 1997
E			10			*Salix drummondiana / Scirpus*	Drummond's willow / bulrush	No		S1	
P, R				27	6	*Nitzschia - Cymbella - Mastogloia*	diatom pond	Yes, but uncommon and restricted in distribution		S1?	associated with gypsum-rich groundwater and widely-varying water level (Timoney et al. 1997b)
P, R				26	5	*Atriplex / Cyanophyta - Bacillariophyceae*	interior patterned saline marsh	No		S1?	associated with saline groundwater and horizontal surface flow of water in nearly level valleys; one known occurrence in Al-Pac FMA area at Clearwater Rive Springs (Timoney 2001b)

P				32		*Stipa – Symphoricarpos / Tortula*	Porcupine Grass – Snowberry	No		SU?	probably fire-dependent in boreal
P, R				29	8	*Pinus banksiana / Oryzopsis pungens*	Jack Pine / Northern Rice Grass	No		S2S3?	fire- and sand-dependent
P, R				30	9	*Elymus – Arctostaphylos uva-ursi*	Slender Wheatgrass – Bearberry	No		SU?	fire- and sand-dependent

Appendix Table 16. Breeding records of 16 rare Alberta birds in the boreal region of northeastern Alberta. Breeding codes: X - species observed, but no indication of breeding; P - pair observed in suitable nesting habitat; T - territory assumed through territorial nesting behavior; CF - adult seen carrying food or fecal sac for young; FL - recently fledged or downy young observed; H - species observed or breeding calls heard in suitable nesting habitat; NY - nest with young. Data provided courtesy of the Federation of Alberta Naturalists, Edmonton, January 2003.

Species	Abundance	Breeding Code	Notes	Date	Latitude	Longitude
American Bittern	1	X		6/15/02	55.2563	-112.0961
American White Pelican	8	X		5/29/99	54.6717	-111.2711
American White Pelican	15	X		7/1/98	54.1333	-111.5333
American White Pelican	26	X		5/29/99	54.8225	-111.9755
American White Pelican	46	X		5/27/00	54.8225	-111.9755
American White Pelican	5	X		7/8/00	55.0000	-115.0000
American White Pelican	6	X		6/17/96	57.7507	-115.5518
American White Pelican	30	X		6/7/94	54.4667	-110.5833
American White Pelican	10	X		6/24/93	54.8333	-110.3333
American White Pelican	16	X		5/26/01	54.8225	-111.9755
American White Pelican	14	X		6/17/01	55.9838	-113.9368
American White Pelican	30	X		6/22/00	54.7681	-111.9611
American White Pelican	5	X		7/8/01	54.6559	-110.0790
American White Pelican	1	X		5/27/01	54.6559	-110.0790
American White Pelican	6	P		6/22/95	54.5483	-110.1209
American White Pelican	6	X		5/31/02	56.0389	-113.8833
American White Pelican	19	X		6/22/02	55.0000	-115.0000
American White Pelican	2	X		6/9/02	55.3172	-113.7843
Bay-breasted Warbler	15	X		5/29/99	54.8225	-111.9755
Bay-breasted Warbler	33	X		5/27/00	54.8225	-111.9755
Bay-breasted Warbler	1	T		7/8/00	55.0000	-115.0000
Bay-breasted Warbler	1	H		6/15/96	58.1833	-115.6833
Bay-breasted Warbler	17	X		5/26/01	54.8225	-111.9755
Bay-breasted Warbler	5	CF		6/22/00	54.7681	-111.9611
Bay-breasted Warbler	3	X		7/8/01	54.6559	-110.0790
Bay-breasted Warbler	1	H		6/24/02	55.5222	-110.7194
Bay-breasted Warbler	1	H		6/25/02	55.8711	-110.8823
Bay-breasted Warbler	8	H		6/29/02	55.5222	-110.7194
Bay-breasted Warbler	4	P		6/9/02	55.3172	-113.7843
Bay-breasted Warbler	4	H		6/15/02	56.0167	-113.6959
Bay-breasted Warbler	2	H		6/20/02	56.0458	-114.0917
Bay-breasted Warbler	1	H		6/21/02	55.4913	-113.8008
Bay-breasted Warbler	1	H		6/4/02	55.5226	-114.0904
Bay-breasted Warbler	6	H		6/8/02	56.7503	-114.4207
Bay-breasted Warbler	4	H		6/10/02	56.0167	-113.6959
Bay-breasted Warbler	3	H		6/14/02	55.3387	-112.5605
Bay-breasted Warbler	6	X		6/14/02	54.9115	-111.4708
Bay-breasted Warbler	6	X		6/21/02	54.9100	-111.7747
Bay-breasted Warbler	9	X		6/15/02	55.2563	-112.0961
Bay-breasted Warbler	10	X		6/9/02	56.7503	-114.4207
Bay-breasted Warbler	15	H		6/26/02	56.9945	-113.4714

Bay-breasted Warbler	3	H	7/5/02	55.1716	-111.7861
Bay-breasted Warbler	11	H	7/8/02	55.4274	-112.4125
Bay-breasted Warbler	5	H	7/9/02	55.3344	-112.8667
Bay-breasted Warbler	3	X	7/7/02	55.7101	-114.7225
Bay-breasted Warbler	3	X	6/10/02	55.1868	-114.7132
Bay-breasted Warbler	3	X	6/16/02	55.3387	-112.5605
Bay-breasted Warbler	1	X	6/7/02	55.3583	-114.5614
Bay-breasted Warbler	10	H	6/28/02	55.2334	-113.6236
Bay-breasted Warbler	2	X	6/18/02	55.3387	-112.5605
Bay-breasted Warbler	4	H	6/28/02	55.4136	-113.3329
Bay-breasted Warbler	2	X	6/25/02	55.4136	-113.3329
Bay-breasted Warbler	1	H	7/2/02	55.3295	-113.1728
Black-backed Woodpecker	2	X	5/27/00	54.8225	-111.9755
Black-backed Woodpecker	1	X	7/8/00	55.0000	-115.0000
Black-backed Woodpecker	5	X	3/12/95	54.4500	-110.0833
Black-backed Woodpecker	1	X	10/29/95	54.4500	-110.0833
Black-backed Woodpecker	5	X	10/15/95	54.4500	-110.0833
Black-backed Woodpecker	1	X	7/8/01	54.6559	-110.0790
Black-backed Woodpecker	1	X	5/27/01	54.5505	-110.2343
Black-backed Woodpecker	1	H	5/27/02	55.1750	-113.2361
Black-backed Woodpecker	1	H	7/7/02	55.7740	-112.5885
Black-backed Woodpecker	1	X	7/7/02	56.7565	-114.7422
Black-backed Woodpecker	1	H	6/7/02	55.0851	-111.6297
Black-backed Woodpecker	2	P	6/8/02	56.7503	-114.4207
Black-backed Woodpecker	1	X	6/21/02	54.9100	-111.7747
Black-backed Woodpecker	1	X	7/8/02	55.4274	-112.4125
Black-backed Woodpecker	1	H	7/9/02	55.6281	-115.0316
Black-throated Green Warbler	16	X	5/29/99	54.8225	-111.9755
Black-throated Green Warbler	17	X	5/27/00	54.8225	-111.9755
Black-throated Green Warbler	3	X	7/8/00	55.0000	-115.0000
Black-throated Green Warbler	1	H	6/20/00	54.4624	-110.1224
Black-throated Green Warbler	4	H	6/6/96	57.8667	-115.3833
Black-throated Green Warbler	5	H	6/7/96	57.8833	-115.5000
Black-throated Green Warbler	2	H	6/24/93	54.8333	-110.3333
Black-throated Green Warbler	5	X	5/26/01	54.8225	-111.9755
Black-throated Green Warbler	6	CF	6/22/00	54.7681	-111.9611
Black-throated Green Warbler	6	NY	6/22/95	54.5483	-110.1209
Black-throated Green Warbler	1	X	5/31/02	56.0389	-113.8833
Black-throated Green Warbler	2	H	5/27/02	55.1750	-113.2361
Black-throated Green Warbler	2	H	5/28/02	55.1750	-113.2361
Black-throated Green Warbler	1	H	5/16/02	55.0851	-111.6297
Black-throated Green Warbler	16	H	6/3/02	55.1526	-113.3114
Black-throated Green Warbler	14	H	6/2/02	55.6687	-113.6633
Black-throated Green Warbler	15	H	6/5/02	55.5226	-114.0904
Black-throated Green Warbler	1	H	7/7/02	55.7740	-112.5885
Black-throated Green Warbler	1	H	7/9/02	55.3344	-112.8667
Black-throated Green Warbler	6	H	6/13/02	55.3518	-114.2494
Black-throated Green Warbler	3	H	6/20/02	56.0458	-114.0917
Black-throated Green Warbler	3	H	6/16/02	55.6166	-114.4086
Black-throated Green Warbler	4	H	6/7/02	55.0851	-111.6297

Black-throated Green Warbler	2	H	6/4/02	55.5226	-114.0904
Black-throated Green Warbler	3	H	6/6/02	55.4500	-115.4500
Black-throated Green Warbler	29	X	6/14/02	54.9115	-111.4708
Black-throated Green Warbler	19	X	6/21/02	54.9100	-111.7747
Black-throated Green Warbler	9	X	6/15/02	55.2563	-112.0961
Black-throated Green Warbler	17	X	6/4/02	55.0244	-115.4738
Black-throated Green Warbler	8	H	7/5/02	55.1716	-111.7861
Black-throated Green Warbler	2	H	7/8/02	55.4274	-112.4125
Black-throated Green Warbler	4	H	7/9/02	55.3344	-112.8667
Black-throated Green Warbler	1	X	7/7/02	55.7101	-114.7225
Black-throated Green Warbler	5	X	7/9/02	55.6281	-115.0316
Black-throated Green Warbler	7	X	6/10/02	55.1868	-114.7132
Black-throated Green Warbler	1	X	6/16/02	55.3387	-112.5605
Black-throated Green Warbler	6	X	6/7/02	55.3583	-114.5614
Black-throated Green Warbler	17	H	6/28/02	55.2334	-113.6236
Black-throated Green Warbler	6	H	6/28/02	55.4136	-113.3329
Black-throated Green Warbler	3	X	6/25/02	55.4136	-113.3329
Black-throated Green Warbler	3	H	5/31/02	55.1526	-113.3114
Black-throated Green Warbler	2	H	7/2/02	55.3295	-113.1728
Black Tern	30	X	6/15/80	55.0000	-114.3333
Black Tern	2	X	7/7/91	55.0000	-115.3667
Black Tern	10	X	5/30/99	54.1502	-111.4838
Black Tern	4	X	5/29/99	54.6717	-111.2711
Black Tern	1	X	5/29/99	54.8225	-111.9755
Black Tern	1	X	7/8/00	55.0000	-115.0000
Black Tern	10	X	6/18/96	58.0524	-115.6335
Black Tern	50	X	6/18/97	58.2008	-116.4352
Black Tern	4	X	6/7/94	54.4667	-110.5833
Black Tern	50	H	5/20/95	54.4500	-110.0833
Black Tern	6	H	6/11/96	58.0167	-115.8833
Black Tern	8	H	6/13/96	58.3333	-116.2500
Black Tern	2	H	6/15/96	58.1833	-115.6833
Black Tern	100	X	5/26/01	54.6559	-110.0790
Black Tern	4	X	7/8/01	54.4303	-110.6318
Black Tern	25	T	6/2/02	55.0000	-115.0000
Black Tern	6	T	6/3/02	55.1667	-115.5000
Black Tern	34	X	6/7/02	55.0000	-118.0000
Black Tern	40	H estimate, unable to count	6/10/02	55.0000	-115.0000
Black Tern	2	FL	7/26/01	55.0000	-115.0000
Black Tern	8	X	6/23/02	55.0000	-115.0000
Black Tern	10	P	6/27/02	55.0000	-115.0000
Black Tern	4	X	7/7/02	55.0000	-115.0000
Black Tern	8	FL	7/14/02	55.0000	-115.0000
Black Tern	12	FL	7/24/02	55.0000	-115.0000
Black Tern	2	X	8/3/02	55.1667	-115.5000
Black Tern	2	X	8/5/02	55.0000	-115.0000
Black Tern	1	X	6/22/02	55.0000	-115.0000
Black Tern	2	X	8/7/02	55.0000	-115.0000
Black Tern	1	X	8/18/02	55.0000	-115.0000

Black Tern	1	X	6/2/02	55.3137	-113.9371
Black Tern	4	X	6/9/02	55.3172	-113.7843
Black Tern	1	X	9/8/02	55.0000	-115.0000
Blackburnian Warbler	6	X	5/29/99	54.8225	-111.9755
Blackburnian Warbler	4	X	5/27/00	54.8225	-111.9755
Blackburnian Warbler	1	H	6/20/00	54.4624	-110.1224
Blackburnian Warbler	5	X	5/26/01	54.8225	-111.9755
Blackburnian Warbler	1	X	7/8/01	54.6559	-110.0790
Blackburnian Warbler	6	NY	6/22/95	54.5483	-110.1209
Blackburnian Warbler	1	CF	7/15/90	54.5500	-110.3000
Blackburnian Warbler	1	X	6/5/02	55.5226	-114.0904
Blackburnian Warbler	4	X	6/14/02	54.9115	-111.4708
Blackburnian Warbler	1	X	6/21/02	54.9100	-111.7747
Brown Creeper	1	X	10/25/81	55.0000	-114.3333
Brown Creeper	1	X	10/29/95	54.4500	-110.0833
Brown Creeper	2	X	5/26/01	54.8225	-111.9755
Brown Creeper	1	H	6/22/00	54.7681	-111.9611
Brown Creeper	2	H	5/28/02	55.1750	-113.2361
Brown Creeper	2	X	5/16/02	55.2586	-111.7900
Brown Creeper	3	X	5/18/02	56.1325	-111.0454
Brown Creeper	1	X	5/16/02	54.9115	-111.4708
Brown Creeper	5	X	5/16/02	54.9115	-111.4708
Brown Creeper	4	X	5/16/02	55.0851	-111.6297
Brown Creeper	4	X	5/18/02	55.6968	-111.1893
Brown Creeper	1	X	5/14/02	54.9100	-111.7747
Brown Creeper	3	H	6/3/02	55.1526	-113.3114
Brown Creeper	6	H	6/2/02	55.6687	-113.6633
Brown Creeper	1	X	6/5/02	55.5226	-114.0904
Brown Creeper	2	H	7/7/02	55.7740	-112.5885
Brown Creeper	1	H	7/9/02	55.3344	-112.8667
Brown Creeper	3	H	6/24/02	55.5222	-110.7194
Brown Creeper	2	H	6/25/02	55.8711	-110.8823
Brown Creeper	14	H	6/29/02	55.5222	-110.7194
Brown Creeper	1	H	6/9/02	55.3172	-113.7843
Brown Creeper	1	H	6/13/02	55.3518	-114.2494
Brown Creeper	1	H	6/15/02	56.0167	-113.6959
Brown Creeper	5	H	6/20/02	56.0458	-114.0917
Brown Creeper	7	H	6/21/02	55.4913	-113.8008
Brown Creeper	3	H	6/16/02	55.6166	-114.4086
Brown Creeper	7	H	6/7/02	55.0851	-111.6297
Brown Creeper	1	H	6/4/02	55.5226	-114.0904
Brown Creeper	1	H	6/10/02	56.0167	-113.6959
Brown Creeper	12	X	6/14/02	54.9115	-111.4708
Brown Creeper	14	X	6/21/02	54.9100	-111.7747
Brown Creeper	9	X	6/15/02	55.2563	-112.0961
Brown Creeper	3	X	6/4/02	55.0244	-115.4738
Brown Creeper	2	H	6/3/02	54.8245	-111.4677
Brown Creeper	11	P	7/5/02	55.1716	-111.7861
Brown Creeper	3	H	7/8/02	55.4274	-112.4125
Brown Creeper	6	H	7/9/02	55.3344	-112.8667

Brown Creeper	3	X	6/10/02	55.1868	-114.7132
Brown Creeper	1	X	6/16/02	55.3387	-112.5605
Brown Creeper	1	X	6/7/02	55.3583	-114.5614
Brown Creeper	2	H	6/28/02	55.2334	-113.6236
Brown Creeper	2	X	6/18/02	55.3387	-112.5605
Brown Creeper	10	H	6/28/02	55.4136	-113.3329
Brown Creeper	1	X	6/25/02	55.4136	-113.3329
Canada Warbler	1	X	7/11/98	55.4825	-114.9028
Canada Warbler	2	X	5/29/99	54.8225	-111.9755
Canada Warbler	3	X	5/27/00	54.8225	-111.9755
Canada Warbler	1	H	6/6/96	57.8667	-115.3833
Canada Warbler	3	H	6/7/96	57.8833	-115.5000
Canada Warbler	3	X	6/12/96	57.8000	-115.3333
Canada Warbler	2	H	6/13/96	58.3333	-116.2500
Canada Warbler	1	H	6/15/96	58.1833	-115.6833
Canada Warbler	1	H	6/24/93	54.8333	-110.3333
Canada Warbler	2	X	5/26/01	54.8225	-111.9755
Canada Warbler	7	X	7/8/01	54.6559	-110.0790
Canada Warbler	1	H	6/2/02	55.6687	-113.6633
Canada Warbler	1	H	7/2/02	55.7101	-114.7225
Canada Warbler	17	H	7/7/02	55.7740	-112.5885
Canada Warbler	1	H	6/24/02	55.5222	-110.7194
Canada Warbler	19	H	6/25/02	55.8711	-110.8823
Canada Warbler	8	H	6/20/02	56.0458	-114.0917
Canada Warbler	1	X	6/16/02	55.6166	-114.4086
Canada Warbler	1	X	6/21/02	54.9100	-111.7747
Canada Warbler	7	H	6/26/02	56.9945	-113.4714
Canada Warbler	1	H	7/5/02	55.1716	-111.7861
Canada Warbler	1	X	6/10/02	55.1868	-114.7132
Cape May Warbler	12	X	5/29/99	54.8225	-111.9755
Cape May Warbler	4	X	5/27/00	54.8225	-111.9755
Cape May Warbler	14	X	5/26/01	54.8225	-111.9755
Cape May Warbler	3	X	7/8/01	54.6559	-110.0790
Cape May Warbler	2	H	6/2/02	55.6687	-113.6633
Cape May Warbler	1	X	6/5/02	55.5226	-114.0904
Cape May Warbler	5	H	7/7/02	55.7740	-112.5885
Cape May Warbler	1	H	6/24/02	55.5222	-110.7194
Cape May Warbler	4	H	6/25/02	55.8711	-110.8823
Cape May Warbler	1	H	6/29/02	55.5222	-110.7194
Cape May Warbler	1	H	7/7/02	56.7565	-114.7422
Cape May Warbler	11	H	6/15/02	56.0167	-113.6959
Cape May Warbler	3	H	6/20/02	56.0458	-114.0917
Cape May Warbler	1	H	6/21/02	55.4913	-113.8008
Cape May Warbler	2	H	6/7/02	55.0851	-111.6297
Cape May Warbler	6	H	6/8/02	56.7503	-114.4207
Cape May Warbler	4	H	6/9/02	56.7565	-114.7422
Cape May Warbler	3	H	6/10/02	56.0167	-113.6959
Cape May Warbler	6	H	6/8/02	55.6016	-112.4230
Cape May Warbler	2	X	6/14/02	54.9115	-111.4708
Cape May Warbler	1	X	6/21/02	54.9100	-111.7747

Cape May Warbler	8	X	6/9/02	56.7503	-114.4207
Cape May Warbler	7	H	6/26/02	56.9945	-113.4714
Cape May Warbler	2	FL	7/5/02	55.1716	-111.7861
Cape May Warbler	1	X	7/9/02	55.6281	-115.0316
Cape May Warbler	2	X	6/10/02	55.1868	-114.7132
Cape May Warbler	2	X	6/16/02	55.3387	-112.5605
Cape May Warbler	4	X	6/7/02	55.3583	-114.5614
Cape May Warbler	1	H	6/28/02	55.2334	-113.6236
Cape May Warbler	3	X	6/18/02	55.3387	-112.5605
Cape May Warbler	2	H	7/2/02	55.3295	-113.1728
Peregrine Falcon	1	X	5/27/00	54.8225	-111.9755
Pileated Woodpecker	2	X	5/29/99	54.8225	-111.9755
Pileated Woodpecker	2	X	7/8/00	55.0000	-115.0000
Pileated Woodpecker	5	X	5/2/95	55.6186	-110.5000
Pileated Woodpecker	1	X	3/18/95	54.4500	-110.0833
Pileated Woodpecker	1	X	3/12/95	54.4500	-110.0833
Pileated Woodpecker	1	H	5/20/95	54.4500	-110.0833
Pileated Woodpecker	1	H	6/6/96	57.8667	-115.3833
Pileated Woodpecker	2	H	6/8/96	57.8833	-115.5000
Pileated Woodpecker	1	H	6/11/96	58.0167	-115.8833
Pileated Woodpecker	1	H	6/15/96	58.1833	-115.6833
Pileated Woodpecker	1	X	5/4/96	54.4500	-110.0833
Pileated Woodpecker	1	X	10/15/95	54.4500	-110.0833
Pileated Woodpecker	4	X	5/26/01	54.8225	-111.9755
Pileated Woodpecker	1	H	6/22/00	54.7681	-111.9611
Pileated Woodpecker	1	X	7/8/01	54.6559	-110.0790
Pileated Woodpecker	2	X	7/8/01	54.4303	-110.6318
Pileated Woodpecker	1	X	6/22/95	54.5483	-110.1209
Pileated Woodpecker	2	X	12/23/01	56.4333	-112.9667
Pileated Woodpecker	1	H	6/23/01	55.9167	-118.5833
Pileated Woodpecker	1	X	5/16/02	54.9115	-111.4708
Pileated Woodpecker	2	H	5/16/02	55.0851	-111.6297
Pileated Woodpecker	1	T	5/18/02	55.6968	-111.1893
Pileated Woodpecker	2	X	5/15/02	54.9100	-111.7747
Pileated Woodpecker	6	H	6/3/02	55.1526	-113.3114
Pileated Woodpecker	3	H	6/2/02	55.6687	-113.6633
Pileated Woodpecker	1	X	6/5/02	55.5226	-114.0904
Pileated Woodpecker	3	H	7/7/02	55.7740	-112.5885
Pileated Woodpecker	2	H	7/9/02	55.3344	-112.8667
Pileated Woodpecker	1	H	6/24/02	55.5222	-110.7194
Pileated Woodpecker	3	H	6/25/02	55.8711	-110.8823
Pileated Woodpecker	1	H	6/29/02	55.5222	-110.7194
Pileated Woodpecker	1	H	7/7/02	56.7565	-114.7422
Pileated Woodpecker	2	H	6/9/02	55.3172	-113.7843
Pileated Woodpecker	1	H	5/23/02	55.0244	-115.4738
Pileated Woodpecker	1	H	6/20/02	56.0458	-114.0917
Pileated Woodpecker	3	H	6/16/02	55.6166	-114.4086
Pileated Woodpecker	1	H	6/8/02	55.6016	-112.4230
Pileated Woodpecker	1	X	6/14/02	54.9115	-111.4708
Pileated Woodpecker	4	X	6/15/02	55.2563	-112.0961

Pileated Woodpecker	2	H		6/26/02	56.9945	-113.4714
Pileated Woodpecker	2	H		7/5/02	55.1716	-111.7861
Pileated Woodpecker	1	X		7/7/02	55.7101	-114.7225
Pileated Woodpecker	2	X		6/18/02	55.3387	-112.5605
Pileated Woodpecker	3	H		6/28/02	55.4136	-113.3329
Sandhill Crane	2	X		5/29/99	54.6717	-111.2711
Sandhill Crane	10	X		4/26/97	54.1333	-111.5333
Sandhill Crane	1	X		5/27/00	54.8225	-111.9755
Sandhill Crane	2	X		6/18/97	58.2008	-116.4352
Sandhill Crane	25	X		5/2/95	55.6186	-110.5000
Sandhill Crane	40	P		6/7/94	54.4667	-110.5833
Sandhill Crane	1	H		5/4/96	54.4500	-110.0833
Sandhill Crane	50	X		10/15/95	54.4500	-110.0833
Sandhill Crane	16	X		5/22/93	54.2500	-111.0833
Sandhill Crane	4	X		6/29/01	56.9147	-117.6087
Sandhill Crane	1	X		7/8/01	54.3667	-110.1000
Sandhill Crane	10	X		5/27/01	54.4368	-110.3926
Sandhill Crane	14	X		5/27/01	54.5505	-110.2343
Sandhill Crane	1	X		7/13/02	55.0000	-115.0000
Sandhill Crane	1	X		7/24/02	55.0000	-115.0000
Sandhill Crane	1	X		8/3/02	55.1667	-115.5000
Sandhill Crane	1	X		8/7/02	55.0000	-115.0000
Sandhill Crane	2	H		5/16/02	55.2586	-111.7900
Sandhill Crane	2	X		5/16/02	54.9115	-111.4708
Sandhill Crane	3	X		5/15/02	54.9100	-111.7747
Sandhill Crane	1	X		6/15/02	55.2563	-112.0961
Sandhill Crane	2	H		7/5/02	55.1716	-111.7861
Sandhill Crane	4	X		6/7/02	55.3583	-114.5614
Sandhill Crane	3	X		6/18/02	55.3387	-112.5605
Short-eared Owl	1	X		5/4/96	54.4500	-110.0833
Trumpeter Swan	1	H		5/1/01	55.1333	-118.7500
Trumpeter Swan	5	FL	pr plus 3 chks	7/26/02	55.0000	-115.0000
Trumpeter Swan	23	X	8 adults 15 cygnets	10/26/02	55.0000	-115.0000
Western Tanager	3	X		5/29/99	54.6717	-111.2711
Western Tanager	11	X		5/29/99	54.8225	-111.9755
Western Tanager	6	X		5/27/00	54.8225	-111.9755
Western Tanager	1	H		6/20/00	54.4624	-110.1224
Western Tanager	3	H		6/6/96	57.8667	-115.3833
Western Tanager	3	H		6/7/96	57.8833	-115.5000
Western Tanager	5	H		6/8/96	57.8833	-115.5000
Western Tanager	1	H		6/11/96	58.0167	-115.8833
Western Tanager	1	X		6/12/96	57.8000	-115.3333
Western Tanager	10	H		6/13/96	58.3333	-116.2500
Western Tanager	3	H		6/15/96	58.1833	-115.6833
Western Tanager	7	X		5/26/01	54.8225	-111.9755
Western Tanager	4	P		6/22/00	54.7681	-111.9611
Western Tanager	1	H		6/12/87	56.4661	-117.9793
Western Tanager	5	X		7/8/01	54.6559	-110.0790
Western Tanager	1	X		6/22/95	54.5483	-110.1209
Western Tanager	1	H		5/26/01	55.1333	-118.7500

Western Tanager	1	X		6/2/02	55.0000	-115.0000
Western Tanager	1	X	male	5/12/02	55.7833	-117.8833
Western Tanager	1	X		7/20/02	55.1667	-115.5000
Western Tanager	1	H		5/27/02	55.1750	-113.2361
Western Tanager	1	H		5/28/02	55.1750	-113.2361
Western Tanager	1	X		5/16/02	55.2586	-111.7900
Western Tanager	1	X		5/16/02	54.9115	-111.4708
Western Tanager	2	H		5/16/02	55.0851	-111.6297
Western Tanager	5	H		6/3/02	55.1526	-113.3114
Western Tanager	8	H		6/2/02	55.6687	-113.6633
Western Tanager	1	H		6/5/02	55.5226	-114.0904
Western Tanager	1	H		7/9/02	55.6281	-115.0316
Western Tanager	11	H		7/7/02	55.7740	-112.5885
Western Tanager	1	H		7/9/02	55.3344	-112.8667
Western Tanager	4	H		6/24/02	55.5222	-110.7194
Western Tanager	2	H		6/25/02	55.8711	-110.8823
Western Tanager	5	H		7/7/02	56.7565	-114.7422
Western Tanager	13	CF		6/9/02	55.3172	-113.7843
Western Tanager	3	H		6/15/02	56.0167	-113.6959
Western Tanager	6	H		6/20/02	56.0458	-114.0917
Western Tanager	4	H		6/21/02	55.4913	-113.8008
Western Tanager	5	H		6/16/02	55.6166	-114.4086
Western Tanager	2	H		6/7/02	55.0851	-111.6297
Western Tanager	1	H		6/6/02	55.4500	-115.4500
Western Tanager	4	H		6/8/02	56.7503	-114.4207
Western Tanager	2	H		6/9/02	56.7565	-114.7422
Western Tanager	2	H		6/10/02	56.0167	-113.6959
Western Tanager	1	H		6/13/02	55.2563	-112.0961
Western Tanager	6	X		6/14/02	54.9115	-111.4708
Western Tanager	9	X		6/21/02	54.9100	-111.7747
Western Tanager	7	X		6/15/02	55.2563	-112.0961
Western Tanager	14	X		6/9/02	56.7503	-114.4207
Western Tanager	10	X		6/4/02	55.0244	-115.4738
Western Tanager	15	H		6/26/02	56.9945	-113.4714
Western Tanager	1	H		7/1/02	55.6281	-115.0316
Western Tanager	13	H		7/5/02	55.1716	-111.7861
Western Tanager	1	H		7/8/02	55.4274	-112.4125
Western Tanager	4	H		7/9/02	55.3344	-112.8667
Western Tanager	1	X		7/9/02	55.6281	-115.0316
Western Tanager	13	X		6/10/02	55.1868	-114.7132
Western Tanager	7	X		6/7/02	55.3583	-114.5614
Western Tanager	14	H		6/28/02	55.2334	-113.6236
Western Tanager	2	H		6/28/02	55.4136	-113.3329
Western Tanager	7	H		7/2/02	55.3295	-113.1728