Biota and Ecological Communities

Chapter 3

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Summary Points

- Northwest Alberta possesses a diverse biota, including both flora and fauna.
- Although our knowledge of the diversity of more primitive simple organisms is grossly incomplete, we do know that they contain remarkable species richness, and play a critical role within ecological communities.
- Systematic and comprehensive inventories exist for but a few species in northwest Alberta, and these are confined to those profile species viewed critical in terms of consumptive use or endangered status.
- The biotic communities of northwest Alberta are exceptionally young from a geologic perspective, reflecting the recent retreat of regional glacial ice sheets ~10,000 years ago.
- Currently, plant communities are diverse and reflect physiographic differences in elevation, slope, aspect and relief, and to a significant extent, disturbance regimes. This gradient in plant community structure has been stratified into assemblages defined as “natural subregions”.
- A considerable portion of northwest Alberta is low in elevation with impaired or minimal drainage. These areas are characterized by fen and bog complexes. Although poorly understood in terms of their ecological role, these organic comlexes contain vast amounts of organic carbon and are pivotal to the hydrological cycle of the region.
- In comparison to more southerly or more coastal regions of similar size in North America, northwest Alberta has a relatively depauperate fish, reptile, amphibian and mammalian fauna. It does, however, support a remarkably high species richness for birds, largely owing to the great number of neotropical bird species that migrate to northwest Alberta to breed and nest during the summer season.
- Those vertebrate species considered to be in need of special management attention for purposes of conserving viable populations in the region include the trumpeter swan, woodland caribou, arctic grayling, and wood bison.
- The level of protection afforded the various natural subregions from industrial activity varies considerably. Most protected areas are in the size range of 100-1000 ha, although the greatest amount of area protected comes from protected areas in the 10,000-100,000 ha range. Those natural subregions currently possessing no level of protection include the Lower Foothills, the Central Mixedwoods, and the Peace River Lowlands. Minimal level of protection exist for the Dry Mixedwood (0.7%), and the Peace River Parkland (1.3%). A moderate level of protection is offered to the Subarctic (4.7%) and Boreal Highlands (5.6%) and a high level of protection exists for the Wetland Mixedwood (12.3%).

Table of Contents

List of Tables

List of Figures

Taxonomic Summary

Plant and animal groups comprise a diverse biotic assemblage in northwest Alberta (Table 1, Figure 1). It is difficult to estimate total species richness as scientists currently have incomplete taxonomic descriptions of arthropods, oligochaetes (segmented worms), round worms, spiders, ticks, mites, lichens, and fungi. However, most taxonomists agree that total biotic richness would be many multiples of the ~1000 species that are described for northwest Alberta. For comparison purposes, estimated species richness of biota for the province of Alberta are provided in Table 2, Figure 2, and Figure 3. The section on arthropods provides an appreciation of taxonomic richness of arthropods and their ecological roles in the boreal forests of Alberta. Ranking of taxa by species richness is presented in Table 1, Figure 2, and Figure 3. Among plant species in northwest Alberta, more vascular plants have been taxonomically described than non-vascular plants (lichens, liverworts, etc.). Among vertebrate taxa, birds are taxonomically dominant to other classes (mammals, amphibians, reptiles), though many bird species occur only seasonally in the boreal forest biome of northwest Alberta.

Table 1. Estimated species richness in taxonomically well known biotic groups in northwest Alberta.

Biotic Group	Total Species
Vascular Plants	479
Birds	239
Lichens	119
Mosses	106
Mammals	46
Fishes	34
Ferns/ Allies	27
Liverworts	13
Amphibians	7
Reptiles	2
Total	1,071

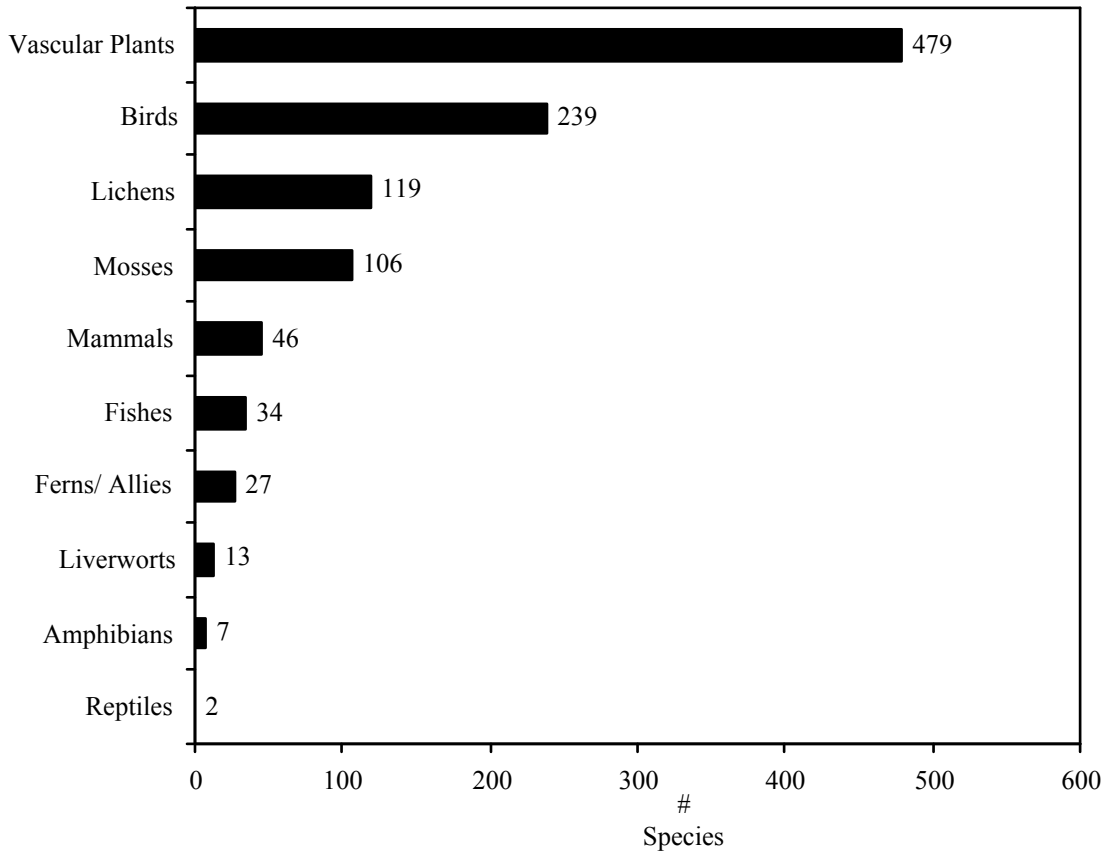

Figure 1. Estimated species richness of selected biotic groups in northwest Alberta.

Table 2. Estimated number of species believed to occur in Alberta, by major taxonomic groups. Data Source: A.T. Finnamore, Provincial Museum of Alberta.

Taxa	Common Names	Species Richness
Fungi	Fungi	12,000
Algae	Algae	18,000
Lichenes	Lichens	unknown
Hepatophyta	Liverworts	162
Bryophyta	Mosses	430
Pteridophyta	Ferns and Allies	65
Coniferophyta	Conifers	23
Magnoliophyta	Flowering Plants	1,115
Protozoa	Protozoans	9,600
Porifera	Sponges	10
Cnidera	Coelenterates	5
Platyhelminthes	Flatworms	850
Gastrotricha	Gastrotrichs	20
Rotifera	Rotifers	400
Nematoda	Round Worms	800
Namatophora	Horse-hair Worms	5
Acanthocephala	Thorny-headed Worms	30
Bryozoa	Moss-like Animals	5
Mollusca	Molluscs	80
Annelida	Segmented Worms	83
Arthropoda	Insects and Spiders	17,700
Chordata	Vertebrates	382
Total		61,765

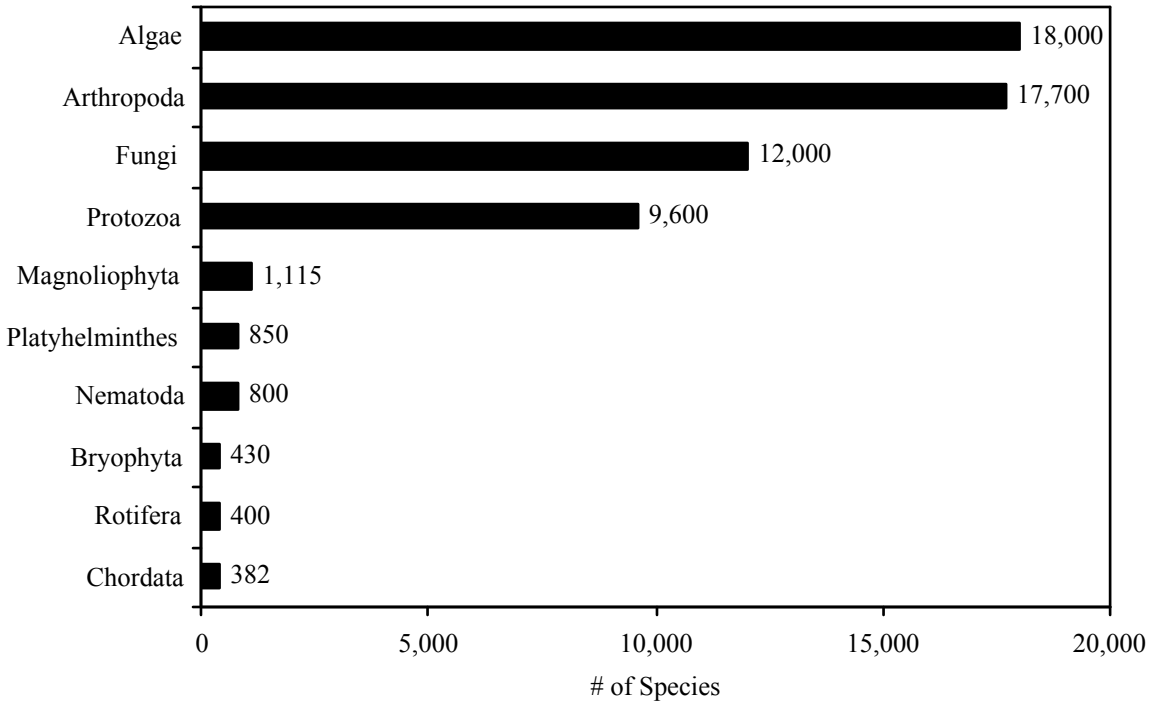

Figure 2. Estimated number of species believed to occur in Alberta, by major taxonomic groups. Data Source: A.T. Finnamore, Provincial Museum of Alberta.

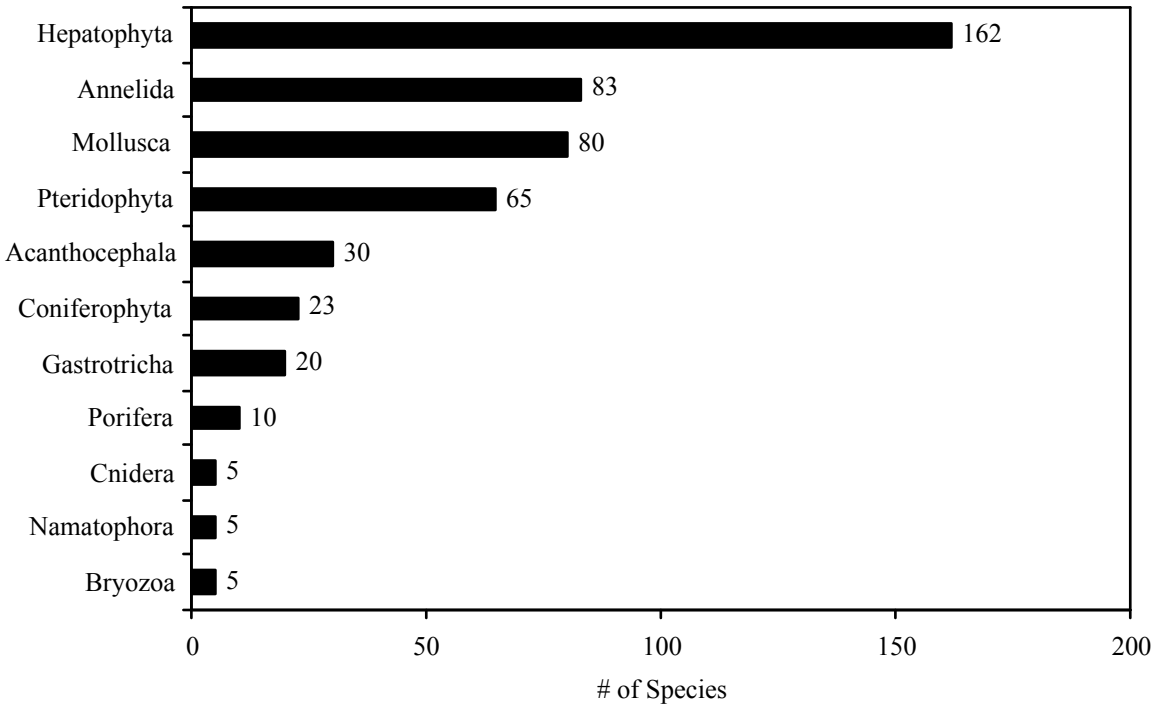

Figure 3. Estimated number of species believed to occur in Alberta, by major taxonomic groups. Data Source: A.T. Finnamore, Provincial Museum of Alberta.

Plants

Species Richness

Within the major forest types of northwest Alberta, a considerable diversity of vascular and non-vascular plants exists. More than 500 species of vascular plants (Table 1, Figure 1) are found in 78 families; of those, almost one-third belong to three families — the composites, grasses, and sedges (Table 3, Table 4). The non-vascular species comprise 119 lichens, 106 mosses, and 13 liverworts (Table 5, Table 6, Table 7).

Based on current taxonomic inventories, thirty species of vascular and non-vascular plants in Alberta are rare, or of uncertain status and requiring more information to assess the viability of populations (Table 8). In many cases, these rare or low-density species are at or near the limit of their range, such as the northern limit for prairie plants or the southern limit for arctic plants. Data pertaining to the status and distribution of plants that are rare or of special concern in Alberta are housed in the Alberta Natural Heritage Information Centre (ANHIC) database maintained by the Alberta Provincial Government.

Table 3. Species richness of vascular plant families found in northwest Alberta. Data Source: Compiled by Greg Greidanus; Dept. Biological Sciences, University of Alberta, Edmonton.

Family	Species Richness	Family	Species Richness
Compositae	62	Cupressaceae	2
Gramineae	57	Elaeagnaceae	2
Cyperaceae	48	Fumariaceae	2
Rosaceae	25	Geraniaceae	2
Ranunculaceae	22	Juncaginaceae	2
Salicaceae	19	Lentibulariaceae	2
Leguminosae	17	Plantaginaceae	2
Cruciferae	15	Polemoniaceae	2
Chenopodiaceae	12	Santalaceae	2
Ericaceae	12	Sparganiaceae	2
Scrophulariaceae	12	Adoxaceae	1
Orchidaceae	10	Amaranthaceae	1
Polypodiaceae	10	Asclepiadaceae	1
Caryophyllaceae	9	Boraginaceae	1
Umbelliferae	9	Cactaceae	1
Equisetaceae	8	Campanulaceae	1
Liliaceae	8	Ceratophyllaceae	1
Polygonaceae	8	Droseraceae	1
Caprifoliaceae	7	Empetraceae	1
Juncaceae	7	Euphorbiaceae	1
Pinaceae	7	Gentianaceae	1
Potamogetonaceae	7	Haloragaceae	1
Grossulariaceae	6	Hippuridaceae	1
Labiatae	6	Hydrophyllaceae	1
Lycopodiaceae	6	Hypericaceae	1
Pyrolaceae	6	Iridaceae	1
Betulaceae	5	Linaceae	1
Onagraceae	5	Malvaceae	1
Primulaceae	5	Menyanthaceae	1
Rubiaceae	4	Myricaceae	1
Saxifragaceae	4	Najadaceae	1
Violaceae	4	Orobanchaceae	1
Ophioglossaceae	3	Parnassiaceae	1
Alismataceae	2	Polygalaceae	1
Apocynaceae	2	Scheuchzeriaceae	1
Araliacea	2	Solanaceae	1
Balsaminaceae	2	Typhaceae	1
Callitrichaceae	2	Urticaceae	1
Cornaceae	2	Valerianaceae	1

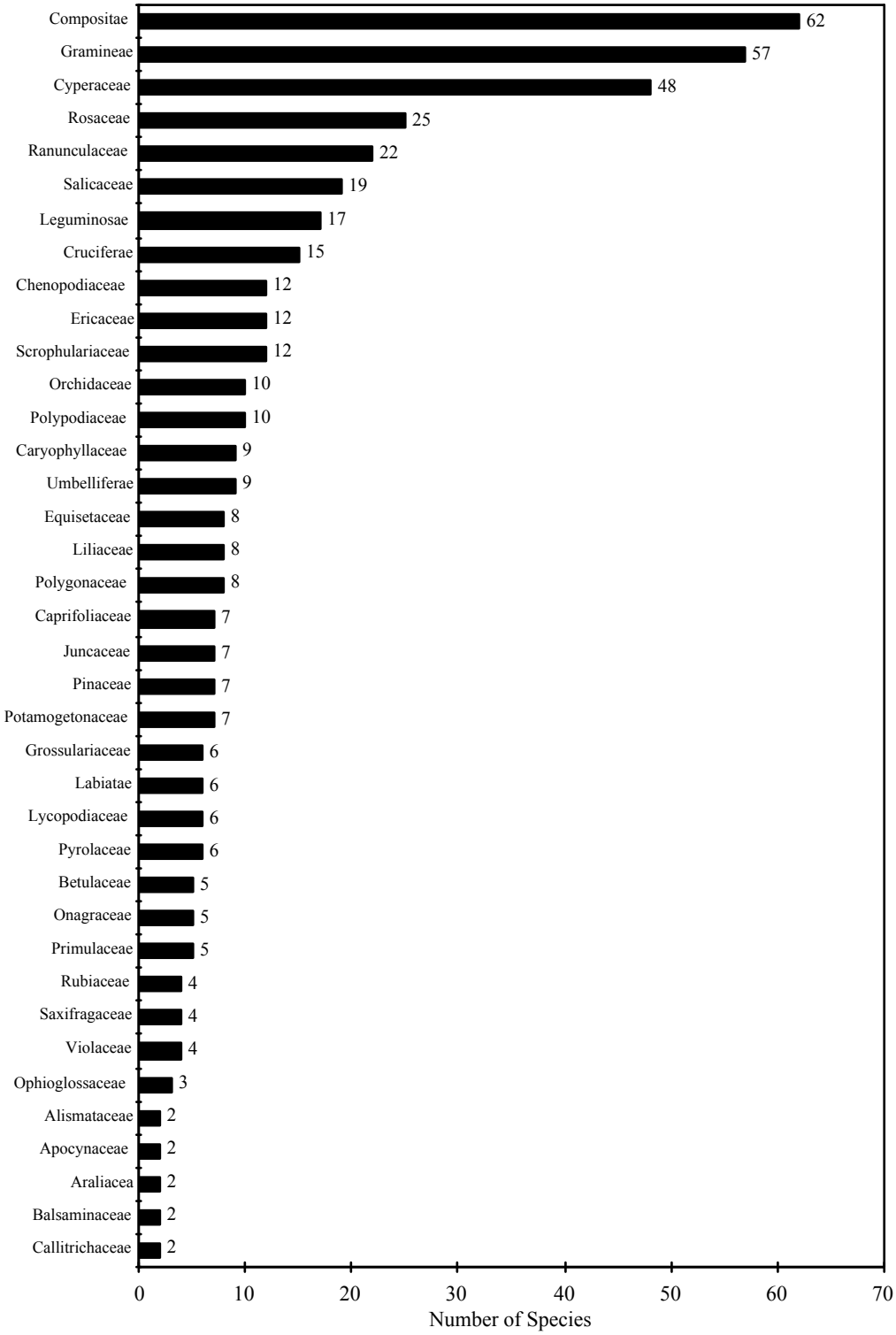

Figure 4. Species richness of plant families occurring in northwest Alberta. Data Source: Compiled by Greg Greidanus; Dept. Biological Sciences, University of Alberta, Edmonton.

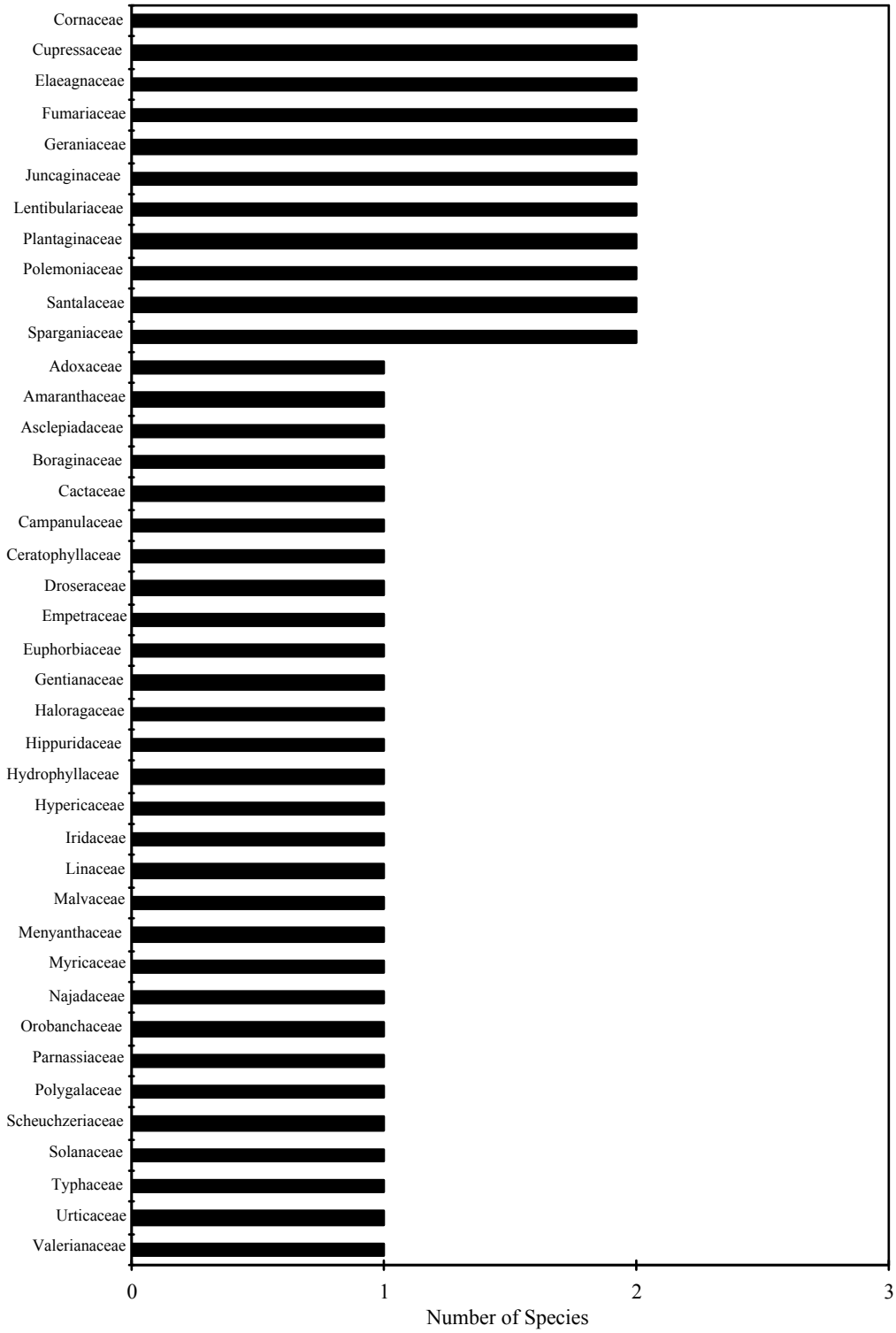

Figure 5. Species richness of plant families occurring in northwest Alberta. Data Source: Compiled by Greg Greidanus; Dept. Biological Sciences, University of Alberta, Edmonton.

Table 4. List of vascular plants of northwest Alberta and their status as determined by the Alberta Natural History Information Centre (ANHIC). Data Source: ANHIC.

Family	Common Name	Latin Name	ANHIC	Plant Type
Cupressaceae	Common Juniper	*Juniperus communis*		Shrub
Cupressaceae	Creeping Juniper	*Juniperus horizontalis*		Shrub
Isoetaceae	Northern Quillwort	*Isoetes echinospora*	S1	Shrub
Pinaceae	Balsam Fir	*Abies balsamea*		Tree
Pinaceae	Subalpine Fir	*Abies lasiocarpa*		Tree
Pinaceae	Tamarack	*Larix laricina*		Tree
Pinaceae	White Spruce	*Picea glauca*		Tree
Pinaceae	Black Spruce	*Picea mariana*		Tree
Pinaceae	Jack Pine	*Pinus banksiana*		Tree
Pinaceae	Lodgepole Pine	*Pinus contorta*		Tree
Typhaceae	Common Cattail	*Typha latifolia*		Forb
Sparganiaceae	Narrow-leaved Bur-reed	*Sparganium angustifolium*		Forb
Sparganiaceae	Giant Bur-reed	*Sparganium eurycarpum*		Forb
Najadaceae	Slender Naiad	*Najas flexilis*		Aquatic
Potamogetonaceae	Floating-leaf Pondweed	*Potamogeton natans*	S2	Aquatic
Potamogetonaceae	Alpine Pondweed	*Potamogeton alpinus*		Aquatic
Potamogetonaceae	Various-Leaved Pondweed	*Potamogeton gramineus*		Aquatic
Potamogetonaceae	Sago Pondweed	*Potamogeton pectinatus*		Aquatic
Potamogetonaceae	White-stem Pondweed	*Potamogeton praelongus*		Aquatic
Potamogetonaceae	Clasping-leaf Pondweed	*Potamogeton richardsonii*		Aquatic
Potamogetonaceae	Large-sheath Pondweed	*Potamogeton vaginatus*		Aquatic
Potamogetonaceae	Flat-stemmed Pondweed	*Potamogeton zosteriformis*		Aquatic
Juncaginaceae	Arrow Grass	*Triglochin maritima*		Forb
Juncaginaceae	Slender Arrow-grass	*Triglochin palustris*		Forb
Scheuchzeriaceae	Scheuchzeria	*Scheuchzeria palustris*		Forb
Alismataceae	Broad-leaved Water-plantain	*Alisma plantago-aquatica*		Forb
Alismataceae	Arrowhead; Wapato	*Sagittaria cuneata*		Forb
Gramineae	(Agroelymus)	*Agroelymus hirtiflorus*		Grass
Gramineae	Macoun's Wild Rye	*Agrohordeum macounii*		Grass
Gramineae	Northern Wheat Grass	*Agropyron dasystachyum*		Grass
Gramineae	(wheat grass)	*Agropyron pseudorepens*		Grass
Gramineae	Western Wheat Grass	*Agropyron smithii*		Grass
Gramineae	Slender Wheat Grass	*Agropyron trachycaulum*		Grass
Gramineae	Hair Grass; Tickle Grass	*Agrostis scabra*		Grass
Gramineae	Water Foxtail	*Alopecurus aequalis*		Grass
Gramineae	Polar Grass	*Arctagrostis arundinacea*	S1	Grass
Gramineae	Slough Grass	*Beckmannia syzigachne*		Grass
Gramineae	Nodding Brome	*Bromus anomalus*		Grass
Gramineae	Fringed Brome	*Bromus ciliatus*		Grass
Gramineae	Awnless Brome	*Bromus inermis*		Grass
Gramineae	Bluejoint; Marsh Reed Grass	*Calamagrostis canadensis*		Grass
Gramineae	Northern Reed Grass	*Calamagrostis inexpansa*		Grass
Gramineae	Plains Reed Grass	*Calamagrostis montanensis*		Grass
Gramineae	Narrow Reed Grass	*Calamagrostis stricta*		Grass
Gramineae	Drooping Wood Reed	*Cinna latifolia*		Grass
Gramineae	Oat Grass	*Danthonia californica*		Grass
Gramineae	Poverty Oat Grass	*Danthonia spicata*	S1	Grass
Gramineae	Tufted Hair Grass	*Deschampsia caespitosa*		Grass
Gramineae	Salt Grass	*Distichlis stricta*		Grass
Gramineae	Canada Wild Rye	*Elymus canadensis*		Grass
Gramineae	Hairy Wild Rye	*Elymus innovatus*		Grass
Gramineae	Red Fescue	*Festuca rubra*		Grass
Gramineae	Rocky Mountain Fescue	*Festuca saximontana*		Grass
Gramineae	Northern Manna Grass	*Glyceria borealis*		Grass
Gramineae	Tall Manna Grass	*Glyceria grandis*		Grass

Family	Common Name	Latin Name	ANHIC	Plant Type
Gramineae	Graceful Manna Grass	*Glyceria pulchella*		Grass
Gramineae	Fowl Manna Grass	*Glyceria striata*		Grass
Gramineae	Hooker's Oat Grass	*Helictotrichon hookeri*		Grass
Gramineae	Sweet Grass	*Hierochloe odorata*		Grass
Gramineae	Foxtail Barley	*Hordeum jubatum*		Grass
Gramineae	June Grass	*Koeleria macrantha*		Grass
Gramineae	Bog Muhly	*Muhlenbergia glomerata*		Grass
Gramineae	Mat Muhly	*Muhlenbergia richardsonis*		Grass
Gramineae	Rough-leaved Rice Grass	*Oryzopsis asperifolia*		Grass
Gramineae	Canadian Rice Grass	*Oryzopsis canadensis*	S1	Grass
Gramineae	Northern Rice Grass	*Oryzopsis pungens*		Grass
Gramineae	Little-seed Rice Grass	*Oryzopsis micrantha*	S1	Grass
Gramineae	Reed Canary Grass	*Phalaris arundinacea*		Grass
Gramineae	Common Reed Grass	*Phragmites australis*		Grass
Gramineae	Plains Bluegrass	*Poa arida*		Grass
Gramineae	Canby Bluegrass	*Poa canbyi*		Grass
Gramineae	Timberline Bluegrass	*Poa glauca*		Grass
Gramineae	Inland Bluegrass	*Poa interior*		Grass
Gramineae	Fowl Bluegrass	*Poa palustris*		Grass
Gramineae	Kentucky Bluegrass	*Poa pratensis*		Grass
Gramineae	Slender Salt-meadow Grass	*Puccinellia distans*		Grass
Gramineae	Nuttall's Salt-meadow Grass	*Puccinellia nuttalliana*		Grass
Gramineae	False Melic	*Schizachne purpurascens*		Grass
Gramineae	Spangletop	*Scolochloa festucacea*		Grass
Gramineae	Annual Dropseed	*Sporobolus neglectus*		Grass
Gramineae	Western Porcupine Grass	*Stipa curtiseta*		Grass
Gramineae	Richardson Needle Grass	*Stipa richardsonii*		Grass
Gramineae	Green Needle Grass	*Stipa viridula*		Grass
Gramineae	Spike Trisetum	*Trisetum spicatum*		Grass
Cyperaceae	Browned Sedge	*Carex adusta*	S1	Sedge
Cyperaceae	Bronze Sedge	*Carex aenea*		Sedge
Cyperaceae	Water Sedge	*Carex aquatilis*		Sedge
Cyperaceae	Narrow Sedge	*Carex arcta*		Sedge
Cyperaceae	Awned Sedge	*Carex atherodes*		Sedge
Cyperaceae	Golden Sedge	*Carex aurea*		Sedge
Cyperaceae	Bebb's Sedge	*Carex bebbii*		Sedge
Cyperaceae	Brownish Sedge	*Carex brunnescens*		Sedge
Cyperaceae	Slender-beaked Sedge	*Carex brevior*		Sedge
Cyperaceae	Hair-like Sedge	*Carex capillaris*		Sedge
Cyperaceae	Capitate Sedge	*Carex capitata*		Sedge
Cyperaceae	Prostrate Sedge	*Carex chordorrhiza*		Sedge
Cyperaceae	Crawford's Sedge	*Carex crawfordii*		Sedge
Cyperaceae	Short Sedge	*Carex curta*		Sedge
Cyperaceae	Dewey's Sedge	*Carex deweyana*		Sedge
Cyperaceae	Two-stamened Sedge	*Carex diandra*		Sedge
Cyperaceae	Two-seeded Sedge	*Carex disperma*		Sedge
Cyperaceae	Northern Bog Sedge	*Cerex gynocrates*		Sedge
Cyperaceae	Hairy-fruited Sedge	*Carex lasiocarpa*		Sedge
Cyperaceae	Mud Sedge	*Carex limosa*		Sedge
Cyperaceae	Livid Sedge	*Carex livida*		Sedge
Cyperaceae	Small-winged Sedge	*Carex microptera*		Sedge
Cyperaceae	Rye-Grass Sedge	*Carex loliacea*	S2	Sedge
Cyperaceae	Norway Sedge	*Carex norvegica*		Sedge
Cyperaceae	Blunt Sedge	*Carex obtusata*		Sedge
Cyperaceae	Bog Sedge	*Carex paupercula*		Sedge
Cyperaceae	Sun-loving Sedge	*Carex pensylvanica*		Sedge
Cyperaceae	Graceful Sedge	*Carex praegracilis*		Sedge

Family	Common Name	Latin Name	ANHIC	Plant Type
Cyperaceae	Meadow Sedge	*Carex praticola*		Sedge
Cyperaceae	Raymond's Sedge	*Carex raymondii*		Sedge
Cyperaceae	Beaked Sedge	*Carex rostrata*		Sedge
Cyperaceae	Rocky Ground Sedge	*Carex saxatilis*		Sedge
Cyperaceae	Hay Sedge	*Carex siccata*		Sedge
Cyperaceae	Low Sedge	*Carex stenophylla*		Sedge
Cyperaceae	Thin-flowered Sedge	*Carex tenuiflora*		Sedge
Cyperaceae	Torrey's Sedge	*Carex torreyi*		Sedge
Cyperaceae	Fox Sedge	*Carex vulpinoidea*		Sedge
Cyperaceae	Needle Spike Rush	*Eleocharis acicularis*		Sedge
Cyperaceae	Creeping Spike Rush	*Eleocharis palustris*		Sedge
Cyperaceae	Close-sheathed Cotton-grass	*Eriophorum brachyantherum*		Sedge
Cyperaceae	Russet Cotton-grass	*Eriophorum chamissonis*		Sedge
Cyperaceae	Slender Cotton-grass	*Eriophorum gracile*		Sedge
Cyperaceae	Sheathed Cotton-grass	*Eriophorum vaginatum*		Sedge
Cyperaceae	Small-fruited Bulrush	*Scirpus microcarpus*		Sedge
Cyperaceae	Pale Bulrush	*Scirpus pallidus*		Sedge
Cyperaceae	Red Bulrush	*Scirpus rufus*	S1	Sedge
Cyperaceae	Common Great Bulrush	*Scirpus validus*		Sedge
Cyperaceae	Dwarf Bulrush	*Scirpus pumilus v. rollandii*	S2	Sedge
Cyperaceae	Water Arum; Wild Calla	*Calla palustris*		Forb
Cyperaceae	Common Duckweed	*Lemna minor*		Aquatic
Cyperaceae	Ivy Duckweed	*Lemna trisulca*		Aquatic
Juncaceae	Thread Rush	*Juncus filiformis*	S2	Rush
Juncaceae	Alpine Rush	*Juncus alpinoarticulatus*		Rush
Juncaceae	Wire Rush	*Juncus balticus*		Rush
Juncaceae	Toad Rush	*Juncus bufonius*		Rush
Juncaceae	Knotted Rush	*Juncus nodosus*		Rush
Juncaceae	Big-head Rush	*Juncus vaseyi*		Rush
Juncaceae	Field Wood-Rush	*Luzula multiflora*		Rush
Juncaceae	Reddish Wood-Rush	*Luzula rufescens*	S1	Rush
Juncaceae	Small-flowered Wood-Rush	*Luzula parviflora*		Rush
Liliaceae	Wild Chives	*Allium schoenoprasum*		Forb
Liliaceae	Rough-fruited Fairybells	*Disporum trachycarpum*		Forb
Liliaceae	Western Wood Lily	*Lilium philadelphicum*		Forb
Liliaceae	Wild Lily-of-the-valley	*Maianthemum canadense*		Forb
Liliaceae	False Solomon's-seal	*Smilacina racemosa*		Forb
Liliaceae	Star-flowered Solomon's-seal	*Smilacina stellata*		Forb
Liliaceae	Three-leaved Solomon's-seal	*Smilacina trifolia*		Forb
Liliaceae	Twisted-stalk	*Streptopus amplexifolius*		Forb
Iridaceae	Common Blue-eyed-grass	*Sisyrinchium montanum*		Forb
Orchidaceae	Venus'-slipper	*Calypso bulbosa*		Forb
Orchidaceae	Pale Coral-root	*Corallorhiza trifida*		Forb
Orchidaceae	Lesser Rattlesnake-plantain	*Goodyera repens*		Forb
Orchidaceae	Tall White Orchid	*Habenaria dilatata*		Forb
Orchidaceae	Northern Green Orchid	*Habenaria hyperborea*		Forb
Orchidaceae	Round-leaved Orchid	*Habenaria orbiculata*		Forb
Orchidaceae	Blunt-leaved Orchid	*Habenaria obtusata*		Forb
Orchidaceae	Northern Twayblade	*Listera borealis*		Forb
Orchidaceae	Round-Leaved Orchid	*Orchis rotundifolia*		Forb
Orchidaceae	Ladie's-tresses	*Spiranthes romanzoffiana*		Forb
Salicaceae	Balsam Poplar	*Populus balsamifera*		Tree
Salicaceae	Aspen	*Populus tremuloides*		Tree
Salicaceae	Little-tree Willow	*Salix arbusculoides*		Shrub
Salicaceae	Beaked Willow	*Salix bebbiana*		Shrub
Salicaceae	Balsam Willow	*Salix pyrifolia*		Shrub
Salicaceae	Hoary Willow	*Salix candida*		Shrub

Family	Common Name	Latin Name	ANHIC	Plant Type
Salicaceae	Basket Willow	*Salix petiolaris*		Shrub
Salicaceae	Drummond's Willow	*Salix drummondiana*		Shrub
Salicaceae	Sandbar Willow	*Salix exigua*		Shrub
Salicaceae	Grey-leaved Willow	*Salix glauca*		Shrub
Salicaceae	Shining Willow	*Salix lucida*		Shrub
Salicaceae	Velvet-fruited Willow	*Salix maccalliana*		Shrub
Salicaceae	Bog Willow	*Salix pedicellaris*		Shrub
Salicaceae	Myrtle-leaved Willow	*Salix myrtillifolia*		Shrub
Salicaceae	Flat-leaved Willow	*Salix planifolia*		Shrub
Salicaceae	Mackenzie's Willow	*Salix prolixa*		Shrub
Salicaceae	Mountain Willow	*Salix pseudomonticola*		Shrub
Salicaceae	Scouler's Willow	*Salix scouleriana*		Shrub
Salicaceae	Autumn Willow	*Salix serissima*		Shrub
Myricaceae	Sweet Gale	*Myrica gale*		Shrub
Betulaceae	Green Alder	*Alnus crispa*		Shrub
Betulaceae	River Alder	*Alnus tenuifolia*		Shrub
Betulaceae	Bog Birch; Dwarf Birch	*Betula glandulosa*		Shrub
Betulaceae	White Birch; Paper Birch	*Betula papyrifera*		Tree
Betulaceae	Beaked Hazelnut	*Corylus cornuta*		Shrub
Urticaceae	Common Nettle	*Urtica dioica*		Forb
Santalaceae	Bastard Toadflax	*Comandra umbellata*		Forb
Santalaceae	Northern Bastard Toadflax	*Geocaulon lividum*		Forb
Polygonaceae	Water Smartweed	*Polygonum amphibium*		Forb
Polygonaceae	Pale Persicaria	*Polygonum lapathifolium*		Forb
Polygonaceae	Striate Knotweed	*Polygonum erectum*		Forb
Polygonaceae	Bushy Knotweed	*Polygonum ramosissimum*		Forb
Polygonaceae	Alpine Bistort	*Polygonum viviparum*		Forb
Polygonaceae	Golden Dock	*Rumex maritimus*		Forb
Polygonaceae	Western Dock	*Rumex occidentalis*		Forb
Polygonaceae	Narrow-leaved Dock	*Rumex triangulivalvis*		Forb
Chenopodiaceae	Silver Saltbush	*Atriplex argentea*		Forb
Chenopodiaceae	Nuttall's Atriplex; Saltbush	*Atriplex nuttallii*		Dwarf Shrub
Chenopodiaceae	Powell's Saltbush	*Atriplex powellii*		Forb
Chenopodiaceae	Spear-scale Saltbush	*Atriplex subspicata*		Forb
Chenopodiaceae	Berlandier Goosefoot	*Chenopodium berlandieri*		Forb
Chenopodiaceae	Strawberry Blite	*Chenopodium capitatum*		Forb
Chenopodiaceae	Maple-leaved Goosefoot	*Chenopodium gigantospermum*		Forb
Chenopodiaceae	Red Goosefoot	*Chenopodium rubrum*		Forb
Chenopodiaceae	Oak-leaved Goosefoot	*Chenopodium salinum*		Forb
Chenopodiaceae	Spear-leaved Goosefoot	*Monolepis nuttalliana*		Forb
Chenopodiaceae	Samphire	*Salicornia europaea*		Forb
Chenopodiaceae	Western Sea-blite	*Suaeda calceoliformis*		Forb
Amaranthaceae	Tumbleweed	*Amaranthus albus*		Forb
Caryophyllaceae	Field mouse-ear Chickweed	*Cerastium arvense*		Forb
Caryophyllaceae	Nodding Chickweed	*Cerastium nutans*		Forb
Caryophyllaceae	Blunt-leaved Sandwort	*Moehringia lateriflora*		Forb
Caryophyllaceae	Drummond's Cockle	*Silene drummondii*		Forb
Caryophyllaceae	Northern Stitchwort	*Stellaria calycantha*		Forb
Caryophyllaceae	Wavy-Leaved Chickweed	*Stellaria crispa*	S2	Forb
Caryophyllaceae	Fleshy Stitchwort	*Stellaria crassifolia*		Forb
Caryophyllaceae	Long-leaved Chickweed	*Stellaria longifolia*		Forb
Caryophyllaceae	Long-stalked Chickweed	*Stellaria longipes*		Forb
Caryophyllaceae	Yellow Pond-lily	*Nuphar variegatum*		Aquatic
Ceratophyllaceae	Hornwort	*Ceratophyllum demersum*		Aquatic
Ranunculaceae	Red and White Baneberry	*Actaea rubra*		Forb
Ranunculaceae	Canada Anemone	*Anemone canadensis*		Forb
Ranunculaceae	Long-fruited Anemone	*Anemone cylindrica*		Forb

Family	Common Name	Latin Name	ANHIC	Plant Type
Ranunculaceae	Cut-leaved Anemone	*Anemone multifida*		Forb
Ranunculaceae	Prairie Crocus	*Anemone patens*		Forb
Ranunculaceae	Tall Anemone	*Anemone riparia*		Forb
Ranunculaceae	Blue Columbine	*Aquilegia brevistyla*		Forb
Ranunculaceae	Marsh Marigold	*Caltha palustris*		Forb
Ranunculaceae	Floating Marsh Marigold	*Caltha natans*		Forb
Ranunculaceae	Tall Larkspur	*Delphinium glaucum*		Forb
Ranunculaceae	Small-flowered Crowfoot	*Ranunculus abortivus*		Forb
Ranunculaceae	Heart-leaved Buttercup	*Ranunculus cardiophyllus*		Forb
Ranunculaceae	White Water Crowfoot	*Ranunculus circinatus*		Forb
Ranunculaceae	Seaside Crowfoot	*Ranunculus cymbalaria*		Forb
Ranunculaceae	Lapland Buttercup	*Ranunculus lapponicus*		Forb
Ranunculaceae	Yellow Water Crowfoot	*Ranunculus gmelinii*		Forb
Ranunculaceae	Macoun's Buttercup	*Ranunculus macounii*		Forb
Ranunculaceae	Bristly Buttercup	*Ranunculus pensylvanicus*		Forb
Ranunculaceae	Prairie Buttercup	*Ranunculus rhomboideus*		Forb
Ranunculaceae	Cursed Crowfoot	*Ranunculus sceleratus*		Forb
Ranunculaceae	Flat-fruited Meadow Rue	*Thalictrum sparsiflorum*		Forb
Ranunculaceae	Veiny Meadow Rue	*Thalictrum venulosum*		Forb
Fumariaceae	Golden Corydalis	*Corydalis aurea*		Forb
Fumariaceae	Pink Corydalis	*Corydalis sempervirens*		Forb
Cruciferae	Purple Rock Cress	*Arabis divaricarpa*		Forb
Cruciferae	Drummond's Rock Cress	*Arabis drummondii*		Forb
Cruciferae	Tower Mustard	*Arabis glabra*		Forb
Cruciferae	Hairy Rock Cress	*Arabis hirsuta*		Forb
Cruciferae	Holboell's Rock Cress	*Arabis holboellii*		Forb
Cruciferae	Lyre-leaved Rock Cress	*Arabis lyrata*		Forb
Cruciferae	Pennsylvanian Bitter Cress	*Cardamine pensylvanica*		Forb
Cruciferae	Green Tansy Mustard	*Descurainia pinnata*		Forb
Cruciferae	Grey Tansy Mustard	*Descurainia richardsonii*		Forb
Cruciferae	Annual Whitlow-grass	*Draba nemorosa*		Forb
Cruciferae	Wormseed Mustard	*Erysimum cheiranthoides*		Forb
Cruciferae	Small-flowered Rocket	*Erysimum inconspicuum*		Forb
Cruciferae	Western Peppergrass	*Lepidium bourgeauanum*		Forb
Cruciferae	Common Peppergrass	*Lepidium densiflorum*		Forb
Cruciferae	Yellow Cress	*Rorippa palustris*		Forb
Droseraceae	Sundew	*Drosera rotundifolia*		Forb
Saxifragaceae	Golden Saxifrage	*Chrysosplenium iowense*		Forb
Saxifragaceae	Green Saxifrage	*Chrysosplenium tetrandrum*		Forb
Saxifragaceae	Richardson's Alumroot	*Heuchera richardsonii*		Forb
Saxifragaceae	Bishop's-cap	*Mitella nuda*		Forb
Parnassiaceae	Northern Grass-of-Parnassus	*Parnassia palustris*		Forb
Grossulariaceae	Skunk Currant	*Ribes glandulosum*		Shrub
Grossulariaceae	Wild Gooseberry	*Ribes hirtellum*		Shrub
Grossulariaceae	Wild Black Currant	*Ribes hudsonianum*		Shrub
Grossulariaceae	Bristly Black Currant	*Ribes lacustre*		Shrub
Grossulariaceae	Wild Gooseberry	*Ribes oxyacanthoides*		Shrub
Grossulariaceae	Wild Red Currant	*Ribes triste*		Shrub
Rosaceae	Saskatoon	*Amelanchier alnifolia*		Shrub
Rosaceae	Woodland Strawberry	*Fragaria vesca*		Forb
Rosaceae	Wild Strawberry	*Fragaria virginiana*		Forb
Rosaceae	Yellow Avens	*Geum aleppicum*		Forb
Rosaceae	Yellow Avens	*Geum macrophyllum*		Forb
Rosaceae	Old Man's Whiskers	*Geum triflorum*		Forb
Rosaceae	Silverweed	*Potentilla anserina*		Forb
Rosaceae	White Cinquefoil	*Potentilla arguta*		Forb
Rosaceae	Plains Cinquefoil	*Potentilla bipinnatifida*		Forb

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Rosaceae	Shrubby Cinquefoil	*Potentilla fruticosa*		Shrub
Rosaceae	Graceful Cinquefoil	*Potentilla gracilis*		Forb
Rosaceae	Rough Cinquefoil	*Potentilla norvegica*		Forb
Rosaceae	Marsh Cinquefoil	*Potentilla palustris*		Dwarf Shrub
Rosaceae	Prairie Cinquefoil	*Potentilla pensylvanica*		Forb
Rosaceae	Three-toothed Cinquefoil	*Potentilla tridentata*		Forb
Rosaceae	Pin Cherry	*Prunus pensylvanica*		Shrub
Rosaceae	Choke Cherry	*Prunus virginiana*		Shrub
Rosaceae	Prickly Rose	*Rosa acicularis*		Shrub
Rosaceae	Prairie Rose	*Rosa arkansana*		Shrub
Rosaceae	Common Wild Rose	*Rosa woodsii*		Shrub
Rosaceae	Cloudberry; Baked-apple Berry	*Rubus chamaemorus*		Forb
Rosaceae	Dwarf Raspberry	*Rubus arcticus*		Forb
Rosaceae	Wild Red Raspberry	*Rubus idaeus*		Shrub
Rosaceae	Dewberry; Running Raspberry	*Rubus pubescens*		Forb
Rosaceae	Western Mountain-ash	*Sorbus scopulina*		Shrub
Leguminosae	Indian Milk-vetch	*Astragalus aboriginum*		Forb
Leguminosae	Alpine Milk-vetch	*Astragalus alpinus*		Forb
Leguminosae	American Milk-vetch	*Astragalus americanus*		Forb
Leguminosae	Two-grooved Milk-vetch	*Astragalus bisulcatus*		Forb
Leguminosae	Canadian Milk-vetch	*Astragalus canadensis*		Forb
Leguminosae	Purple Milk-vetch	*Astragalus dasyglottis*		Forb
Leguminosae	Pretty Milk-vetch	*Astragalus eucosmus*		Forb
Leguminosae	Ascending Purple Milk-vetch	*Astragalus striatus*		Forb
Leguminosae	Loose-flowered Milk-vetch	*Astragalus tenellus*		Forb
Leguminosae	Yukon Milk-vetch	*Astragalus bodinii*		Forb
Leguminosae	Alpine Hedysarum	*Hedysarum alpinum*		Forb
Leguminosae	Northern Hedysarum	*Hedysarum boreale*		Forb
Leguminosae	Creamy Peavine	*Lathyrus ochroleucus*		Forb
Leguminosae	Reflexed Loco-weed	*Oxytropis deflexa*		Forb
Leguminosae	Early Yellow Loco-weed	*Oxytropis sericea*		Forb
Leguminosae	Showy Loco-weed	*Oxytropis splendens*		Forb
Leguminosae	White Clover	*Trifolium repens*		Forb
Leguminosae	Wild Vetch	*Vicia americana*		Forb
Geraniaceae	Bicknell's Geranium	*Geranium bicknelli*		Forb
Geraniaceae	White Geranium	*Geranium richardsonii*		Forb
Linaceae	Wild Blue Flax	*Linum lewisii*		Forb
Polygalaceae	Seneca-root	*Polygala senega*		Forb
Euphorbiaceae	Thyme-leaved Spurge	*Euphorbia serpyllifolia*		Forb
Callitrichaceae	Northern Water-starwort	*Callitriche hermaphroditica*		Aquatic
Callitrichaceae	Vernal Water-starwort	*Callitriche verna*		Aquatic
Empetraceae	Crowberry	*Empetrum nigrum*		Dwarf Shrub
Balsaminaceae	Touch-me-not	*Impatiens capensis*		Forb
Balsaminaceae	Touch-me-not	*Impatiens noli-tangere*		Forb
Malvaceae	Scarlet Mallow	*Sphaeralcea coccinea*		Forb
Hypericaceae	Large Canada St. John’s-wort	*Hypericum majus*		Forb
Violaceae	Early Blue Violet	*Viola adunca*		Forb
Violaceae	Western Canada Violet	*Viola canadensis*		Forb
Violaceae	Marsh Violet	*Viola palustris*		Forb
Violaceae	Kidney-leaved Violet	*Viola renifolia*		Forb
Cactaceae	Brittle Prickly Pear Cactus	*Opuntia fragilis*	S4	Succulent
Elaeagnaceae	Silver-berry; Wolf Willow	*Elaeagnus commutata*		Shrub
Elaeagnaceae	Canadian Buffalo-berry	*Shepherdia canadensis*		Shrub
Onagraceae	Small Enchanter's-nightshade	*Circaea alpina*		Forb
Onagraceae	Fireweed; Great Willow-herb	*Epilobium angustifolium*		Forb
Onagraceae	Northern Willowherb	*Epilobium ciliatum*		Forb
Onagraceae	Narrow-leaved Willowherb	*Epilobium leptophyllum*		Forb

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Onagraceae	Marsh Willowherb	*Epilobium palustre*		Forb
Onagraceae	Broad-Leaved Willowherb	*Epilobium latifolium*		Forb
Haloragaceae	Spiked Water Milfoil	*Myriophyllum exalbescens*		Aquatic
Hippuridaceae	Common Mare's Tail	*Hippuris vulgaris*		Aquatic
Araliacea	Wild Sarsaparilla	*Aralia nudicaulis*		Forb
Araliacea	Devils'-club	*Oplopanax horridum*		Shrub
Umbelliferae	Bulb-bearing Water-Hemlock	*Cicuta bulbifera*		Forb
Umbelliferae	Water-hemlock	*Cicuta maculata*		Forb
Umbelliferae	Narrow-leaved	*Cicuta virosa*		Forb
Umbelliferae	Cow Parsnip	*Heracleum lanatum*		Forb
Umbelliferae	Hairy-fruited Wild Parsley	*Lomatium foeniculaceum*		Forb
Umbelliferae	Spreading Sweet-cicely	*Osmorhiza depauperata*		Forb
Umbelliferae	Snake-root	*Sanicula marilandica*		Forb
Umbelliferae	Water Parsnip	*Sium suave*		Forb
Umbelliferae	Meadow Parsnip	*Zizia aptera*		Forb
Cornaceae	Bunchberry	*Cornus canadensis*		Forb
Cornaceae	Red Osier Dogwood	*Cornus stolonifera*		Shrub
Pyrolaceae	One-flowered Wintergreen	*Moneses uniflora*		Forb
Pyrolaceae	One-sided Wintergreen	*Orthilia secunda*		Forb
Pyrolaceae	Common Pink Wintergreen	*Pyrola asarifolia*		Forb
Pyrolaceae	White Wintergreen	*Pyrola elliptica*		Forb
Pyrolaceae	Greenish-flowered Wintergreen	*Pyrola chlorantha*		Forb
Pyrolaceae	Lesser Wintergreen	*Pyrola minor*		Forb
Ericaceae	Bog Rosemary	*Andromeda polifolia*		Dwarf Shrub
Ericaceae	Alpine Bearberry	*Arctostaphylos rubra*		Dwarf Shrub
Ericaceae	Common Bearberry; Kinnikinnick	*Arctostaphylos uva-ursi*		Dwarf Shrub
Ericaceae	Leather-leaf	*Chamaedaphne calyculata*		Shrub
Ericaceae	Northern Labrador Tea	*Ledum palustre*		Dwarf Shrub
Ericaceae	Common Labrador Tea	*Ledum groenlandicum*		Dwarf Shrub
Ericaceae	Small Bog Cranberry	*Oxycoccus microcarpus*		Dwarf Shrub
Ericaceae	Bog Cranberry	*Oxycoccus uliginosum*	S3	Dwarf Shrub
Ericaceae	Bog Cranberry	*Oxycoccus quadripetalus*		Dwarf Shrub
Ericaceae	Dwarf Bilberry	*Vaccinium caespitosum*		Shrub
Ericaceae	Blueberry	*Vaccinium myrtilloides*		Dwarf Shrub
Ericaceae	Bog Bilberry	*Vaccinium uliginosum*		Dwarf Shrub
Ericaceae	Bog Cranberry; Cow-berry	*Vaccinium vitis-idaea*		Dwarf Shrub
Primulaceae	Fairy Candelabra	*Androsace septentrionalis*		Forb
Primulaceae	Sea Milkwort	*Glaux maritima*		Forb
Primulaceae	Mealy Primrose	*Primula incana*		Forb
Primulaceae	Northern Starflower	*Trientalis borealis*		Forb
Primulaceae	Arctic Starflower	*Trientalis europaea*		Forb
Gentianaceae	Northern Gentian	*Gentianella amarella*		Forb
Menyanthaceae	Buck-bean	*Menyanthes trifoliata*		Forb
Apocynaceae	Spreading Dogbane	*Apocynum androsaemifolium*		Forb
Apocynaceae	Indian Hemp	*Apocynum cannabinum*		Forb
Asclepiadaceae	Low Milkweed	*Asclepias ovalifolia*		Forb
Polemoniaceae	Collomia	*Collomia linearis*		Forb
Polemoniaceae	Jacob's-ladder	*Polemonium acutiflorum*		Forb
Hydrophyllaceae	Franklin's Scorpionweed	*Phacelia franklinii*		Forb
Boraginaceae	Tall Mertensia	*Mertensia paniculata*		Forb
Labiatae	Giant Hyssop	*Agastache foeniculum*		Forb
Labiatae	American Dragonhead	*Dracocephalum parviflorum*		Forb
Labiatae	Wild Mint	*Mentha arvensis*		Forb
Labiatae	(Horse Mint)	*Monarda fistulosa*		Forb
Labiatae	Marsh Skullcap	*Scutellaria galericulata*		Forb
Labiatae	Marsh Hedge Nettle	*Stachys palustris*		Forb
Solanaceae	Wild Tomato	*Solanum triflorum*		Forb

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Scrophulariaceae	Common Red Paint-brush	*Castilleja miniata*		Forb
Scrophulariaceae	Purple Paintbrush	*Castilleja raupii*		Forb
Scrophulariaceae	Cow-wheat	*Melampyrum lineare*		Forb
Scrophulariaceae	Owl-clover	*Orthocarpus luteus*		Forb
Scrophulariaceae	Little Red Elephant	*Pedicularis groenlandica*		Forb
Scrophulariaceae	Wirsing	*Pedicularis labradorica*		Forb
Scrophulariaceae	Purple Rattle	*Pedicularis sudentica*	S1	Forb
Scrophulariaceae	Lilac-flowered Beard-tongue	*Penstemon gracilis*		Forb
Scrophulariaceae	Slender Blue Beard-tongue	*Penstemon procerus*		Forb
Scrophulariaceae	Yellow Rattle	*Rhinanthus minor*		Forb
Scrophulariaceae	American Brooklime	*Veronica americana*		Forb
Scrophulariaceae	Marsh Speedwell	*Veronica scutellata*		Forb
Scrophulariaceae	Hairy Speedwell	*Veronica peregrina*		Forb
Orobanchaceae	Ground-cone	*Boschniakia rossica*	S1	Forb
Lentibulariaceae	Hairy (Small) Butterwort	*Pinguicula villosa*	S2	Forb
Lentibulariaceae	Common Bladderwort	*Utricularia vulgaris*		Aquatic
Plantaginaceae	Western Ribgrass	*Plantago canescens*		Forb
Plantaginaceae	Saline Plantain	*Plantago eriopoda*		Forb
Rubiaceae	Northern Bedstraw	*Galium boreale*		Forb
Rubiaceae	Labrador Bedstraw	*Galium labradoricum*		Forb
Rubiaceae	Small Bedstraw	*Galium trifidum*		Forb
Rubiaceae	Sweet-scented Bedstraw	*Galium triflorum*		Forb
Caprifoliaceae	Twinflower	*Linnaea borealis*		Dwarf Shrub
Caprifoliaceae	Twining Honeysuckle	*Lonicera dioica*		Shrub
Caprifoliaceae	Bracted Honeysuckle	*Lonicera involucrata*		Shrub
Caprifoliaceae	Snowberry	*Symphoricarpos albus*		Shrub
Caprifoliaceae	Buckbrush; Wolfberry	*Symphoricarpos occidentalis*		Shrub
Caprifoliaceae	Low-bush Cranberry; Mooseberry	*Viburnum edule*		Shrub
Caprifoliaceae	High-bush Cranberry	*Viburnum opulus*		Shrub
Adoxaceae	Moschatel	*Adoxa moschatellina*		Forb
Valerianaceae	Northern Valerian	*Valeriana dioica*		Forb
Campanulaceae	Bluebell; Harebell	*Campanula rotundifolia*		Forb
Compositae	Common Yarrow	*Achillea millefolium*		Forb
Compositae	Many-flowered Yarrow	*Achillea sibirica*		Forb
Compositae	Yellow False Dandilion	*Agoseris glauca*		Forb
Compositae	Common Ragweed	*Ambrosia artemisiifolia*		Forb
Compositae	Low Everlasting	*Antennaria aprica*		Forb
Compositae	Broad-leaved Pussytoes, Everlasting	*Antennaria neglecta*		Forb
Compositae	Small leaved Everlasting	*Antennaria parvifolia*		Forb
Compositae	Rosy Pussytoes; Rosy Everlasting	*Antennaria rosea*		Forb
Compositae	Leafy Arnica	*Arnica chamissonis*		Forb
Compositae	Heart-leaved Arnica	*Arnica cordifolia*		Forb
Compositae	Shining Arnica	*Arnica fulgens*		Forb
Compositae	Biennial Sagewort	*Artemisia biennis*		Forb
Compositae	Plains Wormwood	*Artemisia campestris*		Forb
Compositae	Dragonwort	*Artemisia dracunculus*		Forb
Compositae	Pasture Sagewort	*Artemisia frigida*		Forb
Compositae	Long-leaved Sagewort	*Artemisia longifolia*		Forb
Compositae	Prairie Sagewort	*Artemisia ludoviciana*		Forb
Compositae	Herriot's Sagewort	*Artemisia tilesii*		Forb
Compositae	Marsh Aster	*Aster borealis*		Forb
Compositae	Rayless Aster	*Aster brachyactis*		Forb
Compositae	Lindley's Aster	*Aster ciliolatus*		Forb
Compositae	Showy Aster	*Aster conspicuus*		Forb
Compositae	Tufted White Prairie Aster	*Aster ericoides*		Forb
Compositae	Creeping White Prairie Aster	*Aster falcatus*		Forb
Compositae	Western Willow Aster	*Aster hesperius*		Forb

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Compositae	Smooth Aster	*Aster laevis*		Forb
Compositae	Purple-stemmed Aster	*Aster puniceus*		Forb
Compositae	Arctic Aster	*Aster sibircus*		Forb
Compositae	Nodding Beggar-ticks	*Bidens cernua*		Forb
Compositae	Canada Thistle	*Circium arvense*		Forb
Compositae	Drummond's Thistle	*Cirsium drummondii*		Forb
Compositae	Flodman's Thistle	*Cirsium flodmanii*		Forb
Compositae	Northern Daisy Fleabane	*Erigeron acris*		Forb
Compositae	Philadelphia Fleabane	*Erigeron philadelphicus*		Forb
Compositae	Tufted Fleabane	*Erigeron caespitosus*		Forb
Compositae	Horseweed	*Erigeron canadensis*		Forb
Compositae	Tall Fleabane	*Erigeron elatus*		Forb
Compositae	Smooth Fleabane	*Erigeron glabellus*		Forb
Compositae	Spear-leaved Fleabane	*Erigeron lonchophyllus*		Forb
Compositae	Spotted Joe-Pye Weed	*Eupatorium maculatum*	S1	Forb
Compositae	Gumweed	*Grindelia squarrosa*		Forb
Compositae	Sneezeweed	*Helenium autumnale*		Forb
Compositae	Common Tall Sunflower	*Helianthus nuttallii*		Forb
Compositae	Rhombic-leaved Sunflower	*Helianthus subrhomboideus*		Forb
Compositae	Narrow-leaved Hawkweed	*Hieracium umbellatum*		Forb
Compositae	Tall Blue Lettuce	*Lactuca biennis*		Forb
Compositae	Common Blue Lettuce	*Lactuca pulchella*		Forb
Compositae	Palmate-leaved Coltsfoot	*Petasites palmatus*		Forb
Compositae	Arrow-leaved Coltsfoot	*Petasites sagittatus*		Forb
Compositae	Vine-leaved Coltsfoot	*Petasites vitifolius*		Forb
Compositae	Glaucous White Lettuce	*Prenanthes racemosa*		Forb
Compositae	Marsh Ragwort	*Senecio congestus*		Forb
Compositae	Cut-leaved Ragwort	*Senecio eremophilus*		Forb
Compositae	Rayless Ragwort	*Senecio indecorus*		Forb
Compositae	Black-tipped Groundsel	*Senecio lugens*		Forb
Compositae	Balsam Groundsel	*Senecio pauperculus*		Forb
Compositae	Northern Ragwort	*Senecio streptanthifolius*		Forb
Compositae	Sow Thistle	*Sonchus arvensis*		Forb
Compositae	Canada Goldenrod	*Solidago canadensis*		Forb
Compositae	Low Goldenrod	*Solidago missouriensis*		Forb
Compositae	Northern Goldenrod	*Solidago multiradiata*		Forb
Compositae	Showy Goldenrod	*Solidago nemoralis*		Forb
Compositae	Mountain Goldenrod	*Solidago spathulata*		Forb
Compositae	Common Dandelion	*Taraxacum officinale*		Forb
Compositae	Low Townsendia	*Townsendia exscapa*		Forb
Lycopodiaceae	Stiff Club-Moss	*Lycopodium annotinum*		Club-moss
Lycopodiaceae	Running Club-Moss	*Lycopodium clavatum*		Club-moss
Lycopodiaceae	Ground Cedar	*Lycopodium complanatum*		Club-moss
Lycopodiaceae	Tree Club-Moss	*Lycopodium obscurum*		Club-moss
Lycopodiaceae	Mountain Club-Moss	*Lycopodium selago*	SU	Club-moss
Equisetaceae	Common Horsetail	*Equisetum arvense*		Horsetail
Equisetaceae	Swamp Horsetail	*Equistetum fluviatile*		Horsetail
Equisetaceae	Meadow Horsetail	*Equisetum pratense*		Horsetail
Equisetaceae	Dwarf Scouring-rush	*Equisetum scirpoides*		Horsetail
Equisetaceae	Woodland Horsetail	*Equisetum sylvaticum*		Horsetail
Equisetaceae	Scouring Rush	*Equisetum hyemale*		Horsetail
Equisetaceae	Marsh Horsetail	*Equisetum palustre*		Horsetail
Equisetaceae	Variegated Scouring-Rush	*Equisetum variegatum*		Horsetail
Ophioglossaceae	Grape Fern	*Botrychium dusenii*		Fern
Ophioglossaceae	Lance-Leaved Grape Fern	*Botrychium lanceolatum*	S1/S2	Fern
Ophioglossaceae	Grape Fern	*Botrychium virginianum*		Fern
Polypodiaceae	Lady Fern	*Athyrium filix-femina*		Fern

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Polypodiaceae	Fragile Bladder Fern	*Cystopteris fragilis*		Fern
Polypodiaceae	Mountain Bladder Fern	*Cystopteris montana*		Fern
Lycopodiaceae	Mountain Club-moss	*Lycopodium selago*		Club Moss
Lycopodiaceae	Ground-pine	*Lycopodium dendroideum*		Club Moss
Ophioglossaceae	Moonwort	*Botrychium lunaria*		Fern
Polypodiaceae	Slender Lip Fern	*Cheilanthes feei*		Fern
Polypodiaceae	Oak Fern	*Gymnocarpium dryopteris*		Fern
Polypodiaceae	Fragrant Wood Fern	*Dryopteris fragrans*		Fern
Polypodiaceae	Spreading Wood Fern	*Dryopteris expansa*		Fern
Polypodiaceae	Broad Spinulose Shield Fern	*Dryopteris assimilis*		Fern
Polypodiaceae	Narrow Spinulose Shield Fern	*Dryopteris carthusiana*		Fern
Polypodiaceae	Ostrich Fern	*Matteuccia struthiopteris*		Fern

Assignment of Plant Growth Form

Aquatic:	A plant growing in water with no rigid support tissue or well developed root mass. Technically, aquatics are forbs.
Forb:	Herbaceous annual or perennial, possibly in an amphibious habitat.
Dwarf shrub:	Shrubs with an average growth of under .5 m, or a perennial with a partially woody stem.
Succulant:	Used to describe the one rare cactus in the list.
Sedge:	Any member of the Cyperaceae family.
Rush:	Any member of the Juncaceae family.
Shrub:	A woody plant greater than .5 m in height, with multiple stems at the origin.
Tree:	A woody plant with a solitary, possibly branching stem.

Assignment of Common Names

Common names for the vascular plants were taken from either the field guides listed in the bibliography, or from the Alberta Plant and Fungi Master Checklist. If the common names conflicted between the sources, both were listed.

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Table 5. List of mosses found in northwest Alberta.

Taxa	Common Name	*Scientific Name*	ANHIC Status
Mosses	Midway Peat Moss	*Sphagnum magellanicum*	
Mosses	Poor Fen Peat Moss	*Sphagnum angustifolium*	
Mosses	Peat Moss	*Sphagnum fallax*	S2
Mosses	White-toothed Peat Moss	*Sphagnum girgensohnii*	
Mosses	Warnstorf's Peat Moss	*Sphagnum warnstorfii*	
Mosses	Rusty Peat Moss	*Sphagnum fuscum*	
Mosses	Fringed Bog Moss	*Sphagnum fimbriatum*	S2 / S3
Mosses	Pendant Branch Peat Moss	*Sphagnum jensenii*	S4
Mosses	Lindberg's Peat (Bog) Moss	*Sphagnum lindbergii*	S2 / S3
Mosses	Common Hair Cap	*Polytrichum commune*	
Mosses	Juniper Hair Cap, Juniper Moss	*Polytrichum juniperinum*	
Mosses	Slender Hair Cap, Bog Hair Cap	*Polytrichum strictum*	
Mosses	Awned Hair Cap	*Polytrichum piliferum*	
Mosses	Urn-like Pogonatum	*Pogonatum urnigerum*	
Mosses	Alpine Hair Cap	*Pogonatum alpinum*	
Mosses	Common Four-tooth Moss	*Tetraphis pellucida*	
Mosses	Cord Moss	*Funaria hygrometrica*	
Mosses	Tongue-leaf Small Kettle Moss	*Tayloria lingulata*	
Mosses	Narrow-leaved Splachnum	*Tetraplodon angustatus*	
Mosses	Yellow Collar Moss, Fairy Parasols	*Splachnum luteum*	
Mosses	Red Collar Moss	*Splachnum rubrum*	
Mosses	Showy Bristle Moss	*Orthotrichum speciosum*	
Mosses	Blunt-leaved Bristle Moss	*Orthotrichum obtusifolium*	
Mosses	(bristle moss)	*Orthotrichum pellucidum*	
Mosses	(thread moss)	*Bryum caespiticium*	
Mosses	Tall Clustered Thread Moss	*Bryum pseudotriquetrum*	
Mosses	Silvery Bryum	*Bryum argenteum*	
Mosses	Glaucous Thread Moss	*Pohlia cruda*	
Mosses	Pale-leaved Thread Moss	*Pohlia wahlenbergii*	
Mosses	Copperwire Moss, Nodding Pohlia	*Pohlia nutans*	
Mosses	Long-necked Bryum	*Leptobryum pyriforme*	
Mosses	(mnium)	*Mnium marginatum*	
Mosses	Woodsy Leafy Moss, Woodsy Mnium	*Plagiomnium cuspidatum*	
Mosses	Common Leafy Moss	*Plagiomnium medium*	
Mosses	Slender Round Moss	*Rhizomnium gracile*	
Mosses	Common Northern Lantern Moss	*Cinclidium stygium*	
Mosses	Glow Moss, Tufted Moss	*Aulacomnium palustre*	
Mosses	(bartramia)	*Bartramia pomiformis*	
Mosses	(bartramia)	*Bartramia ithyphylla*	
Mosses	(plagiopus)	*Plagiopus oederiana*	
Mosses	Aquatic Apple Moss, Swamp Moss	*Philonotis fontana*	
Mosses	(paludella)	*Paludella squarrosa*	
Mosses	Capillary Thread Moss	*Meesia uliginosa*	
Mosses	Three-angled Thread Moss	*Meesia triquetra*	
Mosses	Golf Club Moss; Black-fruited Weissia	*Catoscopium nigritum*	
Mosses	Hook-leaf Fern Moss	*Thuidium recognitum*	
Mosses	Wiry Fern Moss	*Thuidium abietinum*	
Mosses	(haplocladium)	*Haplocladium microphyllum*	
Mosses	(helodium)	*Helodium blandowii*	
Mosses	(calliergonella)	*Calliergonella cuspidata*	

Taxa	Common Name	*Scientific Name*	ANHIC Status
Mosses	Sausage Moss, Scorpion Feather Moss	*Scorpidium scorpioides*	
Mosses	Three-ranked Feather Moss	*Calliergon trifarium*	
Mosses	Giant Water Moss, Giant Feather moss	*Calliergon giganteum*	
Mosses	Straw Colored Water Moss	*Calliergon stramineum*	
Mosses	(water moss)	*Calliergon sarmentosum*	
Mosses	Common Hook Moss, Clawleaved Feather Moss	*Drepanocladus aduncus*	
Mosses	Sickle Moss, Hook Moss	*Drepanocladus uncinatus*	
Mosses	Hooked Moss	*Cratoneuron commutatum*	
Mosses	Fern Moss	*Cratoneuron filicinum*	
Mosses	(campylium)	*Campylium stellatum*	
Mosses	(campylium)	*Campylium halleri*	
Mosses	Common Beaked Moss	*Eurhynchium pulchellum*	
Mosses	(homoalothecium)	*Homalothecium aeneum*	
Mosses	Golden Fuzzy Fen Moss	*Tomenthypnum nitens*	
Mosses	Waterside Feather Moss	*Brachythecium rivulare*	
Mosses	Golden Ragged Moss	*Brachythecium salebrosum*	
Mosses	(ragged moss)	*Brachythecium groenlandicum*	
Mosses	(cirriphyllum)	*Cirriphyllum cirrosum*	
Mosses	(plagiothecium)	*Plagiothecium denticulatum*	
Mosses	Clay Pigtail Moss	*Hypnum lindbergii*	
Mosses	Rolled-leaf Pigtail Moss	*Hypnum revolutum*	
Mosses	(pigtail moss)	*Hypnum vaucheri*	
Mosses	(pylaisiella)	*Pylaisiella polyantha*	
Mosses	(platygyrium)	*Platygyrium repens*	
Mosses	(platydictya)	*Platydictya jungermannioides*	
Mosses	Knight's Plume	*Ptilium crista-castrensis*	
Mosses	Schreber's Moss, Big Redstem	*Pleurozium schreberi*	
Mosses	Stairstep Moss	*Hylocomium splendens*	
Mosses	(rhytidiadelphus)	*Rhytidiadelphus triquetrus*	
Mosses	Pipecleaner Moss	*Rhytidium rugosum*	
Mosses	(orthothecium)	*Orthothecium chryseum*	
Mosses	(hedwigia)	*Hedwigia ciliata*	
Mosses	(myurella)	*Myurella julacea*	
Mosses	(lescuraea)	*Lescuraea radicosa*	
Mosses	(climacium)	*Climacium dendroides*	
Mosses	(bryobrittonia)	*Bryobrittonia longipes*	
Mosses	(encalypta)	*Encalypta procera*	
Mosses	(encalypta)	*Encalypta rhaptocarpa*	
Mosses	(screw moss)	*Tortula norvegica*	
Mosses	Hairy Screw Moss	*Tortula ruralis*	
Mosses	(barbula)	*Barbula convoluta*	
Mosses	(gymnostomum)	*Gymnostomum recurvirostrum*	
Mosses	Twisted Moss	*Tortella tortuosa*	
Mosses	Fragile Screw Moss	*Tortella fragilis*	
Mosses	Broom Moss	*Dicranum scoparium*	
Mosses	Electric Eels, Wavy Dicranum	*Dicranum polysetum*	
Mosses	Curly Heron's Beak Moss	*Dicranum fuscescens*	
Mosses	Wavy Dicranum	*Dicranum undulatum*	
Mosses	(dicranella)	*Dicranella varia*	
Mosses	(dichodontium)	*Dichodontium pellucidum*	

Taxa	Common Name	*Scientific Name*	ANHIC Status
Mosses	(oncophorus)	*Oncophorus virens*	
Mosses	Slender Stemmed Hair Moss	*Ditrichum flexicaule*	
Mosses	Purple Horn-toothed Moss	*Ceratodon purpureus*	
Mosses	Erect Fruited Iris Moss	*Distichium capillaceum*	
Mosses	Inclined-fruited Iris Moss	*Distichium inclinatum*	
Mosses	(racomitrum)	*Racomitrium canescens*	
Mosses	(grimmia)	*Grimmia affinis*	
Mosses	(grimmia)	*Grimmia anodon*	
Mosses	(shistidium)	*Schistidium apocarpum*	
Mosses	(shistidium)	*Schistidium rivulare*	

Table 6. List of liverworts found in northwest Alberta.

Taxa	Common Name	Scientific Name	ANHIC Status
Liverworts	Northern Naugehyde Liverwort	*Ptilidium ciliare*	
Liverworts	Naugehyde Liverwort	*Ptilidium pulcherrimum*	
Liverworts	Leafy Liverwort	*Lophozia ventricosa*	
Liverworts	(lophozia)	*Lophozia incisa*	
Liverworts	Common Leafy Liverwort	*Barbilophozia lycopodioides*	
Liverworts	Little Hands Liverwort	*Lepidozia reptans*	
Liverworts	Hard Scale Liverwort	*Mylia anomala*	
Liverworts	Cedar-shake Liverwort	*Plagiochila asplenioides*	
Liverworts	(scapania)	*Scapania cuspiduligera*	
Liverworts	Shiny Liverwort	*Pellia neesiana*	
Liverworts	(pressia)	*Preissia quadrata*	
Liverworts	Green-tongue Liverwort	*Marchantia polymorpha*	
Liverworts	Snake Liverwort	*Conocephalum conicum*	

Table 7. List of lichens found in northwest Alberta.

Taxa	Common Name	Scientific Name	ANHIC Status
Lichens	Aspen Comma	*Arthonia patellulata*	
Lichens	(calicium)	*Calicium viride*	
Lichens	(xylographa)	*Xylographa abietina*	
Lichens	(diploschistes)	*Diploschistes scruposus*	
Lichens	(lecidea)	*Lecidea tessellata*	
Lichens	(tremolecia)	*Tremolecia atrata*	
Lichens	Shingle Lichen	*Hypocenomyce scalaris*	
Lichens	(lecidea)	*Lecidea cinnabarina*	
Lichens	(lecidella)	*Lecidella euphorea*	
Lichens	(mycoblastus)	*Mycoblastus sanguinarius*	
Lichens	(lecidea)	*Lecidea atrobrunnea*	
Lichens	(trapeliopsis)	*Trapeliopsis granulosa*	
Lichens	Green Map Lichen	*Rhizocarpon geographicum*	
Lichens	(map lichen)	*Rhizocarpon geminatum*	
Lichens	Button Lichen	*Buellia punctata*	
Lichens	(dimelaena)	*Dimelaena oreina*	
Lichens	(acarospora)	*Acarospora chlorophana*	
Lichens	(sporastatia)	*Sporastatia testudinea*	
Lichens	(dermatocarpon)	*Dermatocarpon miniatum*	
Lichens	(toninia)	*Toninia caeruleonigricans*	
Lichens	(fulgensia)	*Fulgensia bracteata*	
Lichens	(rhizoplaca)	*Rhizoplaca melanophthalma*	
Lichens	(rhizoplaca)	*Rhizoplaca chrysoleuca*	
Lichens	(crusted orange lichen)	*Caloplaca holocarpa*	
Lichens	(candelariella)	*Candelariella vitellina*	
Lichens	(pertusaria)	*Pertusaria dactylina*	
Lichens	(ochrolechia)	*Ochrolechia upsaliensis*	
Lichens	Spray Paint Lichen, Fairy Puke	*Icmadophila ericetorum*	
Lichens	(haematomma)	*Haematomma lapponicum*	
Lichens	(rim lichen)	*Lecanora rupicola*	
Lichens	(aspicilia)	*Aspicilia caesiocinerea*	
Lichens	(aspicilia)	*Aspicilia cinerea*	
Lichens	(lepraria)	*Lepraria neglecta*	
Lichens	(baeomyces)	*Baeomyces rufus*	
Lichens	Stump Cladonia	*Cladonia botrytes*	
Lichens	(cladonia)	*Cladonia bacillaris*	
Lichens	(cladonia)	*Cladonia coniocraea*	
Lichens	(cladonia)	*Cladonia carneola*	
Lichens	(cladonia)	*Cladonia deformis*	
Lichens	Cladonia Scales	*Cladonia cariosa*	
Lichens	Red Pixie Cup	*Cladonia coccifera*	
Lichens	False Pixie Cup	*Cladonia chlorophaea*	
Lichens	(cladonia)	*Cladonia fimbriata*	
Lichens	(cladonia)	*Cladonia pocillum*	
Lichens	Pixie Cup Lichen, Brown Pixie Cup	*Cladonia pyxidata*	
Lichens	(cladonia)	*Cladonia cervic. v. verticillata*	
Lichens	Sieve Cup Lichen	*Cladonia multiformis*	
Lichens	Powdered Funnel Cladonia	*Cladonia cenotea*	

Taxa	Common Name	Scientific Name	ANHIC Status
Lichens	Pioneer Cladonia	*Cladonia cornuta*	
Lichens	Brown-foot Cladonia	*Cladonia gracilis*	
Lichens	Orange-foot Lichen	*Cladonia ecmocyna*	
Lichens	(cladonia)	*Cladonia bellidiflora*	
Lichens	(cladonia)	*Cladonia squamosa*	
Lichens	Shrub Funnel Lichen	*Cladonia crispata*	
Lichens	Shingled Cladonia	*Cladonia scabriuscula*	
Lichens	Green Reindeer Lichen	*Cladina mitis*	
Lichens	Star Reindeer Lichen	*Cladina stellaris*	
Lichens	Grey Reindeer Lichen	*Cladina rangiferina*	
Lichens	Prickle Cladonia, Spike Lichen	*Cladonia uncialis*	
Lichens	(cetraria)	*Cetraria tilesii*	
Lichens	Moonshine Cetraria	*Cetraria pinastri*	
Lichens	Curled Cetraria	*Cetraria cucullata*	
Lichens	(cetraria)	*Cetraria nivalis*	
Lichens	(cetraria)	*Cetraria ericetorum*	
Lichens	Icelandmoss	*Cetraria islandica*	
Lichens	(cetraria)	*Cetraria platyphylla*	
Lichens	(cetraria)	*Cetraria hepatizon*	
Lichens	(melanelia)	*Melanelia stygia*	
Lichens	Lustrous Brown Lichen	*Melanelia exasperatula*	
Lichens	(platismata)	*Platismatia glauca*	
Lichens	(rock shield)	*Parmelia omphalodes*	
Lichens	Salted Shield	*Parmelia saxatilis*	
Lichens	Waxpaper Lichen	*Parmelia sulcata*	
Lichens	Green Speckleback	*Flavopunctelia flaventior*	
Lichens	(arctoparmelia)	*Arctoparmelia centrifuga*	
Lichens	Green Starburst	*Parmeliopsis ambigua*	
Lichens	Grey Starburst	*Parmeliopsis hyperopta*	
Lichens	(xanthoparmelia)	*Xanthoparmelia taractica*	
Lichens	(hood lichen)	*Hypogymnia austerodes*	
Lichens	Monk's Hood Lichen	*Hypogymnia physodes*	
Lichens	(hood lichen)	*Hypogymnia metaphysodes*	
Lichens	(leptogium)	*Leptogium saturninum*	
Lichens	(pannaria)	*Pannaria pezizoides*	
Lichens	(psorama)	*Psoroma hypnorum*	
Lichens	Chocolate Chip Lichen	*Solorina crocea*	
Lichens	(solarina)	*Solorina saccata*	
Lichens	Freckled Lichen	*Peltigera aphthosa*	
Lichens	Dog Lichen	*Peltigera canina*	
Lichens	(peltigera)	*Peltigera rufescens*	
Lichens	Apple Pelt, Boxboard Felt Lichen	*Peltigera malacea*	
Lichens	Small Felt Lichen	*Peltigera didactyla*	
Lichens	Green Kidney	*Nephroma parile*	
Lichens	Frog Pelt, Finger Felt Lichen	*Peltigera neopolydactyla*	
Lichens	(kidney lichen)	*Nephroma arcticum*	
Lichens	Lungwort	*Lobaria pulmonaria*	
Lichens	Granulated Shadow	*Phaeophyscia orbicularis*	
Lichens	(phyconia)	*Physconia muscigena*	
Lichens	Hooded Rosette	*Physcia adscendens*	

Taxa	Common Name	Scientific Name	ANHIC Status
Lichens	Grey-eyed Rosette	*Physcia aipolia*	
Lichens	Elegant Orange lichen	*Xanthoria elegans*	
Lichens	Pincushion Orange	*Xanthoria polycarpa*	
Lichens	(orange lichen)	*Xanthoria fallax*	
Lichens	(rocktripe)	*Umbilicaria virginis*	
Lichens	(rocktripe)	*Umbilicaria torrefacta*	
Lichens	(rocktripe)	*Umbilicaria proboscidea*	
Lichens	(coral)	*Stereocaulon alpinum*	
Lichens	Woolly Coral	*Stereocaulon tomentosum*	
Lichens	(worm lichen)	*Thamnolia subuliformis*	
Lichens	(dactylina)	*Dactylina ramulosa*	
Lichens	Spiny Heath Lichen	*Coelocaulon aculeatum*	
Lichens	(witch's hair)	*Alectoria ochroleuca*	
Lichens	Velcro Lichen	*Pseudephebe pubescens*	
Lichens	(horsehair)	*Bryoria glabra*	
Lichens	Powdery Beard	*Usnea lapponica*	
Lichens	Sugary Beard	*Usnea hirta*	
Lichens	(old man's beard)	*Usnea alpina*	
Lichens	Spruce Moss	*Evernia mesomorpha*	
Lichens	Punctured Gristle	*Ramalina dilacerata*	
Lichens	Wolf Lichen	*Letharia vulpina*	

For non-vascular plants, verifiable common names are generally not available (Vitt et al. 1988). Both of the checklists for the mosses and the lichens only list species by their latin binomer. Bryophyte taxonomists are having enough trouble ensuring consistency in the genus and species descriptions, let alone common names.

The field guides do give common names for the nonvascular plants, which were included in the list, but these names are not verifiable. They are also not consistent between field guides.

If a moss or lichen species without a common name was found, one was assigned to it based on familiar species. If there were other species from the same genera with a common name in the list, the root of the common name was assigned to the unnamed species. If the unnamed species was the solitary species representing its genera, the genus name was assigned as the common name.

Common names in brackets generally refer to the genus and is used for those species where no common vernacular exists.

Table 8. List of plant species in northwest Alberta that are currently listed on the Alberta Natural Heritage Information Centre (ANHIC) Plant Species of Special Concern° (1997). Also included are rare species in the northwest region as identified by Packer and Bradley (1984). Data Source: ANHIC.

Common Name	Scientific Name	ANHIC Status
Brittle Prickly-Pear	*Opuntia fragilis*	S4
Dwarf Bulrush	*Scirpus pumilus v. rollandii*	S2
Fringed Bog Moss	*Sphagnum fimbriatum*	S2 or S3
Reddish Wood-Rush	*Luzula rufescens*	S1
Lindberg's Bog Moss	*Sphagnum lindbergii*	S2 or S3
Pendant Branch Peat Moss	*Sphagnum jensenii*	S4
Peat Moss	*Sphagnum fallax*	S2
Polar Grass	*Arctagrostis arundinacea*	S1
White Adder's-Mouth	*Malaxis monophylla*	S2
Floating-Leaf Pondweed	*Potamogeton natans*	S2
	Conardia compacta	S2
Lance-Leaved Grape Fern	*Botrychium lanceolatum*	S1 or S2
Wavy-Leaved Chickweed	*Stellaria crispa*	S2
Thread Rush	*Juncus filiformis*	S2
Red Bulrush	*Scirpus rufus*	S1
Bog Bilberry	*Vaccinium uliginosum*	S3
Northern Quillwort	*Isoetes echinospora*	S1
Rye-Grass Sedge	*Carex loliacea*	S2
Mountain Club-Moss	*Lycopodium selago*	SU
Small Butterwort	*Pinguicula villosa*	S2
Purple Rattle	*Pedicularis sudetica*	S1
Additional Rare Species in Region; taken from Packer and Bradley (1984)		
Mountain Bladder Fern	Cystopteris montana	S1
Poverty Oat Grass	Danthonia spicata	S1
Canadian Rice Grass	Oryzopsis canadensis	S1
Little-seed Rice Grass	Oryzopsis micrantha	S1
Browned sedge	Carex adusta	S1
Small Bitter Cress	Cardamine parviflora	S1
Russian Ground-cone	Boschniakia rossica	S1
Joe Pye-weed	Eupatorium purpureum	S1

S1 ≤5 occurrences or only a few remaining individuals or may be imperiled because some factor of its biology makes especially vulnerable to extirpation

S2 6–20 occurrences or with many individuals in fewer occurrences; or may be susceptible to extirpation because of some factor of its biology

S3 21–200 occurrences, may be rare and local throughout it s range, or in a restricted range (may be abundant in some locations or may be vulnerable to extirpation because of some factor of its biology)

S4 apparently secure under present conditions, typically >100 occurrences, may be rare in parts of its range, especially peripherally

SU status uncertain often because of low search effort or cryptic nature of the element; possibly in peril, unrankable, more information needed.

° since a complete inventory of the plant species of northwest Alberta does not exist, it is not possible to assemble a complete list of those plant species that are considered rare or threatened. As such, the plant species listed in the above table is incomplete and conservative.

Development of plant communities in post-glacial northwest Alberta

Prepared by Cliff Wallis of Cottonwood Consultants Ltd.

Northern forests and their associated vegetation and wildlife evolved under changing climatic conditions. The vegetation today is a reflection of past climates and the disturbance events they set the stage for. Growth rates, species composition, longevity, biomass and frequency and magnitude of disturbance events (fire, flooding) are dictated by climate.

Pollen studies and dating of sediment cores provide some insights into the postglacial vegetation succession in northwest Alberta. Most paleoecological studies in western interior Canada have focused on regional vegetation history and lake development. Regional vegetation histories have been reconstructed using data from pollen studies of sediments in small lake basins. Few papers have focused on wetland development.

Some of the most relevant paleoecological studies include those of White and Mathewes (1986) who describe events from field work in the Saddle Hills area and Hansen (1952) who worked the area between Grande Prairie and Lesser Slave Lake. Ritchie (1987) provides a good synthesis of work in the western interior of Canada. Zoltai and Vitt (1990) and MacDonald (1984) sampled several wetland systems in northern Alberta. Nicholson and Vitt (1990) and Kuhry et al. (1992) provide valuable insights into the process of wetland development.

Powell (1981) provides a general overview of the impact of climate on boreal forests. The following descriptions of post-glacial events represent a summary and integration of the results presented by the various authors. Much of this data is applicable to the southern portion of the study area. Differences have been noted where there is available northern data that differs substantially from the southern data.

Considerable caution must be used when interpreting the pollen record. *Populus* spp. (poplars) are poorly represented in many of the strata due to the conditions at the time of sedimentation. This does not mean that poplars were an insignificant part of the landscape. Poplar pollen is not well preserved in peat. Aspen and balsam poplar have likely been important components of the forests of northwestern Alberta ever since the first woodlands were established in early postglacial time.

The proposed general sequence of events for landscape level post-glacial vegetation succession is:

Period (yrs before present)	Description
12,000 BP	ice-free conditions; first colonizing plants
11,700-11,000 BP	poplar, willow, sage, grass and sedge predominate; presence of pine and spruce
8,700-8200 BP	increase in paper birch; decline in spruce; possibly increased fires with enhanced seasonality
7,400 BP	peak of pine
5,000 BP	contemporary vegetation

Early Post-glacial Conditions (12,000 to 11,000 BP)

Between 12000 and 10000 BP there was a rapid recession of the ice sheets followed by a large ice free area (Ritchie 1987). From 12000 to 11700 BP was a period of active ice melting. Initially, the area was relatively treeless. There was considerable recently exposed mineral soil and abundant water, both ponded and flowing. Aquatic plants predominated including *Carex* spp. (sedges), *Myriophyllum* sp. (milfoil), *Typha* sp. (cattail), *Polygonum amphibium* (water smartweed), *Potamogeton* spp. (pondweeds), *Drepanocladus* spp. (bog mosses) and algae. The domination of wetlands by *Typha* (cattail) and the lack of peatland development suggested frequent and severe periods of drought through the next 4000 to 6000 years. Large fluctuations in water levels resulted in little peat formation.

Upland vegetation included sage, chenopods, grasses and other pioneering herbs that could readily colonize the emerging substrates. Shrubs included *Betula* spp. (bog birches), *Shepherdia canadensis* (Canada buffaloberry) and low heathy or ericaceous species (*Ledum*, *Vaccinium*). Evidence of permafrost and extensive fossil dunes suggest a mean annual temperature about 10°C lower than today, with very strong winds from the northwest and drier conditions than at present (Ritchie 1987). MacDonald (1984) worked on a site near the eastern end of the Caribou Mountains. This similarly showed an initial vegetation dominated by sages, grasses and sedges with a slight shift in dates (11000 to 9600 BP), likely due to the more northerly latitude and higher elevation.

From 11700 to 11500 BP, there likely was an open poplar woodland as the land became more vegetated. Pollen analyses showed a high degree of *Populus* spp. (poplars) as well as *Salix* spp. (willows) and *Artemisia* spp. (sages). Vance (1986) indicated that poplar and willow were likely no more abundant than they are today. *Pinus* spp. (pines) were apparently not present in the region. Other prominent groups included grasses, sedges, *Betula* spp. (bog birches), chenopods, *Shepherdia canadensis* (Canada buffaloberry) and wetland forbs including *Myriophyllum* (water milfoil), *Potamogeton* (pondweed) and *Typha* (cattail). It appears that the wetland species that were initially present continued to thrive and there was already formation of organic deposits.

From 11500 to 11000 BP, *Alnus* spp. (alders), *Betula* spp. (bog birches) and *Salix* spp. (willows) were the predominant woody species. Willow was likely more abundant than alder on both the uplands and near water courses. Grasses increased on the uplands. While *Carex* spp. (sedges) decreased slightly, they were still prominent. *Abies* (fir), *Pinus* (pine) and *Picea* (spruce) were likely present as minor elements of the regional vegetation. In the Caribou Mountains, bog birches increased at 9000 BP followed by a short lived peak in willows.

Raup (1946) suggested that the occurrence of pine on the apparently unglaciated higher portions of the Caribou Mountains might indicate a glacial refugium in this area. This does not correspond with pollen samples taken at more southern locations. It likely indicates a more rapid postglacial advance from other ice-free areas in western North America while reinvasion of eastern boreal vegetation was impeded by retreating continental glaciers and meltwaters. Evidence also suggests that *Pinus contorta* (lodgepole pine) did not survive the last ice age in Beringia; however, *Betula glandulosa* (swamp birch) and various ericaceous species probably did persist in Beringia and spread eastward during deglaciation (Ritchie 1987). There is evidence that balsam poplar did survive in Beringia and, with its efficient dispersal mechanisms rapidly expanded in response to the abrupt warming. Ritchie (1987) indicates that the forest margin may have advanced at a phenomenal average rate of 200 to 300 m per year.

The Rise of Upland Woodlands (11,000 to 8,700 BP)

From 11000 to 8700 BP, upland forests became well established between the Rocky Mountains and the retreating continental glacier as more organic matter was incorporated into the soil and as succession proceeded from the initial pioneering species and poplars. *Picea* spp. (spruces) and, to a lesser extent, *Pinus* spp. (pines) dominated but *Populus* spp. (aspen and balsam poplar) were likely present, though their prevalence is unknown. In addition to the bog birches, tree birches gained prominence. There were marked increases at 10000 BP in *Picea* (first *P. glauca*, white spruce, followed by *P. mariana*, black spruce, both reaching a maximum about 9500 BP). Towards the end of this period, spruce underwent two significant declines while pines gradually rose then declined.

The Pine Peak (8,700 to 5,000 BP)

From 8700 to 5000 BP, there are marked fluctuations in the prominence of *Betula* spp. (birches), *Pinus* spp. (pines) and *Picea* spp. (spruces). Initially, spruces drop significantly while tree birches peak between 8700 and 8200 BP, followed by *Alnus* spp. (alders). This rise in alder may not reflect a major increase in the overall vegetation.

Betula spp. (birches) were prevalent as the main fire successional species during the latter part of the previous period and the early part of this period. It has been suggested that this was due to the presence of an ice mass some 600-900 km northeast of the study area. This ice mass provided an outflow of cold air that enhanced the role of birch rather the pine in fire successional vegetation. Winters were likely cold and exceptionally long with short, hot and fire-prone summers. By 7400 BP, there was only a small remnant of the Laurentide ice sheet and the outflow of cold air was reduced and the growing season lengthened, thereby favoring pine over birch.

Pines increased starting at about 8000 BP rising to a peak about 7500-7000 BP during the height of the warm, dry Hypsithermal. Birches and alders decline, recovering slightly towards the end of the period. It is thought that pines comprised abut 20% of the forest cover and were prone to fires during this time.

There is no evidence that the warm dry Hypsithermal period contributed to the advance of the grassland into forested areas. Soil factors, especially the presence of solonetzic soils, appear to the be the prime determinants of Peace River grasslands (Wilkinson and Johnson 1983).

While there were ongoing accumulations of organic peat deposits in northern locales ever since early deglaciation, extensive peat development and expansion of boreal fens, swamps and bogs southward began about 6000 BP. There was flooding of depressions before these dates but the areas were dominated by marshy vegetation and not boreal peatlands. When peat accumulation started, conifers were present but there is evidence of stands of deciduous forest as well. Fens were not present south of 54°30'N latitude before 6000 BP. North of this line, some fens may have been present at least 3000 years earlier (9000 BP) but extensive peatland development did not begin until 8000 to 7500 BP (Zoltai and Vitt 1990).

A Cooler and Moister Climate – Development of Contemporary Vegetation (5,700 BP to present)

Between 5000 and 4000 years BP, the climate became cooler and wetter with conditions similar to today. Vance (1986) suggests that this could have been as early as 7500 BP in northern Alberta.

Within the pollen samples from 5700 BP to the present, there was a slow decline of *Picea* spp. (spruces) towards the end of the period with a corresponding increase in *Pinus* spp. (pines) and some increase in grasses. The last 3000 years have been relatively stable with conditions analogous to the contemporary vegetation that persists today.

The contemporary upland (including riparian) vegetation is transitional between the Foothills and Boreal Natural Regions. It includes successional forests of lodgepole pine or jack pine, aspen, balsam poplar, white spruce and black spruce.

Drier sandy sites are often dominated by jack pine, although lodgepole pine occurs in the Foothills along the western edge of the study area and on well-drained soils in Subarctic environments in the Caribou Mountains and Cameron Hills. Although the successional pathway for these sandy upland forests may be to black or white spruce, the sandy soil and short fire return interval ensure that this seldom happens.

With increasingly disorganized or poor drainage and discontinuous permafrost as one travels from south to north and from lower to higher elevations, black spruce become dominant in the "upland" vegetation. This is especially true in Wetland Mixedwood, Boreal Highland and Subarctic Subregions.

Aspen tends to dominate in the Dry Mixedwood Subregion and on southerly slopes in the Boreal Highland Subregion. Successional pathways are to a white spruce-dominated mixed woodland but frequent fires keep a significant portion of the area in deciduous-dominated earlier seral stages.

Riparian floodplains are dominated by a mosaic of successional *Salix* spp. (willows), *Alnus tenuifolia* (river alder), balsam poplar and white spruce. These habitats are dependent on major flood events to create favorable conditions for new seedlings or vegetative shoots.

Paludification is responsible for the majority of peat development. This is directly related to climate. There was a slow progression from marsh to fen (nutrient rich) to bog (nutrient poor) conditions although Kuhry et al. (1992) noted that this change could be rapid, particularly in areas of acidic rock on the Canadian Shield. In more northerly areas, paludification began about 8000 BP (Nicholson and Vitt 1990). In southern areas, paludification started at about 5000 to 4500 BP. As the wetlands developed and evolved, the complex patterning (e.g. water tracks, tree islands) seen today gradually emerged. *Sphagnum* spp. (peat mosses) began to dominate in many wetlands as the climate approximated that of today and the peatlands became increasingly acidified at about 4500 BP in the north and 2500 BP in the south (Zoltai and Vitt 1990).

Contemporary wetlands (fens, bogs, marshes) are dominated by black spruce, *Larix laricina* (tamarack) as well as *Salix* spp. (willows), *Betula* spp. (bog birches), ericaceous shrubs, graminoids (especially *Carex* spp.-sedges), bog mosses and *Sphagnum* spp. (peat mosses). Some wetland systems appear to be filling in and are very slowly succeeding to more woody vegetation, including closed forest types dominated by black spruce. In other cases, fire appears to play a role in removing sufficient tree cover to cause the water table to rise and put the wetlands back to an earlier seral stage. Extensive peatland development is relatively new. Young nutrient rich fens are still rapidly expanding and nutrient poor bogs are rare or slowly being developed. This process may be limited by the strongly calcareous nature of the underlying parent materials (Nicholson and Vitt 1990).

Flooding along stream valleys and around lake basins refills abandoned channel and shoreline wetlands, maintaining marsh environments. Tree, shrub and graminoid dominated fen systems depend on water flow through them while bogs occur where the water is stagnant. There is clear documentation that the vegetation in the watershed of a peatland influences the hydrology. Forest cover (especially coniferous) results in a reduced but more stabilized water yield. Local disturbances (e.g fire) may cause hydrological changes that could affect the peatland system (Kuhry *et al.* 1992).

Extensive grasslands that once occurred on the upland ecoregions (Peace River Parkland and Dry Mixedwood) have largely been converted to cropland – grasslands are now confined to southerly and westerly facing slopes in the major stream valleys. Soil texture and salinity, moisture regime, topographic position, presence of permafrost, floods and fires are major controlling factors for the present vegetation.

The 20th Century and the Importance of Disturbance Events

The proportions of the dominant vegetation vary in relation to climate, topography, soil, fire history, and disease and pest outbreaks. Ritchie (1987) suggests that the forests are controlled at a regional level by major landforms and

associated soils. At a local level, fire and other disturbance events like flooding play a dominant role in determining the vegetation. Natural fires and major flood events have led to a mosaic of "disturbance patches" of different successional stages.

Key disturbance features include:

- flooding for maintenance of riparian balsam poplar and willow as well as wetland (bog, fen and marsh) systems; and
- fire for maintenance of earlier seral stages of forests including pine and aspen vegetation; fire may also play a role in creating earlier seral stages in wetland systems.

Although temperature effects are considered limiting factors for tree growth in northern Alberta, soil moisture perhaps plays a more substantial direct role. In poorly-drained areas such as on clay tills and in areas of permafrost, excessive moisture inhibits tree growth. Discontinuous permafrost is prevalent at higher elevations and more northerly latitudes in this area. Further north, the forest-tundra ecotone occurs within and subparallel to the zone of continuous permafrost (Jacoby and Ulan 1981). Ritchie (1984) suggests that white spruce is less tolerant of permafrost than black spruce; therefore, in areas of permafrost, white spruce often occupies more well-drained uplands and black spruce is most prevalent in peaty lowlands.

There is considerable variability from decade to decade in climatic patterns. Over the centuries, the impact of these short-term fluctuations has been to help add some diversity in the landscape by facilitating disturbance events and resulted in the creation of disturbance patches (e.g. reversion to earlier successional stages with fires and floods).

There have been significant changes in the climate of northwestern Alberta over the last century. Street and McNicholl (1983) indicate that there were two major periods of severe soil moisture deficit in the Rycroft area (Peace River country) during the years 1928 to 1981:

summer 1928 – spring 1933

summer 1942 – spring 1947

Other generally dry periods occurred during 1949 to 1954 and 1960 to 1964. Soil moisture remained above normal for an unusually long seven years from 1972 to 1979.

Mean annual temperatures have risen 2.2–3.0°C (Wheaton 1998) over the last 30 years. This was coupled with a similar rise during the period from 1909–1958 and a lengthening of the frost-free period by some 20 days. This is a significantly greater increase than for other forested regions of Canada and reflects an anomaly that is centered on Alberta and the Yukon.

There is concern that, if this trend continues, there may be a considerable shift in the patterns of disturbance and, therefore, the distribution of the vegetation communities. With warmer and potentially drier conditions, there may be a resultant increase in fire frequency, a loss of wetlands and a reduction in spruce and fir conifer forests in favor of pine and aspen dominated types.

Flooding Disturbance and Floodplain and Wetland Succession

Several *Salix* species (willows) and *Alnus rugosa* (river alder) are characteristic of alluvial soils where flooding occurs on a regular basis along rivers and lakeshores. They are often succeeded by balsam poplar, especially along larger rivers. Balsam poplar is succeeded by white spruce. *Abies balsamea* (balsam fir) is generally restricted by soil types in western Canada largely to alluvial soils in valley bottom positions where it often associates with white spruce and balsam poplar – it is more prevalent in northeastern Alberta. Stands of balsam fir are occasionally found on other sites that have not experienced fire events for long periods of time.

In wetlands, there is a succession from open water and marsh vegetation through grasses and sedges to *Betula glandulosa* (swamp birch) and conifer trees. *Larix laricina* (tamarack) is successional to black spruce in the fen-bog succession. Black spruce occurs on upland clayey soils as well as on organic soils in lowlands.

Fire Disturbance and Succession

Alnus crispa (green alder) and *Shepherdia canadensis* (Canada buffaloberry) are pioneering species on recently disturbed upland sites. *Pinus banksiana* (jack pine) and *Aspen* occur early in forest succession, usually following fire. They are quickly replaced in the succession by white spruce on sites that are not too sandy and sometimes *Betula papyrifera* (paper birch). Paper birch is a short-lived tree that plays a secondary role in forest succession – it often occurs on sandier soils and slopes. While pine would likely continue to thrive on sand dunes in the absence of

fire and some southerly slopes on hill systems would support aspen, disturbance is a key factor in the current extent of these species in northern Alberta.

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Peatland Complexes

prepared by Linda A. Halsey and D. H. Vitt, University of Alberta

modified from Alberta Wetland Inventory Standards" (1996) in Alberta Vegetation Inventory Standards Version 2.2, Resource Data Division. Alberta Environmental Protection

Definition Of Wetlands And Wetland Classes

In Canada wetlands have been defined as "...land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment" (NWWG 1988). The environmental processes that control wetland development form hydrologic, chemical, and biotic gradients and commonly have strong cross-correlations. These interrelated gradients are here divided into five nodes that define the wetland classes used in this report, of which three are non-peat forming wetlands generally having <40 cm of accumulated organics and two are peatlands with >40 cm of accumulated organics. Non-peat forming wetlands are subdivided as 1) shallow open water, 2) marsh, and 3) swamp; whereas peatlands can be subdivided into 1) fen and 2) bog (Figure 6). This primary wetland subdivision forms the foundation for defining Alberta wetlands and has been recognized by the Provincial Government within draft policy (Alberta Water Resources Commission 1993).

A) Non Peat-Accumulating Wetlands

In these regions, rates of decomposition exceed rates of accumulation, thereby ensuring that peat does not form.

Shallow Open Waters are non-peat forming wetlands that are characterized by aquatic processes confined to less than 2 m depth at midsummer. These wetlands have submergent to floating vegetation and form a transition to truly aquatic ecosystems. The chemistry of this wetland class is variable and does not distinguish it from the remaining four wetland classes, and floristic composition is dependent on chemical conditions.

Marshes are open, non-peat forming wetlands that are dominated by sedges (Cyperaceae) and other monocots. Marshes are characterized by seasonal water level fluctuations, relatively high amounts of water flow, and are influenced by ground and surface waters. As a result, concentrations of nitrogen and phosphorus are high, leading to abundant vascular plant production; however, peat accumulation is limited by high decomposition rates. Bryophytes are generally lacking or not abundant as they do not compete well with rapid vascular plant growth and do not tolerate large fluctuations in seasonal water levels. As with shallow open waters, chemical differences in marshes strongly influence their floristic composition. Alkaline marshes (dominated by calcium and bicarbonate) are dominated by *Carex*, *Scirpus*, and *Typha*, whereas saline marshes (dominated by sodium and sulfate) are largely occupied by *Salicornia* and *Scirpus*.

Swamps are forested, wooded or shrubby non-peaty wetlands. Swamps and marshes have a poorly developed bryophyte layer that results from strong seasonal water level fluctuations and high vascular plant production. Peat accumulation is limited in swamps as decomposition rates are high. Vegetatively swamps are quite diverse and in Alberta may be composed of some combination of *Larix laricina*, *Picea mariana*, *Betula*, and *Salix*.

B) Peat-Accumulating Wetlands

In these regions, rates of accumulation exceed rates of decomposition, thereby ensuring that peat does form.

Peatlands differ from non-peat forming wetlands by a combination of interrelated hydrologic, chemical, and biotic factors that results in a decrease in decomposition relative to plant production allowing for the accumulation of peat. The stabilization of seasonal water levels and restriction of water flow through a wetland allows for the establishment and development of a bryophyte layer. The stabilization of regional water tables appears to have been an important component in the successional change from prairie marshes to boreal fens in the western interior of Canada over the past 10,000 years (Zoltai and Vitt 1990).

The establishment of a bryophyte layer results in the accumulation and maintenance of nutrients in a nonavailable form, reducing vascular plant production. Stabilized water levels, anaerobic conditions, and decreased nutrient availability lead to a substantial decrease in decomposition rates, that results in the development of peat

accumulating ecosystems (Vitt and Kuhry 1992). Biotic (Sphagnum presence) and chemical (decomposition) processes lead to acidification and oligotrophication. Alberta peatlands are classified into geogenous fens and ombrogenous bogs, each with distinctive indicator species, acidity, alkalinity, and base cation content (Figure 6). The distribution of peatlands in northwest Alberta are shown in Figure 7, Figure 8, Figure 9. These figures indicate areas that have greater than 50% of their area comprised of bogs and/or fens.

Fens are geogenous ecosystems that are affected by mineral soil waters (ground and/or surface) that may be relatively rich in mineral elements. Fens can be subdivided on the basis of hydrology into: soligenous and largely influenced by flowing surface water; topogenous and largely influenced by stagnant ground water; or limnogeneous and largely influenced by associated lakes and ponds. All three fen types have water levels at or near the peat surface. Soligenous fens commonly have discrete patterns of open pools (flarks) alternating with elongate, shrubby to wooded ridges (strings) oriented perpendicular to the direction of surface water flow. These patterned fens may be either acidic or basic. Topogenous, limnogenous, and some soligenous fens are nonpatterned. Fens can be open and dominated by *Carex, Scirpus*, and *Eriophorum*; shrubby and dominated by birch and willow; or wooded to forested dominated by some combination of black spruce, tamarack, birch, and willow.

Originally based on criteria derived from vegetation, fens have in the past been subdivided on the basis of the number of indicator species. Poor fens are low in indicator species, while extreme-rich fens are high in indicator species; moderate-rich fens are intermediate. This gradient of indicator species correlates with a chemical gradient (Sjörs 1952). Poor fens are acid (pH 4.5-5.5), poor in base cations and have no or little alkalinity. They are dominated by oligotrophic and mesotrophic species of *Sphagnum*. Moderate-rich fens have slightly acid to neutral pH (5.5-7.0) and have low to moderate alkalinity with a ground layer of brown mosses namely: *Drepanocladus, Brachythecium, Calliergonella*, and low abundances of mesotrophic species of *Sphagnum*. Extreme-rich fens have basic pH (above 7.0), high concentrations of base cations, and high alkalinity. They are characterized by species of *Drepanocladus*, *Scorpidium*, and *Campylium* and may contain marl deposits. Intermediate fens, although present in eastern Canada have not yet been identified in Alberta.

Bogs are ombrogenous peatlands that receive their water only from precipitation and have low water flow. The water table is generally 40-60 cm below the peat surface. For these reasons bogs are acidic ecosystems with pH below 4.5; they are poor in base cations, and have no alkalinity. Bogs are dominated by oligotrophic species of *Sphagnum*; feather mosses: *Pleurozium schreberi* and *Hylocomium splendens*; and lichens of *Cladonia* and *Cladina*. They may be open, wooded or forested with trees limited to black spruce. As a result of the low thermal conductivity of dry Sphagnum, bogs have lower surface water temperatures then other surrounding organic and nonorganic soils. Permafrost is consequently restricted to bogs at its southern limit, where it forms peat plateaus and palsas (Vitt *et al.* 1994).

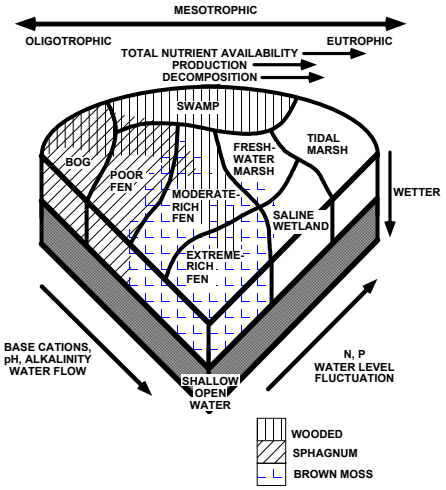

Figure 6. Ternary diagram of wetland classes and their relationship to chemical and biotic gradients Data Source: Modified from Vitt 1994.

Distribution of Peatlands in northwest Alberta

Figure 7, Figure 8, and Figure 9 show the distribution of peatlands within the P1/P2 FMUs, the PRPD FMA and northwest Alberta, respectively, where the combined coverages exceeded 50% of the landscape.

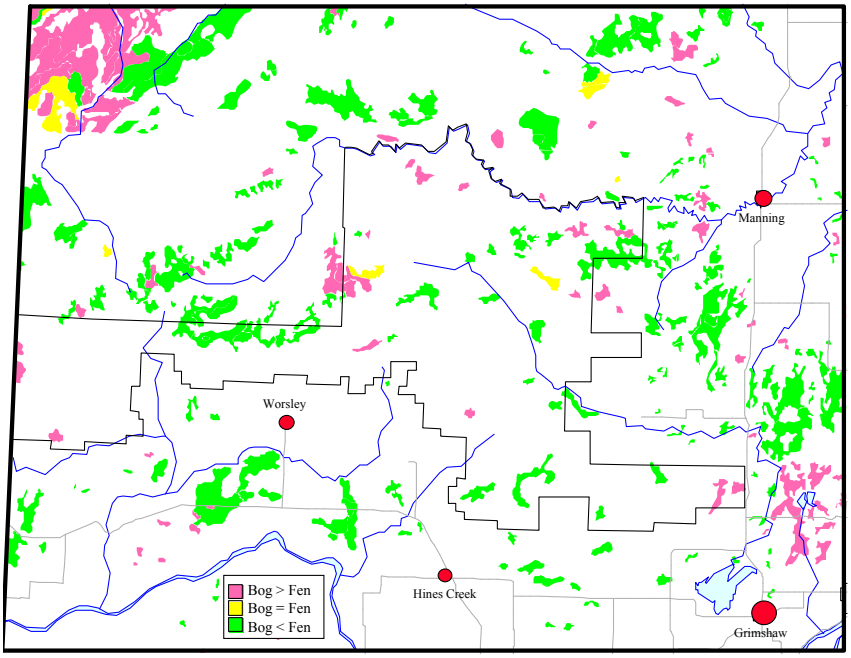

Figure 7. Peatlands distribution in the P1 and P2 FMUs of northwest Alberta. Only areas where combined fen and bog coverages exceed 50% are indicated. Data Source: Modified from: Vitt *et al.* 1996.

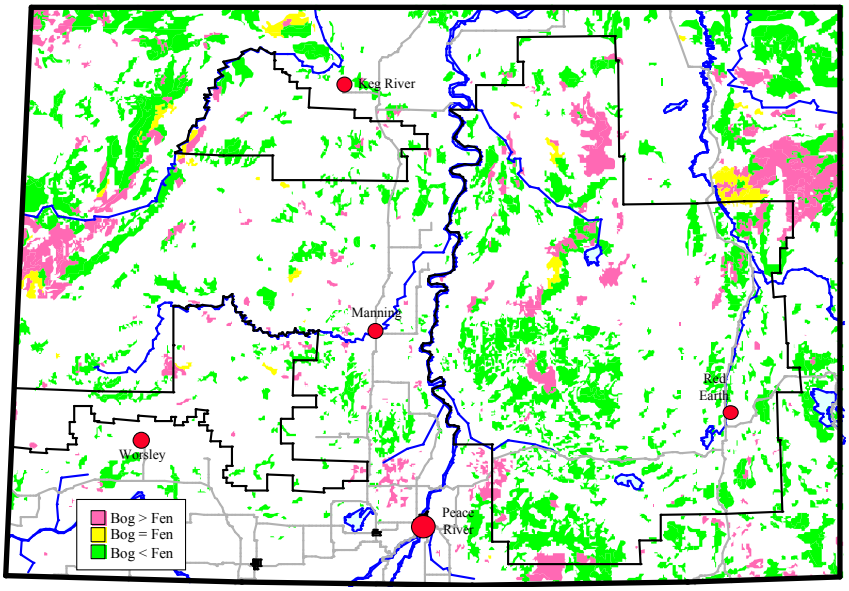

Figure 8. Peatlands distribution in the PRPD FMA. Only areas where combined bog and fen coverages exceeded 50% are indicated. Data Source: Modified from: Vitt *et al.* 1996.

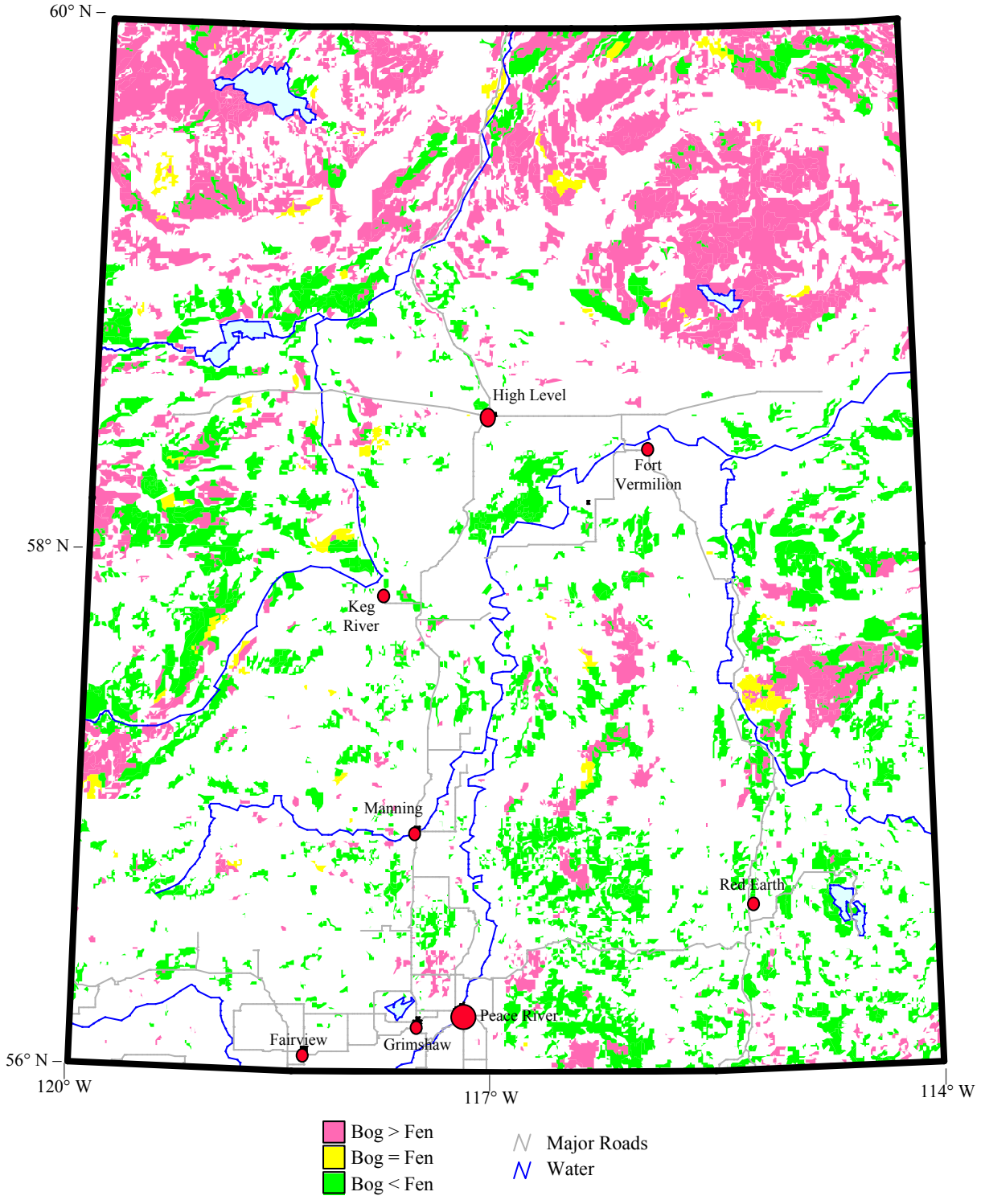

Figure 9. Peatlands distribution in northwest Alberta. Only areas where combined fen and bog coverages exceeded 50% are indicated. Data Source: Modified from: Vitt *et al.* 1996.

Definition and Identification of Wetland Landforms

The classification scheme used for this report follows the classes developed by the National Wetlands Working Group (NWWG) (1988). Subdivision of these classes follows a hierarchical system that follows a more simplified design than that chosen by NWWG (1988). As the classification is simpler it is more appropriate for the scale of inventory being conducted here. The classification system used in this report has been sanctioned by the Alberta Vegetation Inventory Standards Development Group and incorporated into the Alberta Vegetation Inventory (Version 2.2) as the Alberta Wetland Inventory Classification Standards.

The Alberta Wetland Inventory Classification contains four levels that include (Table 10):

- wetland class (NWWG 1988);
- vegetation modifier;
- wetland complex landform modifier; and
- local landform/vegetation modifier.

A description of these levels and coding is contained in Table 9. Of the possible combinations that can occur, 15 wetland types are common in Alberta (Halsey *et al.* 1996). These are defined and described in the following section. A comparison of wetland forms used in this report to those used by the NWWG (1988) is shown in Table 9.

Table 9. Wetland classification scheme. Data Source: Alberta Vegetation Inventory (version 2.2) 1988.

Major Category	Secondary Category	Code
Wetland Class	Bog	B
	Fen	F
	Swamp	S
	Marsh	M
	Shallow Open Water	W
	Non-wetland	Z
	Anthropogenic feature	A
Vegetation Modifier	Forested: closed canopy >70% tree coverage	f
	Wooded: open canopy >6-70% tree coverage	t
	Open: shrubs, sedges, graminoids, herbs, etc. <6% tree cover	o
Wetland Complex	Permafrost is present	x
Landform Modifier	Patterning is present	p
	Permafrost or patterning is not present	n
Local Landform	Collapse scar	c
Modifier	Internal lawn with islands of forested peat plateau	r
	Internal lawns	i
	No internal lawns are present	n
	Shrub cover >25% when tree cover ≤6%	s
	Graminoid dominated with shrub cover ≤25% and tree cover ≤6%	g

Bogs

Bogs develop in areas of restricted surface water flow and are found along drainage divides, in stagnation zones of peatland complexes created in the lee of surface water flow obstructions, and in small, isolated basins. Bogs are subdivided into forms based on forest cover, with open bogs having <6% cover (excluding areas that have recently burned), wooded bogs having >6 to 70% cover, and forested bogs having >70% cover. In continental western Canada, bogs are forested exclusively with black spruce (Vitt *et al.* 1994). The presence of permafrost and internal lawns is also used in subdividing bogs following Vitt *et al.* (1994). Following these criteria, five bog forms can be recognized in Alberta. These include:

*Veneer bogs with or without collapse scars (**Boxc** and **Boxn**)*

Veneer bogs have a scanty tree cover (generally ≤6%) and may contain circular to irregularly shaped collapse scars that have a sharp boundary with the surrounding bog. They are permafrost dominated, with collapse scars occurring where underlying permafrost has melted. Ground cover on the veneer bog is dominated by feathermosses such as *Hylocomium splendens* and *Pleurozium schreberi*, interspersed with hummocks of *Sphagnum fuscum*. Lichens of *Cladonia*, *Cetraria*, and *Cladina* are also common. Collapse scars are located approximately 100 cm lower than the bog surface and have a ground cover dominated by *Carex* and wet species of *Sphagnum*.

On aerial photographs, veneer bogs are recognized by a light tone and a rough texture generated by the high reflectance of patchy lichen ground cover (Figure 10). They can be associated with circular collapse scars that have an even lighter and brighter tone. Unlike other peatlands in Alberta, veneer bogs may be found on low angle slopes grading into wooded, permafrost dominated bogs (peat plateaus) in areas where the surface expression is level. When found on low angle slopes, veneer bogs are associated with medium toned, parallel runnels oriented downslope representing drainage areas that are wooded with black spruce and tamarack.

*Wooded to forested permafrost bogs (peat plateaus) with or without collapse scars (**Btxc**, **Bfxc**, **Btxn**, and **Bfxn**)*

Wooded to forested permafrost bogs have a relatively flat, raised surface, that is dominated by a ground layer of lichens (mostly species of *Cladina* and *Cladonia*), sometimes interspersed with *Pleurozium schreberi*, *Sphagnum fuscum*, and *Polytrichum strictum*. Wooded to forested, permafrost bogs are found in increasing frequency north of the Lower Foothills and north of the southern extension of the Dry Mixedwood Subregion (Vitt *et al.* 1994). They are typically more heavily forested at the southern limit of their occurrence, with crown closure decreasing as mean annual temperature decreases. The amount of bare surface peat increases as crown closure increases. Collapse scars are typically 100 cm lower than the surrounding bog surface and may be present as isolated, circular areas or as interconnected, elongate drainage channels. Wooded to forested, permafrost bogs with collapse scars are often referred to as peat plateaus with collapse scars (Zoltai 1971, NWWG 1988).

Aerial photo recognition of wooded to forested permafrost bogs is based on a dark tone, and a smooth, "velvety" texture (Figure 10, Figure 11). Small, circular, light toned areas (representing collapse scars) within a matrix of black spruce forest is diagnostic of this wetland form. Unlike other wooded bog wetland forms, wooded to forested permafrost bogs can have margins with acute angles while nonpermafrost bogs tend to have rounded margins.

*Wooded bogs without internal lawns (**Btnn**)*

Wooded bogs without internal lawns have a flat, homogenous surface that is uniformly wooded. Bogs without internal lawns occur as islands within large complex fens or as peninsulas protruding into large fens. Bogs can also be found confined to small basins associated with hummocky terrain or in broad, poorly defined depressions as well as along drainage divides. Ground cover is dominated by *Sphagnum*, including *S. fuscum, S. magellanicum*, *and S. angustifolium* with lichens generally representing <50% of the groundcover (Belland and Vitt 1995).

On aerial photographs, wooded bogs without internal lawns are recognized by a medium to dark tone and a smooth, "velvety" texture (Figure 12). There is no evidence of surface water movement as there is in wooded fens and unlike coniferous swamps, they are not found in areas of fluctuating water levels such as along stream courses, though they may occur adjacent to small isolated, circular to scallop-shaped lakes. Wooded bogs are distinguished from stands of black spruce occurring on uplands by their smooth, level surface, and relatively low tree height.

*Wooded bogs with forested permafrost bog and internal lawns (**Btnr**)*

Wooded bogs with forested permafrost bog and internal lawns are characterized by a heterogeneous surface that is dominated by wooded bog with a ground cover of *Sphagnum fuscum* and lichens, interspersed with densely forested bog having a scant ground cover dominated by feather mosses. Areas of densely forested bog are elevated above the

surrounding wooded bog by >40 cm, representing areas of relict permafrost and often are found in radiating patterns emanating from the bog crest. Associated with areas of dense black spruce crown closure are open, wet, internal lawns dominated by *Sphagnum* and *Carex* containing dead trees. Internal lawns are generally 40-60 cm lower than the surrounding wooded, non-permafrost bog and are irregular in shape. These internal lawns differ from those previously mentioned due to the presence of standing dead trees as well as their smaller maximum elevational differences to the surrounding bog.

Stratigraphic analyses of bogs with internal lawns from Alberta reveal an uppermost layer of about 30-50 cm of wet, oligotrophic species of Sphagnum, underlain by a thin layer of sedges followed by a layer dominated by *Polytrichum strictum* or *Pleurozium schreberi*, and abundant wood and/or black spruce needles. Beneath this last layer is a thick layer of a variety of more decomposed macrofossils, all indicating a habitat of dry wooded bog suggesting that substantial change occurred from a relatively dry, wooded bog habitat to a wet open lawn without transitional phases. Such changes are consistent with thermal subsidence of permafrost peatlands and the ergodic distribution of landforms comprising this wetland form (Vitt *et al.* 1994).

Wooded bogs with forested permafrost bog and internal lawns are recognized on aerial photos as medium toned wetlands without any evidence of surface water movement (Figure 13). These bogs generally occur as islands or peninsulas within large, complex peatlands and have smooth, rounded margins. A "blotchy" pattern of distinctly darker and “fuzzy” lighter tones are present, representing permafrost bog and internal lawns respectively. Internal lawns are located within a nonpermafrost bog matrix, whereas collapse scars are surrounded by a matrix of peat plateau.

*Wooded bogs with internal lawns (**Btni**)*

This bog type is characterized by the presence of open, wet *Sphagnum*-*Carex*-dominated internal lawns, often containing partially buried stands of dead trees within a uniformly wooded bog island or peninsula. Common species of *Sphagnum* occurring in these internal lawns are *S. angustifolium, S. riparium*, and *S. fallax*. On the drier part of these lawns, near the bog margins, hummocks of *S. fuscum* or *S. magellanicum* may be found supporting small black spruce trees. These hummocks provide a transition between the bog and the lawn, obscuring the division between them. Internal lawns are 40-60 cm lower than the surrounding wooded bog surface and may occur in extensive, irregular patterns radiating from the bog island center, or in indistinct, nonradiating patterns. Although permafrost is absent, thin, seasonal frost layers can last well into late summer. Internal lawns represent previous areas of permafrost that have historically degraded (Vitt *et al.* 1994, Halsey *et al.* 1995).

Wooded bogs with internal lawns are recognized on aerial photos as medium toned wetlands without any evidence of surface water movement (Figure 14). These bogs generally occur as islands or peninsulas within large, complex peatlands and have smooth, rounded margins. A "blotchy" pattern of “fuzzy” lighter tones is present within this wetland form representing islands of internal lawns.

Fens

Vegetative patterns that result from the presence of surface water flow allow for the distinction of fens from bogs. Fens have been subdivided on the basis of: 1) presence of landforms (strings and flarks) oriented perpendicular to surface water flow direction(s) in a parallel or reticulate pattern; 2) forest cover with open fens having £ 6% cover, and wooded fens having >6% cover of black spruce and/or tamarack; 3) presence of peat plateaus and internal lawns in wooded fens.

*Patterned fens (**Fopn** and **Ftpn**)*

Patterned fens have a heterogeneous surface characterized by open, wet flarks, and drier shrubby to wooded strings and margins (Figure 13, Figure 14, Figure 15). A patterned fen can be considered open or wooded depending on which component of the patterning (string or flarks) dominates. Strings are oriented perpendicular to surface water flow, forming sinuous ribs on gently sloping terrain, and nets on more level terrain where surface water flow is multidirectional, resulting in the development of flow interference patterns. String forest cover may be any combination of tamarack, black spruce, birch, and willow. Potential ground cover is very diverse, ranging from mesotrophic species of Sphagnum in poor fens; to *Tomenthypnum nitens* and associated brown mosses in moderate-rich fens; to *Scorpidium scorpioides* and associated brown mosses in extreme-rich fens. In Alberta, the development of strings and flarks is restricted to fens, and, hence, is diagnostic of this wetland form, allowing it to be readily identified from aerial photos.

*Nonpatterned, open, shrub-dominated fens (**Fons**)*

Shrubs of *Betula* and *Salix* (generally those species growing below shoulder height) are common in fens, and have >25% cover in this fen type with conifers having ≤6% cover. Shrub-dominated fens are found as small isolated basins, and as flat, featureless fens that slope gently in the direction of drainage.

Nonpatterned, open, shrub-dominated fens can be recognized on aerial photographs by the presence of surface water movement and a lack of patterning (Figure 16). This fen type can be distinguished from other nonpatterned fen types by its medium gray tone that has a tendency to be "blotchy", reflecting the variation in shrub canopy closure, and on small scale photos by the crenulate nature of the forest canopy. Nonpatterned, open, shrub-dominated fens can be poor or rich (Vitt and Chee 1990, Beckingham and Archibald 1996).

*Nonpatterned, open, graminoid-dominated fens (**Fong**)*

Nonpatterned, open, graminoid-dominated fens are characterized by the presence of a continuous *Carex* cover with £ 6% tree cover and <25% shrub cover. Open, graminoid-dominated poor fens occur as collapse scars in association with peat plateaus and have a ground cover of Sphagnum found in wet, poor fens (Belland and Vitt 1995). They also occur as laggs associated with bog islands and have a ground cover characterized by drier oligotrophic species of *Sphagnum* such as *S. fallax*, or *S. angustifolium* (Nicholson 1987). Open, graminoid-dominated fens also occur as small isolated basins; and as flat, featureless fens that slope gently in the direction of drainage and may be poor, moderate-rich, or extreme-rich (Vitt and Chee 1990, Nicholson and Gignac 1995).

Open, graminoid dominated fens can be distinguished from other nonpatterned fen types on airphotos by a light to very light gray tone with a smooth texture (Figure 17). This peatland type can grade into wet meadows associated with uplands and non-peat forming wetlands associated with aquatic ecosystems (marshes and shallow open waters). Wet meadows are distinguished from open, graminoid-dominated fens by an undulating surface expression, whereas non-peat forming wetlands are found in areas of fluctuating water level such as along the margins of lakes and streams.

*Nonpatterned, wooded fens with no internal lawns (**Ftnn**)*

Nonpatterned, wooded fens with no internal lawns have >6% tree cover of some combination of black spruce and/or Tamarack. An understory of shrubs of *Betula* and *Salix* is not uncommon. The ground cover of wooded fens can be Sphagnum or brown moss dominated. Wooded fens with no internal lawns have a smooth, homogenous surface that is medium gray in tone and has a "velvety" texture on aerial photos (Figure 17). The boundary between wooded fen and mineral upland can be difficult to distinguish and has been determined here on the basis of slope with wooded fens being found only on level surfaces. Nonpatterned, wooded fens with no internal lawns can be poor, moderate-rich, or extreme-rich (Vitt and Chee 1990, Nicholson and Gignac 1995, Beckingham and Archibald 1996).

*Nonpatterned, wooded fens with islands of forested peat plateau and internal lawns (**Ftnr**)*

In some wooded fens, small islands (peat plateaus) can be found that are forested exclusively with black spruce. These forested islands are surrounded and associated with wetter and lower areas than the surrounding wooded fen representing internal lawns. These lawns contain standing, dead trees and are dominated by graminoid species and wetter species of *Sphagnum* or brown moss than the surrounding wooded fen. A woody debris layer is present stratigraphically within internal lawns at a depth of 20-40 cm. Plants, usually growing under drier conditions, such as *Pleurozium schreberi* or *Tomenthypnum nitens*, have been found in this woody debris layer. Remnants of these forested "islands" are still present around the lawns and are recognized by a narrow zone of denser tree cover dominated by black spruce. This results in a "ghost" image of the former extent of the peat plateau that has degraded (Vitt *et al.* 1994).

A heterogeneous tone characterizes aerial photos of this wetland form, with a medium toned matrix interspersed with distinct, darker toned peat plateaus and “fuzzy”, lighter toned internal lawns (Figure 10). Internal lawns can be ringed with a slightly darker toned border. Islands of peat plateaus and associated internal lawns in wooded fen are generally located along the margins of mineral uplands or large bogs.

*Nonpatterned, wooded fens with islands of internal lawns (**Ftni**)*

As with the previous wetland form, islands of internal lawns occur as wetter depressions in the surrounding wooded fen; however, unlike the previous wetland form, no small islands forested exclusively with black spruce are present. Aerial overflights reveal the presence of dead trees tilted in random directions on the fen lawns, indicating the former existence of densely wooded, small permafrost bodies. Internal lawns are ringed by a narrow zone of denser tree cover dominated by black spruce marking the former extent of peat plateau. Internal lawns have a ground cover

containing wetter species of *Sphagnum* or brown moss than the surrounding wooded fen that may be poor, moderate-rich, or extreme-rich.

As with the previous wetland form a heterogeneous tone characterizes aerial photos of wooded fens with islands of internal lawns. A medium toned matrix is interspersed with “fuzzy”, lighter toned internal lawns that can be ringed with a slightly darker toned border (Figure 18). Islands of internal lawns in wooded fen are generally located along the margins of mineral uplands or large bogs.

Marshes (**Mong**)

Marshes are distinguished from other wetland forms by lack of tree or shrub cover resulting in a light tone on aerial photographs. Unlike open, graminoid-dominated fens, marshes require frequent flooding and are associated with fluctuating water levels. In Alberta, marshes may be saline (Na) or calcareous (Ca) and can be distinguished from open, graminoid-dominated fens by their association with the margins of streams and lakes. Marshes are also distinguished on aerial photos by their association with shallow open water.

Swamps

Swamps are recognized by their location in the landscape next to water bodies that flood frequently or are associated with fluctuating water levels such as is found along peatland margins. Unlike marshes, which do not support a shrub or tree cover due to seasonally wet or regional climatic conditions, swamps are wooded or shrub covered.

*Coniferous swamps (**Sfnn** and **Stnn**)*

Coniferous swamps are forested and have a dense tree cover. They generally have >70% cover of some combination of black spruce and tamarack. They occur in Alberta in association with floodplains and streams and along the margins of some peatland complexes. Coniferous swamps are recognized from aerial photographs by their position in the landscape, level topography, uniform tree height, and dense forest cover. Tree height is greater in swamps than in fens as organic accumulation is <40 cm.

*Deciduous swamps (**Sons**)*

Deciduous swamps have >25% shrub cover, dominated by species of *Salix* that generally grow above shoulder height. Bryophytes are uncommon due to fluctuating water tables. Deciduous swamps occur along floodplains and stream terraces, and along peatland margins. On aerial photographs deciduous swamps are recognized by their position in the landscape, a medium to dark tone, and by a "blotchy" texture that reflects the variation in shrub canopy closure. On small scale aerial photographs shrub vegetation has a crenulate pattern that is easily distinguished. Deciduous swamps are differentiated from open, shrub-dominated fens by shrub size and landscape position.

Shallow Open Waters (**Wonn**)

This wetland class is distinguished by its association with other wetland forms, particularly marshes in the south and thermokarst basins in the north associated with peat plateaus. On aerial photographs shallow open waters are recognized as small pools of water with smooth, to irregular margins that may be distinct or gradational. Mottling on the water surface is not uncommon and is caused by the presence of emergent vegetation. Water bodies with scalloped margins are often found within peatlands. These water bodies are generally not considered to be shallow open waters as they are greater than 2 m in depth and function as aquatic systems.

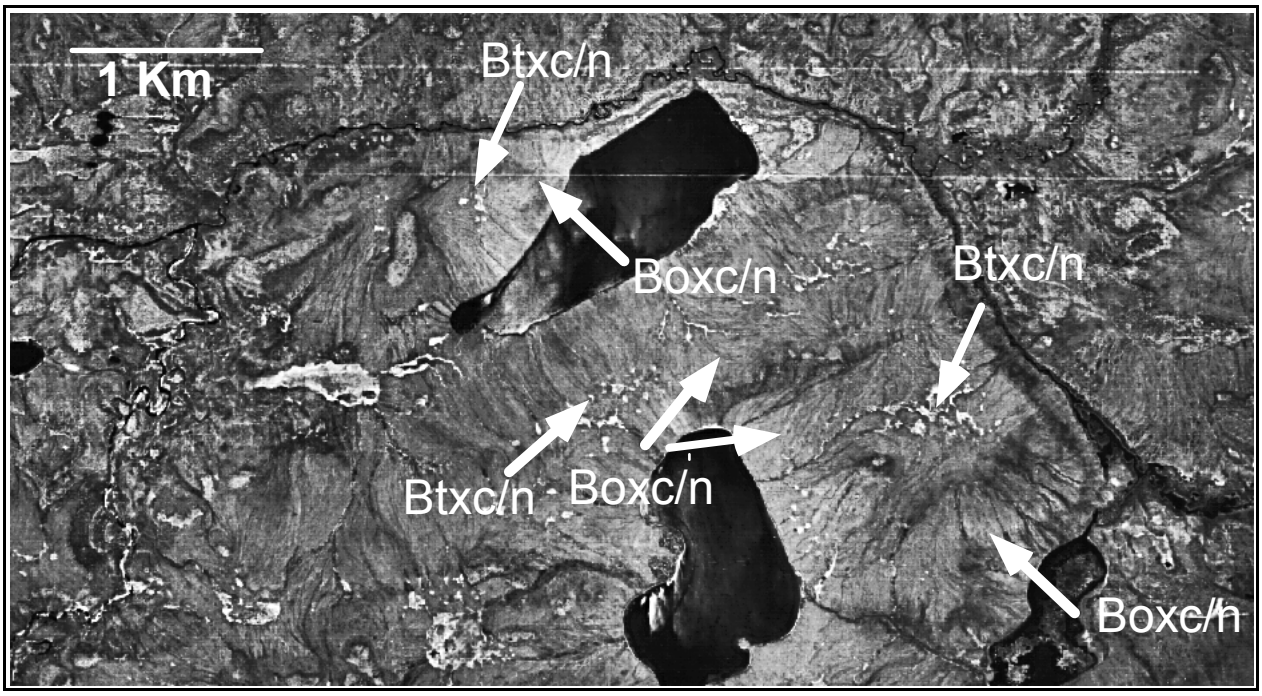

Figure 10. Aerial photograph of veneer bogs (Boxc/n) from the Caribou Mountains, Alberta (59° 25'N and 115° 38'W). The veneer bogs are characterized by their low angle of slope and by the presence of runnels that contain denser, taller trees and mimic drainage patterns. On flat terrain these veneer bogs grade into wooded, permafrost dominated bogs (Btxc/n). Data Source: Vitt *et al.* 1996.

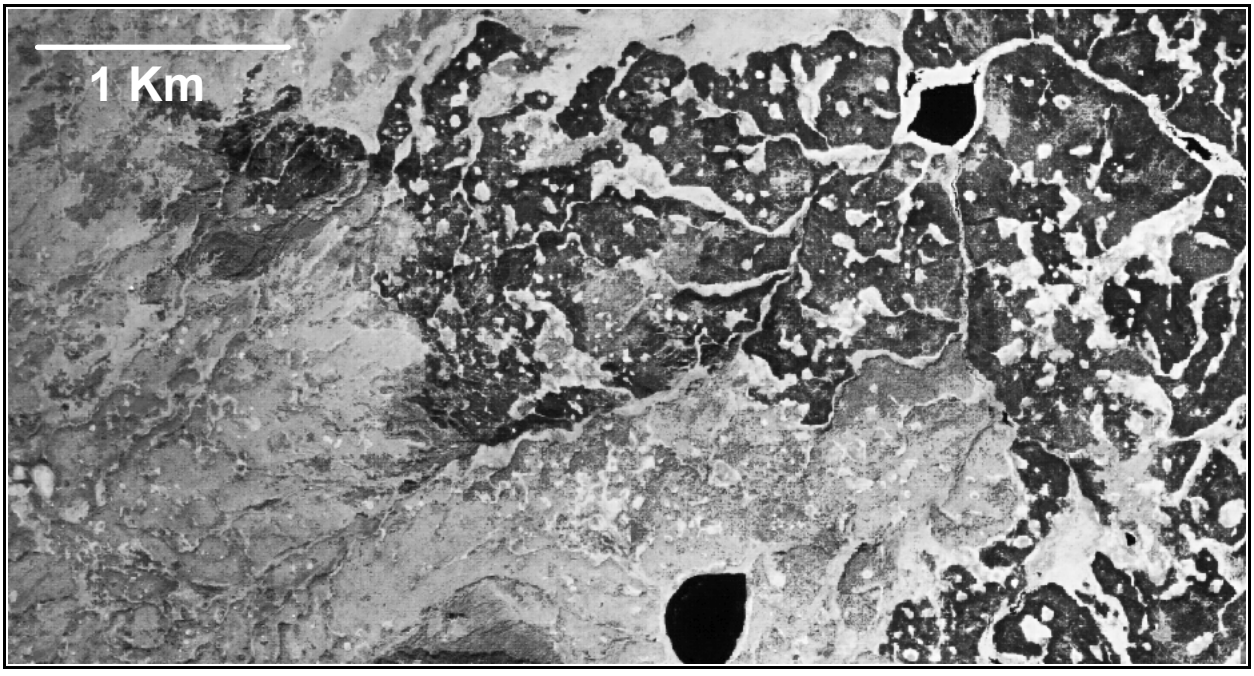

Figure 11. Aerial photograph of an extensive wooded permafrost bog with collapse scars from the Birch Mountains of Alberta (57° 47'N and 112° 31'W). The development of collapse scars represented by the light, bright tones on the photo (or collapse scars) has been in some cases linked to fire (Zoltai 1993). Burned areas (darker tone) have larger collapse scars that have been integrated with drainage resulting from temporary degradation of permafrost. As vegetation is reestablished, permafrost will expand and the collapse scars will decrease in size and surface drainage will become less ordered. Data Source: Vitt *et al.* 1996.

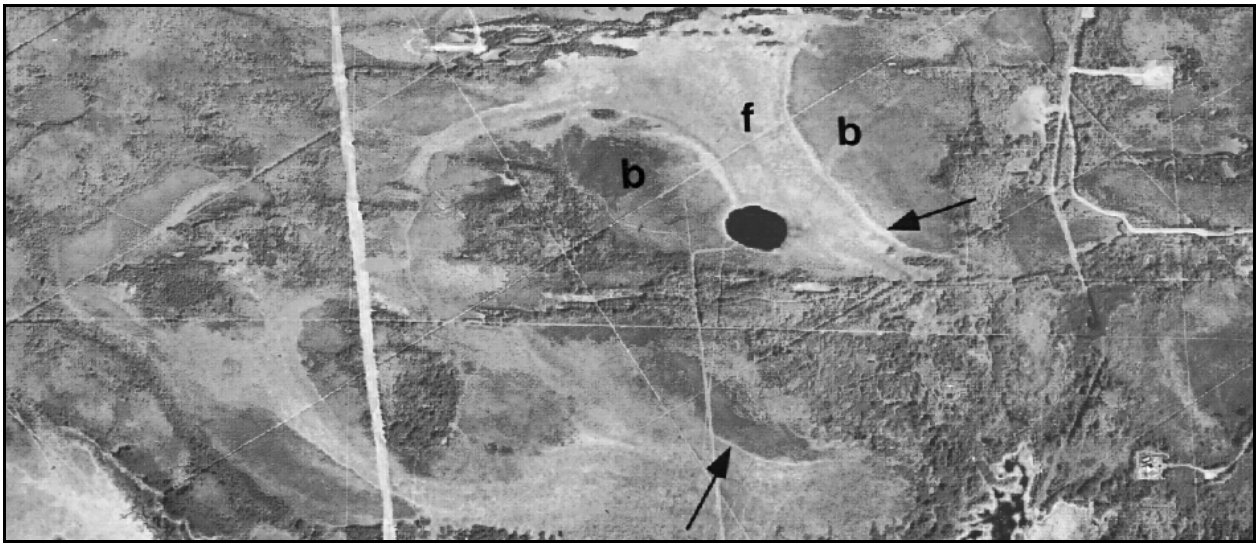

Figure 12. Bog islands with no internal lawns in the area of Grande Prairie, Alberta (54° 02' N and 118° 42'W). These bog islands (b) have developed as peninsulas in areas of water stagnation, within a larger fen (f). Arrows point to wetter, open areas of the fen surrounding the bog margin termed water tracks. Data Source: Vitt *et al.* 1996.

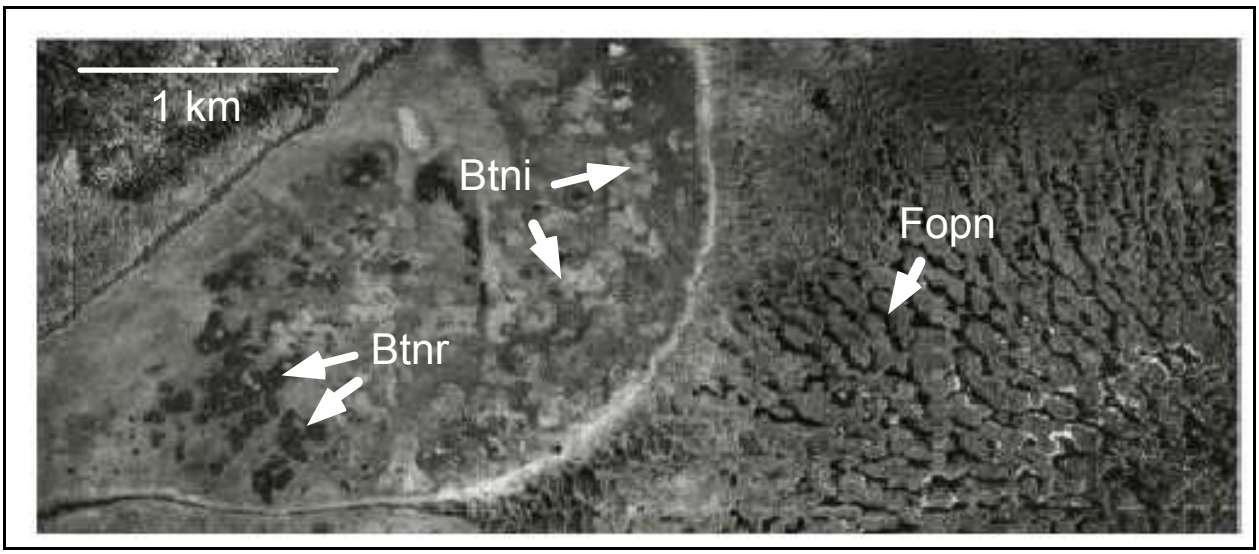

Figure 13. These wooded bogs with areas of forested, permafrost bog and internal lawns (Btnr) are located near McClelland Lake, Alberta on the edge of a large, patterned fen (Fopn) (56° 25'N and 111° 15'W). The slightly elevated bogs lack surface water movement in contrast to the surrounding fen. Darker toned areas within the bog islands represent areas of forested, permafrost bog, while lighter toned areas within the bog islands represent islands of internal lawns. Data Source: Vitt *et al.* 1996.

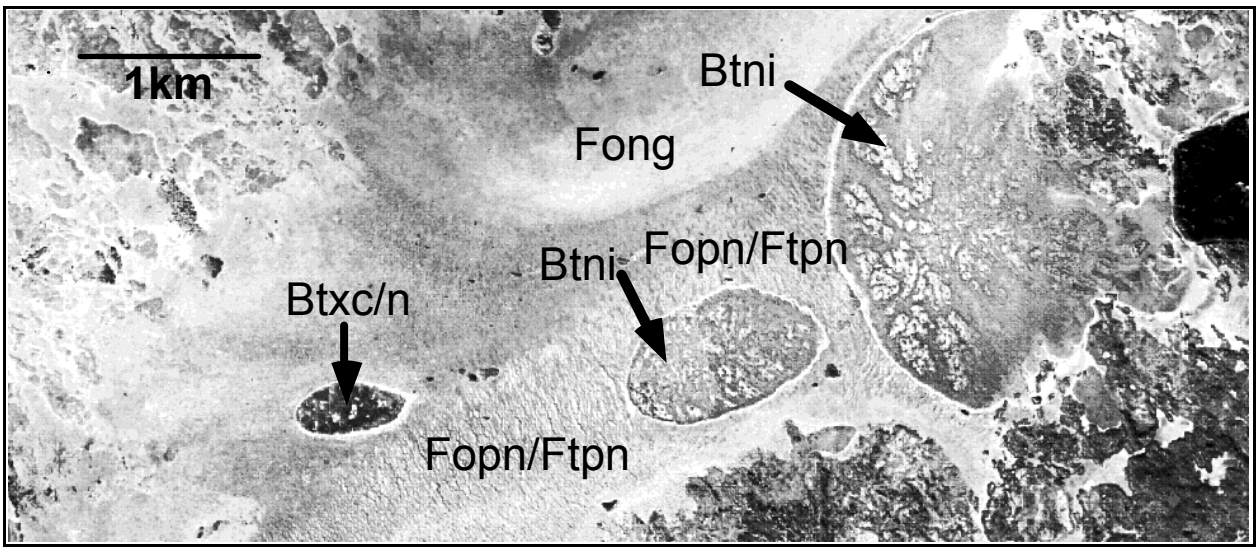

Figure 14. Aerial photograph of wooded bogs with internal lawns (Btni) from eastern Alberta (55° 28' N and 111° 48' W). These bogs are occurring as islands within a larger patterned fen (Fopn/Ftpn). Arrows pointing to the irregularly shaped lighter toned areas are the internal lawns within the bog islands. The most westerly bog island (Btxc/n) still contains a substantial amount of permafrost even at this southerly latitude. Data Source: Vitt *et al.* 1996.

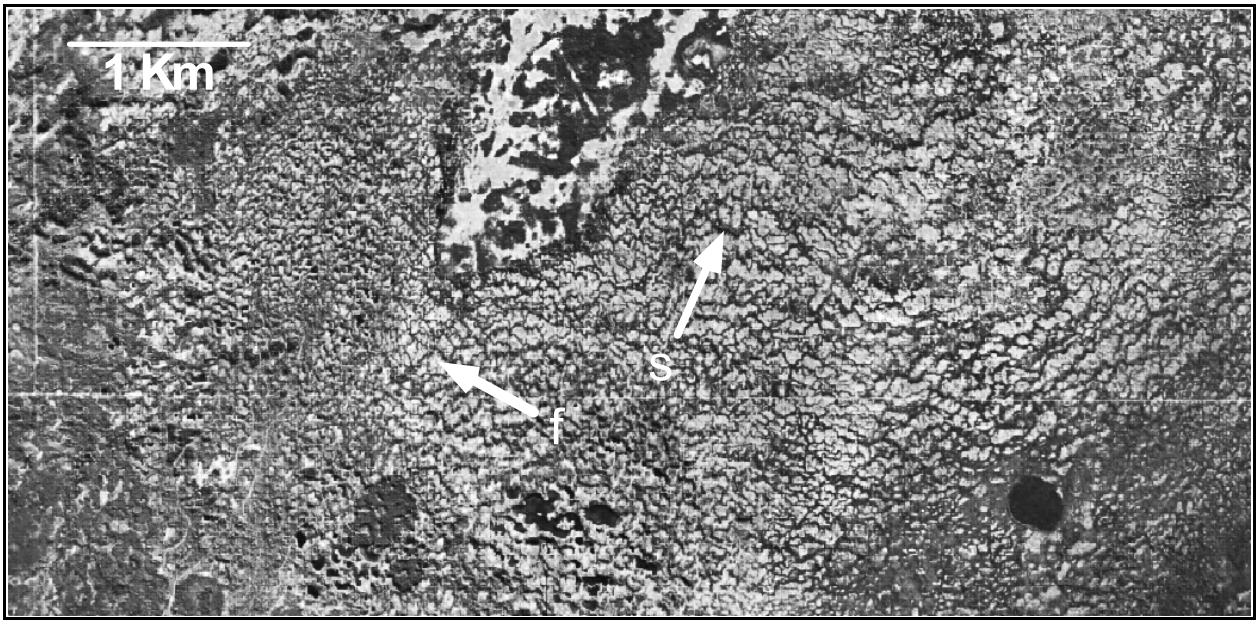

Figure 15. Patterned fen from northwestern Alberta (59° 01' N and 118° 23' W). The patterned fen has a reticulate pattern of dry strings (s) and wet flarks (f). In some cases permafrost has developed in the strings resulting in the formation of small, linear wooded permafrost bogs. Data Source: Vitt *et al.* 1996.

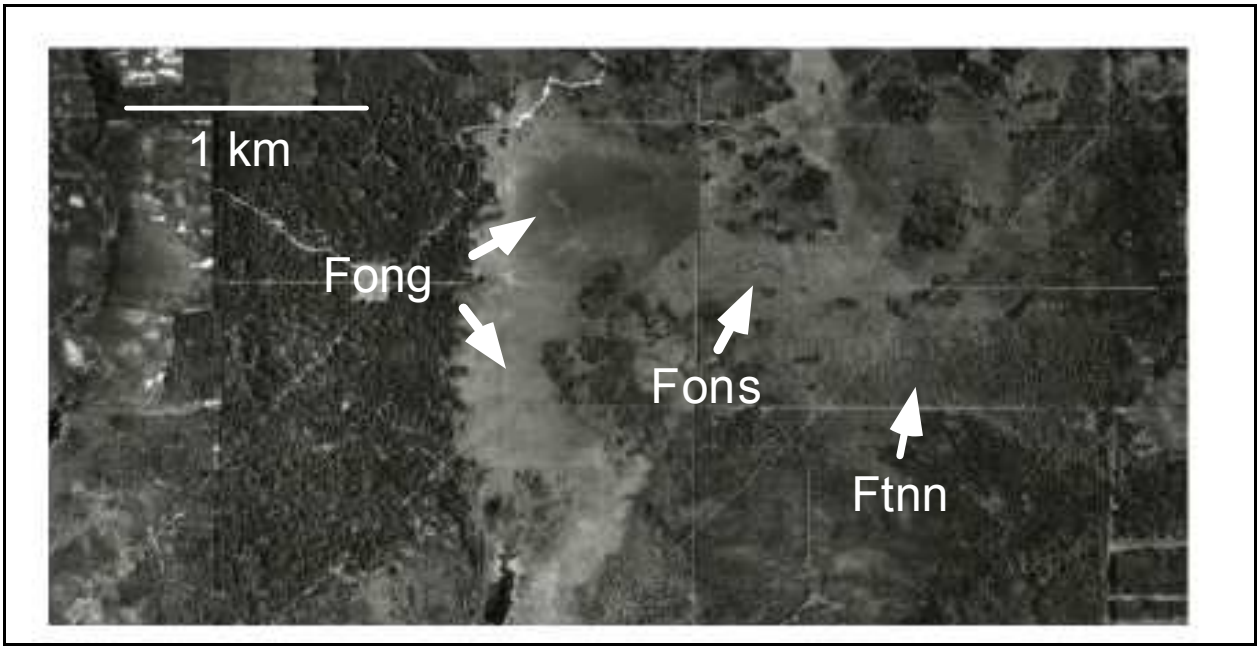

Figure 16. Open, shrub-dominated (Fons) and graminoid-dominated (Fong) fens, and a tree-dominated (Ftnn) fen from central Alberta (54° 37' N and 113° 48' W). Data Source: Vitt *et al.* 1996.

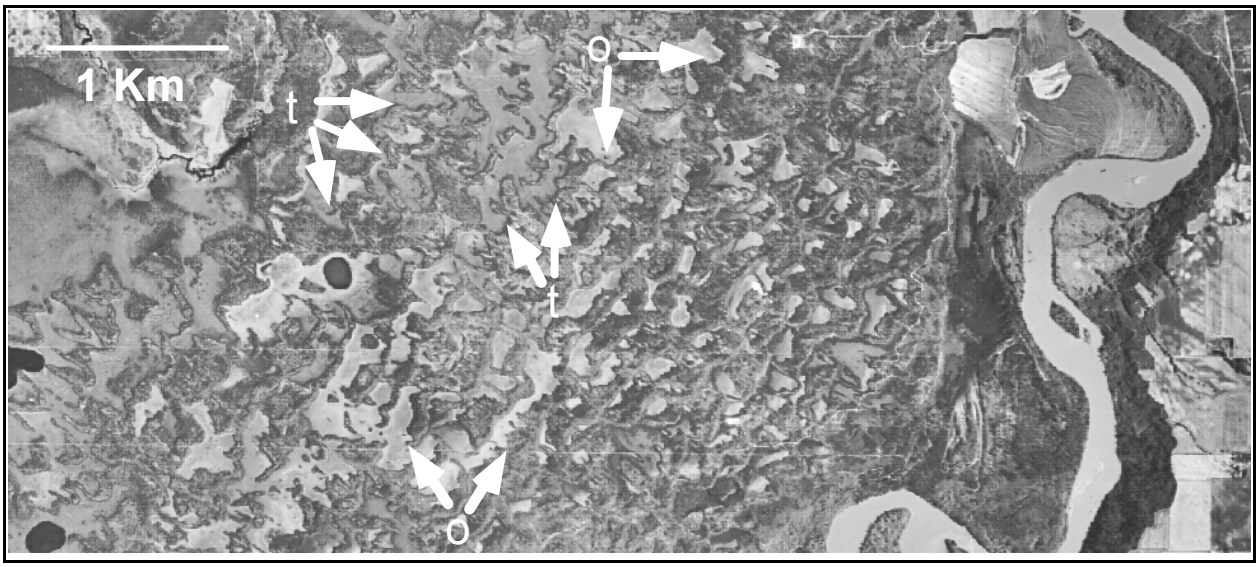

Figure 17. Fens within a dune complex located along the Athabasca River (54° 23' N and 115° 27' W). Light toned peatland areas consist of open, graminoid-dominated fens, while darker peatland areas are wooded fens with no internal lawns (t). Data Source: Vitt *et al.* 1996.

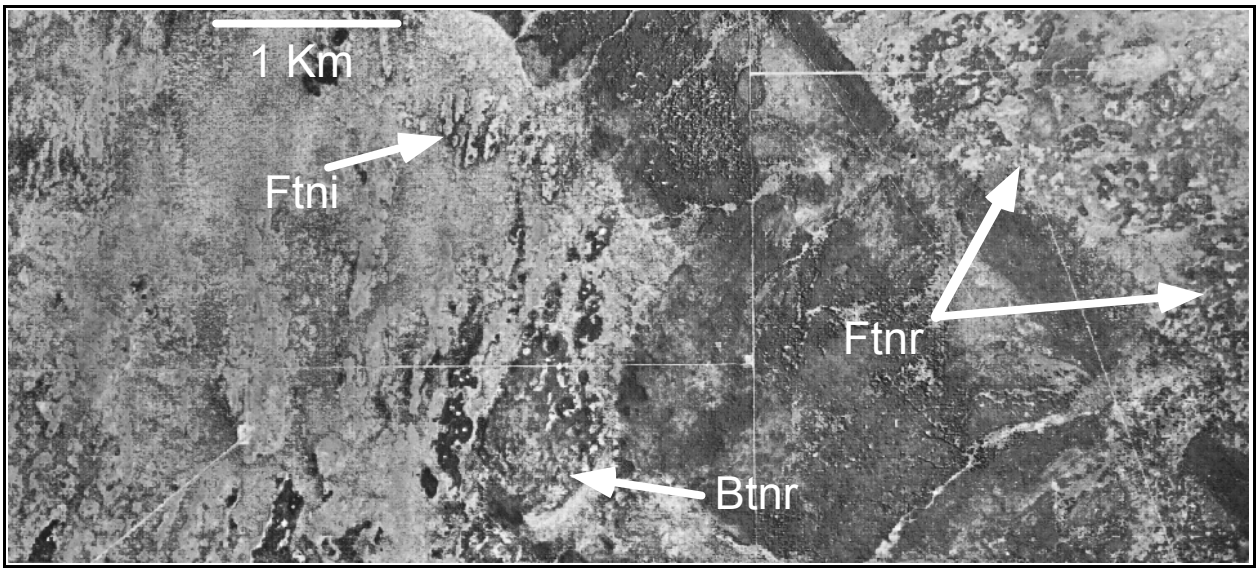

Figure 18. Aerial photograph of a peatland complex from central Alberta 56° 33’ N and 112° 32’ W. This peatland is composed of a wooded fen with areas of forested peat plateau and internal lawns (Ftnr), areas of wooded fen with internal lawns (Ftni) and wooded bogs with forested peat plateau and internal lawns (Btnr). Data Source: Vitt *et al.* 1996.

Table 10 below describes the similarities and differences in the wetland descriptions as provided by the Peat Taskforce and the National Wetland Working Group.

Table 10. Comparison of wetland forms used in this report to wetland forms of the NWWG (1988).

Peat Taskforce wetland forms	National Wetland Working Group Forms
Bogs	
Veneer bog bogs with or without collapse scars (Boxc/n)	Veneer bog
Wooded to forested permafrost bog with or without collapse scars (Btxc/n)	Wooded peat plateau, palsa bog, and collapse scar bog
Wooded bogs with forested peat plateaus and internal lawns (Btnr)	Basin bog, flat bog, northern plateau bog, floating bog, mound bog, and shore bog
Wooded bogs with internal lawns (Btni)	Basin bog, flat bog, northern plateau bog, floating bog, mound bog, and shore bog
Wooded bogs with no internal lawns (Btnn)	Basin bog, flat bog, northern plateau bog, floating bog, mound bog, and shore bog
Fens	
Patterned fen (Fopn/Ftpn)	Northern ribbed fen, net fen, channel fen, horizontal fen, ladder fen, and spring fen
Nonpatterned, open, shrub-dominated fen graminoid-dominated fen (Fons)	Basin fen, channel fen, horizontal fen, slope fen, and stream fen
Nonpatterned open graminoid-dominated fen (Fong)	Basin fen, channel fen, collapse scar fen, floating fen, horizontal fen, spring fen, shore fen, and stream fen
Nonpatterned, wooded fen with forested peat plateau and internal lawns (Ftnr)	Horizontal fen, channel fen, and stream fen
Nonpatterned, wooded fen with internal lawns (Ftni)	Horizontal fen, channel fen, and stream fen
Nonpatterned, wooded fen with no internal lawns (Ftnn)	Horizontal fen, channel fen, and stream fen
Marshes	
Marsh (Mong)	Active and inactive delta marsh channel marsh, floodplain marsh, kettle marsh, seepage track marsh, shallow basin marsh, shore marsh, stream marsh, and terminal basin marsh
Swamps	
Coniferous Swamp (Sfnn/Stnn)	Floodplain swamp, peat margin swamp, shore swamp, basin swamp, and stream swamp
Deciduous Swamp (Sons)	Floodplain swamp, peat margin swamp, shore swamp, basin swamp, and stream swamp
Shallow Open Water	
Shallow Open Waters (Wonn)	Channel water, delta water, kettle water, oxbow water, shore water, stream water, terminal basin water, and thermokarst water

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Arthropods

General Review of Arthropods of the Boreal Forest

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Overview: Arthropod Diversity

Invertebrates comprise 80-95% of the world's described species (Wilson 1992). Close to 1 million arthropod species have been described but this is surely less than half the total species richness as estimates range from 5 to 80 million extant species (Wilson 1988; Erwin 1988; Stork 1988). This illustrates both the ecological importance of arthropods and human ignorance. There are approximately 34,000 described species of terrestrial arthropods in Canada (Danks 1993*a*). We have described approximately 1/2 of the total fauna suggesting there may be as many as 67,000 extant arthropod species in the country (Danks 1993*a*).

Taxonomic knowledge of terrestrial arthropods in Canada varies immensely by group (Table 11). The two main arachnid groups represented in Canada are the mites and ticks (Order Acari), and spiders (Order Araneae). Although the spider fauna is well known in Canada, the Acari are poorly understood even though they play important ecological roles in soil. Of the dominant insect orders, only the beetles (Order Coleoptera), moths and butterflies (Order Lepidoptera), and true bugs (Order Hemiptera) are reasonably well understood taxonomically. These estimates are based on adults; we know even less about the early life stages of arthropods. It is suggested, for example, that less than 5% of the early stages of Hymenoptera, 10% of the early stages of beetles, and 4.5% of the early stages of mites and ticks are known (Danks 1993*b*). Life history, ecology, feeding habits, and behavior of arthropods have been well studied for insects of economic importance (e.g. spruce budworm, tussock moth, bark beetles, and forest tent caterpillar), but these characteristics are poorly known for the majority of forest arthropods.

The boreal forest occupies over 2.6 million km^2 in Canada. The forests in this region are primarily coniferous to the north with large regions of aspen-dominated patches further south. This region is characterized by strong seasonal variation with short, warm, moist summers and long, cold, dry winters. The boreal zone shows extreme spatial and temporal heterogeneity with a wide range of microhabitats suitable for a diverse arthropod fauna (Danks and Foottit 1989). There are 12,000 named insects in the boreal zone of Canada, and estimates suggest there are ~22,000 insect species in this region (Danks and Foottit 1989).

Table 11. Number of species and state of knowledge of selected groups of terrestrial arthropods reported from Canada. Data Source: Danks 1979, 1993a.

Group	Common Name	Estimated percentage of Canadian species known	Number of species known
Acari	mites and ticks	20	1,915
Araneae	spiders	90	1,256
Coleoptera	beetles	74	6,748
Diptera	flies	49	7,058
Lepidoptera	moths and butterflies	70	4,692
Hymenoptera	bees, wasps, ants	36	6,028
Hemiptera	true bugs	73	3,079
All terrestrial arthropods		51	33,755

The Importance of Arthropods in Forest Ecosystems

Arthropods are crucial to the functioning of forest ecosystems. They play dominant roles in key ecological processes; arthropods are decomposers, consumers, predators and parasites. They inhabit every conceivable niche and fill numerous functional roles important in sustaining a healthy forest.

Beneath the forest floor, arthropods contribute to nutrient cycling, litter decomposition and maintenance of soil structure (Price 1973; Petersen and Luxton 1982; Spence 1985). Continual decomposition of plant and animal matter is essential to recycling organic material in forests. Large predatory spiders and beetles can exert a stabilizing influence on their prey, and they can help reduce populations of potential forest pests (Gertsch 1979; DeBach and Rosen 1991). Parasitoids are also essential in forests as many Hymenoptera are known to parasitize economically important insect pests (DeBach and Rosen 1991). Even "pest" insects such as some defoliators are vital to forests as their population fluctuations and periodic outbreaks may in turn help regulate forest primary production (Mattson and Addy 1975).

Highly valued forest vertebrates, such as birds and bears, also depend on arthropods. Insectivorous birds depend on arthropods as a food resource. Other birds and many mammals depend on insect-pollinated plants for food and shelter, and hence are indirectly influenced by arthropods.

Arthropod Sampling

Arthropods can be sampled by a variety of techniques. Pitfall traps are commonly used for ground and litter-dwelling species. These traps are usually plastic containers sunk into the ground containing insect preservative. They are accommodated with a roof to prevent flooding during heavy rain. Pitfall traps (often 6 to 12) are usually placed along a transect in a forest, with several transects in each stand. It is difficult to sample insects quantitatively in certain habitats such as coarse woody material (CWM). One technique is to rear insects from wood sections cut from snags and logs. Another is to place window traps on the boles of snags and measure insect activity associated with the snag. Other techniques, such as light trapping, sweeping, beating, collections by hand, and pheromone traps, are also commonly employed to catch arthropods.

Case Studies of Arthropods in the Boreal Forests of Alberta

Below are three case studies relating to arthropods in the boreal forests of Alberta. These case studies are based on past and on-going research at the University of Alberta and the Canadian Forest Service on arthropod communities throughout the province (Figure 19). These studies attempt to understand how arthropods are influenced by various disturbance regimes, and whether arthropod communities are sensitive to changes in spatial scale. Although not all of these studies fall within the DMI forest management area, inferences can be drawn from this work that are applicable to many parts of the boreal forest in Alberta.

Figure 19. Map of Alberta showing approximate locations of the insect case studies.

Spider Succession in Fire- and Harvest-Origin Aspen-Mixedwood Stands

Spiders are characterized by their eight legs and two body parts (cephalothorax and abdomen). Spiders in Alberta range in size from 1 mm to 25 mm and colour from dull grey to bright orange and yellow. They occupy virtually all habitats from the riparian zones along forest streams to high altitude scree slopes to human buildings. Spiders rank seventh in global diversity with 34,000 described species worldwide (Coddington and Levi 1991). A local study suggests there may be 300-400 species living in the boreal zone in Alberta (Buckle and Holmberg 1989). Spiders are ubiquitous and range in density from 0.64 to 842/m^2 (Turnbull 1973).

Spiders are well known taxonomically, easily sampled, and have well known life history characteristics as most are true generalist predators. Spider communities are often placed in guilds based on their predatory behavior as some species rely on webs to capture prey and others hunt without the use of silk. For these reasons spiders have been used as an indicator taxa for assessing the effects of human-caused disturbance on ecosystems (Huhta 1971; McIver *et al.* 1992).

This case-study is part of a large inter-disciplinary project called the Fire and Harvest Residual Study initiated in 1995 by the Alberta Research Council. This study is designed to test how the regeneration of aspen-mixedwood forests in northern Alberta is influenced by harvesting compared to the natural course of succession following wildfire. It is believed that wildfire disturbance patterns can act as a guide for producing more ecologically sound harvesting patterns (Hunter 1993). Spiders can be used as an indicator for assessing how the succession of aspen forest is influenced by stand origin. The null hypothesis states that no faunal differences exist in stands originating from wildfire compared to harvesting one, 14, and 28 years following disturbance. These preliminary results are based on unpublished data from the first two years of the project and caution must be used when interpreting the results as the research is on-going.

Twelve aspen-dominated (*Populus tremuloides* Michx. represent greater than 80% of stems) stands were chosen for this research and are in the vicinity of Slave Lake, Calling Lake, Red Earth Creek, and Fort McMurray (Figure 19). Six stands are fire-origin and six stands are harvest-origin and represent three age classes: 1 year, 14 years, and 28 years. Spiders were sampled using pitfall traps.

A preliminary total of ~7,400 spiders from 12 families and over 100 species were collected in 1996 and 1997. Three of these species are undescribed and considered new to science. The wolf spiders (family Lycosidae) were numerically dominant, representing 44% of the total catch. The spider family Linyphiidae (small sheet-web spiders) were the most diverse with at least 40 species represented.

Preliminary results from year one are presented below. The spider fauna shows a clear succession in both fire- and harvest-origin stands (Figure 20). Young stands are dominated by wolf spiders (family Lycosidae) and as the stands age the fauna is represented by an increasing proportion of other spider families. In particular, the family Linyphiidae come to represent a larger proportion of the community. This is expected as spiders from this family are known to prefer older forests providing numerous microhabitats in the leaf litter and forest floor not found in young stands (Huhta 1971). These spiders build small sheet webs in structurally complex litter while active, fast-moving wolf spiders prefer open habitats. It is believed that female wolf spiders selectively search warm sunny areas to hasten development of their egg sacs (Edgar 1971).

There are also differences between the spider communities in one year stands originating in harvest compared to one year stands originating in wildfire. Early pyrogenic stands are completely dominated by wolf spiders where as young harvest stands support a relatively large percentage of linyphiid spiders (Figure 20). This suggests the linyphiid spiders are unable to re-colonize one year fire-origin stands as readily as one year harvest stands. Those Linyphiid spiders that are deep in the organic layer may survive winter harvesting events; a wildfire, which can complete remove the organic layer, may destroy soil and litter-dwelling linyphiid species and their habitat.

The importance of habitat heterogeneity for spiders is evident when habitat preferences for certain species are investigated. *Pardosa moesta*, and *P. fuscula* are found primarily in early harvest stands and *P. hyperborea* and *P. uintana* prefer young wildfire stands. *Allomengea dentisetis* is present in all ages of harvest-origin stands but it does not appear in stands originating from wildfire until 14 years after disturbance. *Bathyphantes pallidus* and *Lepthyphantes intricatus* show preferences towards 14 and 28 year old stands corresponding to increased habitat heterogeneity. Spiders operate on a small scale (i.e.,10-15 m) and changes in microhabitat conditions such as vegetation architecture, litter complexity, humidity, moisture, exposure, and temperature significantly influence species distributions (Reichert and Gillespie 1986; Uetz 1991).

Comparisons of diversity and abundance suggest harvested stands support higher numbers of spiders, but are generally less diverse than wildfire stands. Cluster analysis and ordination analysis suggest that early pyrogenic

spider communities are quite distinct from the fauna in other stand types. The spider fauna from wildfire and harvested stands do become more similar as stands age and the striking differences observed in young stands are less in older stands.

Summary

All of the above case studies demonstrate that the distribution of different stand age classes and residual patches after harvesting and fire affect how insects and spiders orient themselves across the landscape. The dispersal of arthropods into suitable habitats depends on the proximity of patches to one another and to adjacent residual forest stands. For example, old-growth beetle species can disperse to forest fragments provided the forest patches are close together, large enough (i.e. not entirely edge), and are not out-competed by other species. Spiders also depend on adjacent forests and residual patches as these habitats are sources for re-colonization of open areas following harvesting and wildfire.

As with fire, forest harvesting dramatically changes arthropod communities. Although diversity and abundance often increase, dominance patterns and community structure are altered. In the Hinton area, 10 species of carabids steadily decreased in abundance following logging to the point where they were absent in regenerating stands. Edges created by forest harvesting affected some carabid species but there were no clear patterns observed. Studies of beetles in lodgepole pine forests and spiders in aspen-mixedwood stands show the fauna follows a definable trajectory following disturbance. Faunal succession is dependent on disturbance type, taxa, and forest type.

Is spatial scale important for arthropod communities? The case studies suggest that arthropods respond to different structural characteristics of forest stands at different spatial scales. For instance, the saproxylic beetle fauna at Eureka River is quite different from that found at Lac La Biche. This may be due to topography and the distribution of stand ages and stand types. Stand age characteristics (floral composition, tree volume, canopy closure, litter development, etc.) further determine habitat availability. These habitats are subdivided into microhabitats and this is the level at which beetles and spiders operate. Since different species have different microhabitat requirements, arthropod communities depend on variation at this level, and all of the structural characteristics of forests across spatial scales are interdependent.

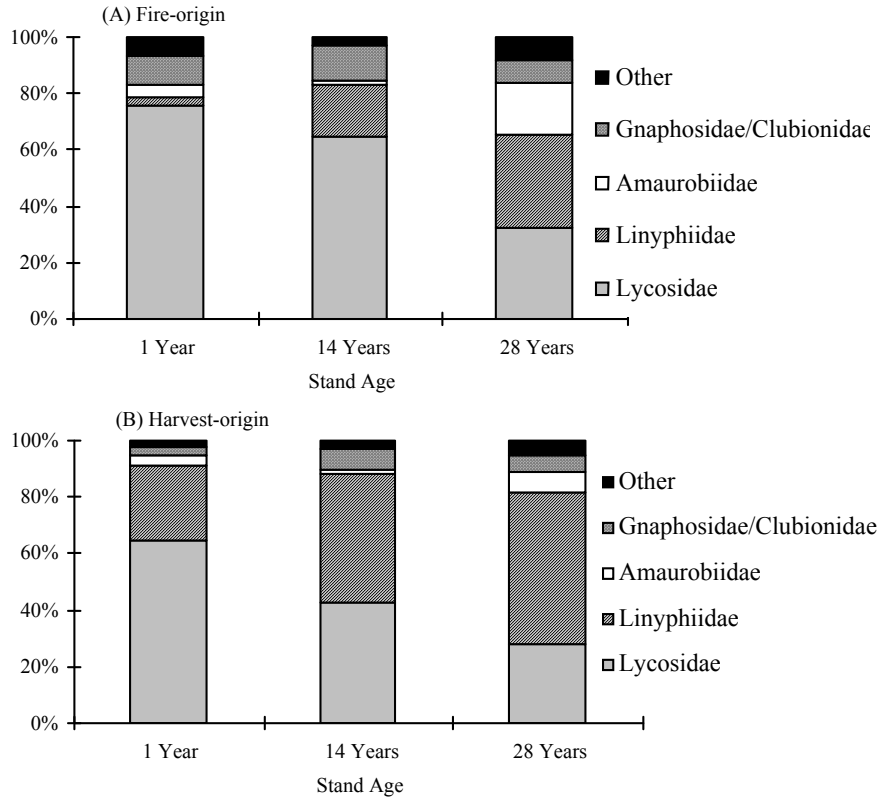

Figure 20. Frequency (percent) of dominant spider families (1996 data) by A) stand age; Fire-origin, and B) Harvest-origin.

Edge and Patch Dynamics: Ground Beetles from Lodgepole Pine Forests

Ground beetles, members of the family Carabidae, range in size from a few millimetres to several centimetres, are generally black but have members that are iridescent or metallic colored, and are fast runners and generally good flyers (however, there are species that have different wing morphs or lack wings entirely). Ground beetles are known to inhabit many different microhabitats such as stream edges, bogs and marshes, decaying organic matter, and are common in soil and leaf litter. Ground beetles are mainly generalist predators, feeding on a wide variety of other invertebrates, but there are also opportunists that have been found scavenging in carrion and other ephemeral habitats. Carabids are ideal for environmental monitoring because they are relatively well known taxonomically and ecologically, they include species that are endemic to localized areas and are sensitive to habitat disturbance, they have large populations, and they can be sampled inexpensively and stored indefinitely for future study. Therefore, ground beetles have been used widely as bioindicators of habitat disturbance in many different countries (e.g. Arnoldi and Matveev 1973; Lenski 1982; Holliday 1984; Desender and Turin 1989; de Vries and den Boer 1990).

A study of the effects of forest harvesting on ground beetle assemblages from mixed lodgepole pine-white spruce stands was conducted in the Hinton and Swan Hills areas (Figure 19), and is reported in Niemelä *et al.* (1993) and Spence *et al*. (1996). The hypothesis tested was that changes in carabid assemblages are most pronounced in recent clear cut areas and that the resemblance of the fauna to that of mature forest increases as succession proceeds. To study the effects of harvesting, ground beetles were sampled from forests ranging in age from one year to 27 years post harvest and compared to stands greater than 80 years since the last fire. To study edge effects the beetle fauna from 2 year old cutblocks, the stand-cut interface, and residual blocks of old-growth lodgepole pine were compared.

Ground beetles respond to edge and forest fragmentation. Niemelä *et al.* (1993) found that ground beetle diversity was highest in the recent cut areas, however, abundance was similar between recent cutblocks and some mature stands (Figure 21). If edges are included in the analysis (Spence *et al.* 1996), cut areas were similarly highest in species diversity, however, edges had higher diversity than adjacent forest. Highest beetle abundance was recorded from clear-cut areas, followed by the adjacent old-growth forest, and then along the edge.

A major finding was that dominance structure of carabid assemblages changed considerably after cutting. The five most numerous species accounted for a significantly lower proportion of the sample in regenerating stands than in mature stands. These results were further confirmed in a cluster analysis which showed that replicates of the same stand ages formed pairs (Figure 22), and assemblages in the three youngest age classes (1,2 and 9-10 years) were more similar to those from mature stands than from older regenerating stands. In addition, two species showed clear preferences for the cutblock/forest edge (Figure 23). Three species caught in the highest numbers in the cutblocks were also commonly captured to the interior limit of the trapping in forest (Figure 24a). Some species designated as forest specialists were also captured with a higher than expected frequency in the cutblocks (Figure 24b and c), suggesting that some forest specialists can maintain populations in cutblocks for up to 2 years post-harvest. However, many of these species are likely to be lost by 10 years post harvest due to a reduction or loss of suitable habitat structure.

To summarize, carabid assemblages of the regenerating stands differed from those of mature stands; the pattern of similarity of beetle assemblages in mature stands was more complex than in regenerating stands reflecting its more diverse habitat structure.

Carabid beetles respond to logging in different ways. Although species richness and abundance often increased after harvesting, faunal dominance and structure changed considerably. There are a group of beetle species designated as forest generalists, whose populations were not detrimentally affected by forest harvesting. A second set of species, designated as open-habitat specialists, generally increased in richness and abundance in the more open regenerating stands. A third set of species, the forest specialists, however, are very sensitive to habitat change. Populations of many of these species, such as *Carabus chamissonis* Fisch., *Leistus ferruginosus* Mnh., and *Nebria intermedia* V.D., often declined precipitously after harvesting; an additional seven species showed a steady decrease in population size and were absent 9 years following logging.

Landscape effects, such as fragmentation, reduce area of suitable habitat and break up remaining habitat into small fragments. Furthermore, patch edges play a role in how carabid communities arrange and distribute themselves, but these responses are variable and difficult to interpret. These findings are reflected in the differences in beetle faunas north and south of Hinton. Sites south of Hinton have been logged for over 30 years, whereas logging north of Hinton is adjacent to undisturbed, old-growth forest. Source patches of mature forest south of Hinton may be too small to support populations of old-growth carabids, or dispersal capabilities of these carabids may be limited by large inter-patch distances. Sites north of Hinton, being directly adjacent to undisturbed old-growth forest, still promote movement of old-growth carabids between patches. However, carabid assemblages from old-growth forests

tend to be different from those of older regenerating stands, where movement of open-habitat species into regenerating and adjacent mature forest compartments alters community structure. An additional concern is the loss of those species with reduced dispersal abilities. Some flightless forest specialists are missing from regenerating stands, and this response could lead to cumulative losses over large landscapes.

It should be noted that not all carabid species designated as old-growth specialists in lodgepole pine forests are old-growth specialists in other forest types. For example, four old-growth specialists in lodgepole pine forests did not show similar specialization in old-growth aspen stands near Lac La Biche (Spence *et al.* 1996). Thus, apparent specialization in old-growth is not a species characteristic but appears to result from some interaction between a species and certain forest characteristics.

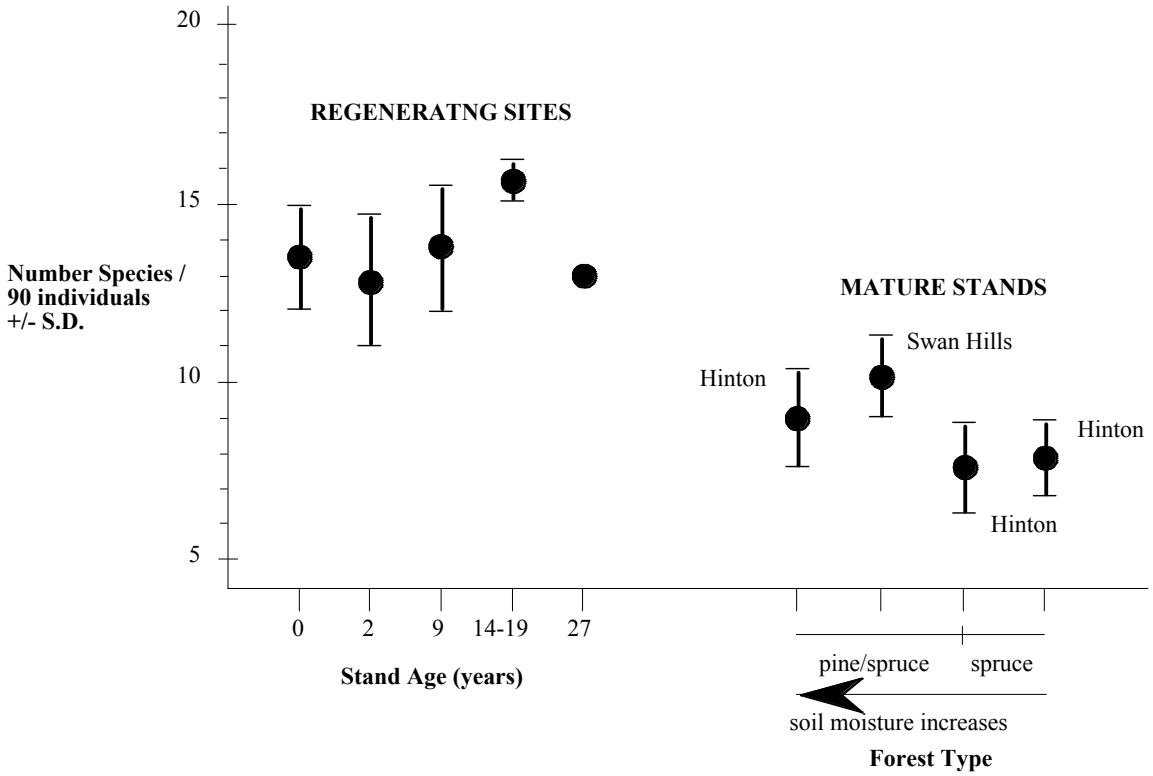

Figure 21. The number of species per 90 individuals (total captured in the 27-year-old sites in 1990) estimated by rarefaction in the eight other forest types. Data from 1990 was used for 9- to 27-year-old sites and for the mature stands, and data from 1991 for 1- to 2-year-old sites. The stands labeled as Hinton and Swan Hills are the mature stands (i.e. >80 years-old). Data Source: Niemelä *et al.* (1993).

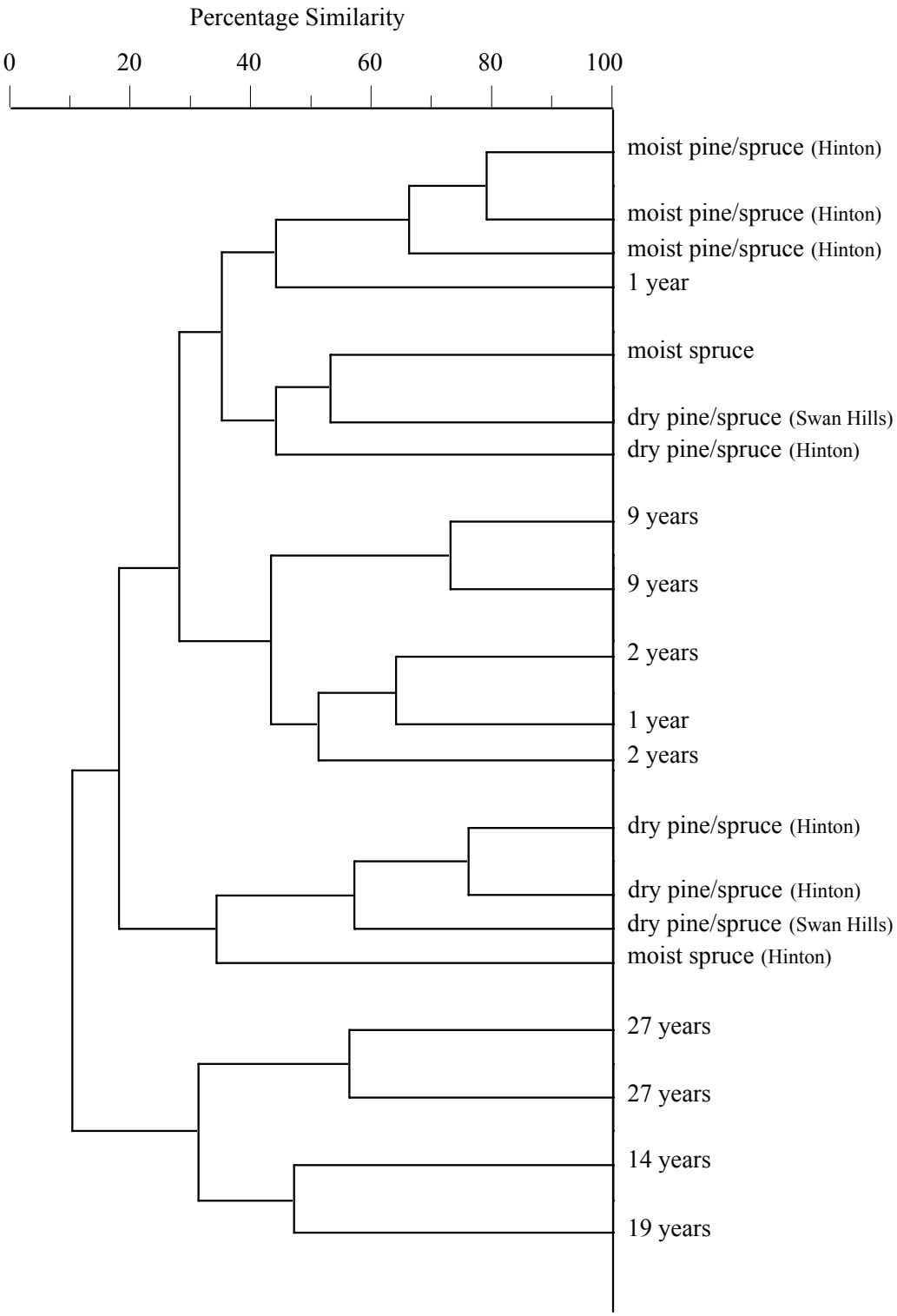

Figure 22. A cluster analysis of the carabid assemblages at all sites, based on the Bray-Curtis index of percentage similarity. The total data from the sites were used. The stands labeled as Hinton and Swan Hills in brackets indicate mature stands (i.e. >80 years-old.). Data Source: Niemelä *et al.* (1993).

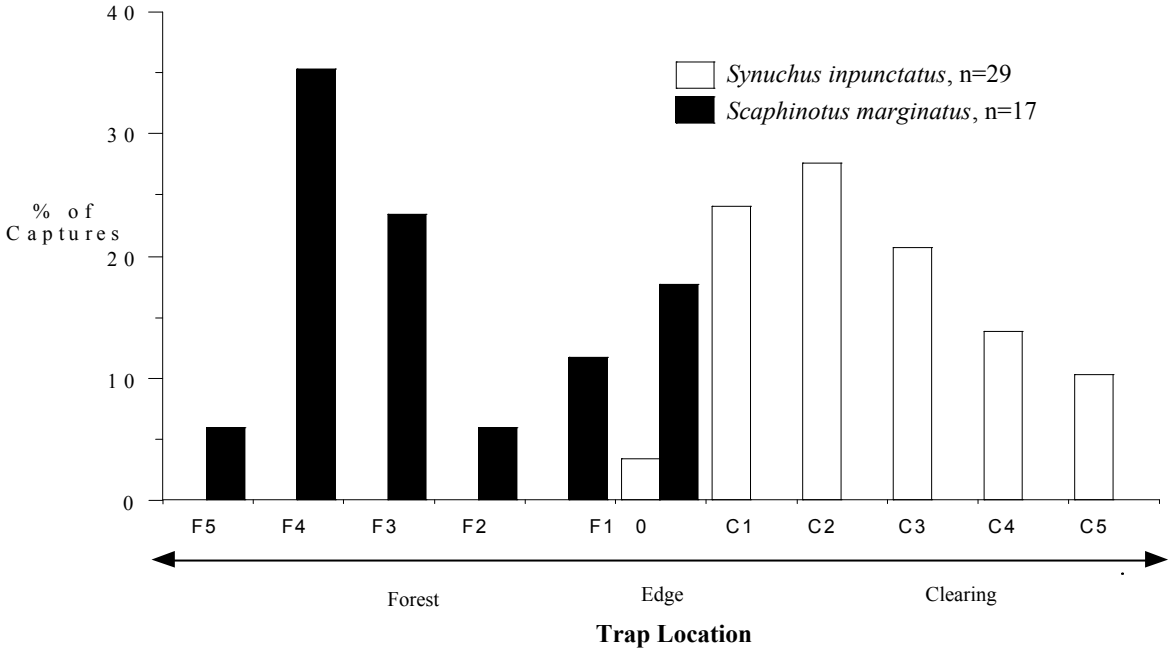

Figure 23. Captures of *Synuchus impunctatus* and *Scaphinotus marginatus* in relation to forest edge. Percentages were calculated over five traplines. Data Source: Spence *et al.* (1996). (F=forest, C=clear-cut, 0=stand edge, 1=5m, 2=10m, 3=20m, 4=40m, 5=80m).

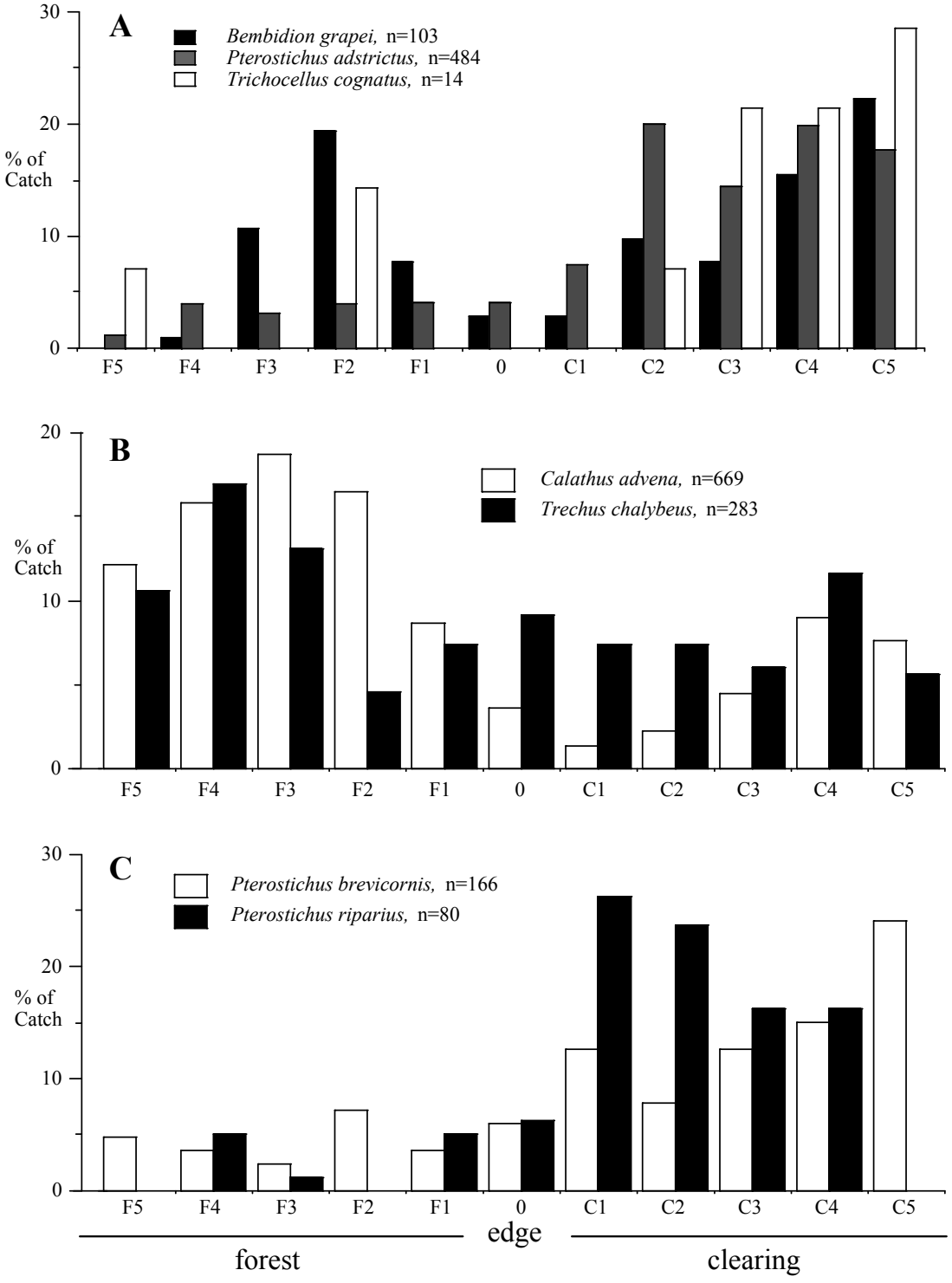

Figure 24. Captures of open-habitat specialists (A) and old-growth specialists (B and C) in relation to forest edge. Percentages were calculated over five traplines. Data Source: Spence *et al.* (1996). (F=forest, C=clear-cut, 0=stand edge, 1=5m, 2=10m, 3=20m, 4=40m, 5=80m).

Spatial Scales and Saproxylic Coleoptera in the Aspen-Mixedwood

A saproxylic beetle is one that is dependent during some part of its life cycle upon wood, phloem or bark of moribund or dead trees (standing or fallen), wood-inhabiting fungi, or the presence of other saproxylics in mutualistic, symbiotic, predatory or parasitic relationships (Speight 1989). This encompasses a large and diverse beetle fauna, with species ranging from less than a millimetre, to many centimetres in size. These species are largely involved in the decomposition of woody material, and the subsequent return of these nutrients back to the soil. Saproxylic species have been shown to be profoundly affected by habitat fragmentation due to forest management, agriculture, oil and gas exploration and other human activities (Heliövaara and Väisäinen 1984, Speight 1989, Väisäinen *et al.* 1993, Siitonen 1994, Siitonen and Martikainen 1994). However, little information about this community is available from Canada. Only a few studies on saproxylic insect guild structure (Pielou and Verma 1968) or the taxonomy and biology of pest taxa (Bright 1976, 1987) have been completed.

In response to concerns about ecological effects of large scale harvest of aspen in Alberta's boreal forest, a study was set up to describe the saproxylic invertebrate fauna associated with *Populus* CWM, and to investigate how this fauna varies across different spatial scales such geographic regions, stand ages, degree of wood decay, and type of CWM (snags and logs). Results of this research are reported in Hammond (1996, 1997) and Spence *et al*. (1997).

Beetle communities associated with *Populus* CWM were sampled at two sites in north-central Alberta, near Touchwood Lake east of Lac la Biche and north of Fairview near Eureka River (Figure 19). These sites are dominated by trembling aspen, but also include white and black spruce, balsam poplar, birch and other coniferous trees in lesser amounts. Two stand ages were studied, old-growth or post-rotation age (herein defined as >100 years since last fire), and mature or rotation age (herein defined as 40-80 years since last fire). Three wood decay classes were used to separate wood into minimally decayed (decay class 1), moderately decayed (decay class 2), and advanced decay (decay class 3), based on external characteristics of snags and logs.

A total of 10,833 beetles were collected, representing over 63 families and 340 species. Of these, 257 beetle species were known to be saproxylic and were included in analyses (Hammond 1997). The following spatial scale comparisons are based upon unpublished rearing data only, and caution must be used in interpreting this material as analysis is ongoing.

Regional Comparisons. In general, there was little difference in beetle abundance between regions; however, beetle diversity seemed higher at Lac la Biche (Table 12). Overall, the saproxylic beetle fauna was only 57% similar between the two regions, suggesting that the distributions of species across the landscape is quite varied (Table 12).

Stand Age Comparisons. Beetle abundance seemed higher in wood cut from mature stands than wood cut from old stands, and there was little difference in diversity between the two stand ages (Table 12). Again, the two stand ages were only 50% similar in faunal structure, suggesting that species have stand age preferences (Table 12). These differences may be related to stand age characteristics such as tree size, canopy gaps, and volume of fallen CWM.

Decay Class Comparisons. The abundance of saproxylic beetles appeared highest in decay class 2 and 1 wood, and tended to drop off in decay class 3 wood. Diversity, however, showed a different pattern with diversity highest in decay class 2 and 3 wood, and lowest in decay class 1 wood (Table 12). Although decay classes 2 and 3 clustered together, the similarity between them was only about 53%, suggesting that saproxylic beetles also have preferences for certain levels of wood decay (Table 12).

Snag and Log Comparisons. Snags and logs tended to be similar in the average number of beetles reared from them, however, logs tended to have higher species diversity (Table 12). Again, faunal similarity between snags and logs was quite low, only 59%, suggesting that saproxylic beetles tend to orient themselves with respect to CWM type (Table 12).

Thus, saproxylic beetle species strongly respond to spatial scale. Certain species are unique to one geographic region, stand age, wood decay type, or CWM type. This suggests that these species are sensitive to different structural characteristics of forest stands, and if these particular stand characteristics are lost due to forest fragmentation, these species could disappear.

Other Research Priorities

There are numerous on-going studies of arthropods in the boreal forests of Alberta. One large-scale project titled Ecological Management Emulating Natural Disturbance (EMEND) is further investigating how arthropod communities develop under different disturbance regimes. It is hopeful that this project will provide data on

Lepidoptera, Hymenoptera, Coleoptera, and Araneae. The silvicultural control of spruce budworm is currently underway in spruce dominated mixedwood in north-western Alberta. This project is examining how different forest management techniques influence the spruce budworm, its parasitoid complex, and other non-target groups. The influence of fire-skips as sources of beetle recolonization of burned lodgepole pine stands is being studied near Grande Prairie. Lepidoptera in aspen-mixedwood stands near Lac La Biche have also been studied.

Future research should be directed in the following areas. More base-line data is required for poorly known arthropod groups. The lack of basic taxonomic information about many insect and arachnid groups makes faunistic studies difficult. For instance, soil communities are virtually unknown yet are crucial to forest ecosystems. It should be pointed out that to adequately inventory, monitor, and study ecological requirements of any community, it is necessary to confidently identify the flora and fauna. It is also important to further our understanding of how stand structural characteristics influence both the distribution, diversity, and abundance of arthropods. Are there any sets of stand characteristics that can be used to confidently predict whether particular arthropod species will inhabit an area? In addition, we must ask more process-oriented questions which will shed more light on how arthropods influence boreal forest productivity.

Table 12. Rarefaction (±standard deviation) estimates of species diversity and the mean standardized abundance of saproxylic beetles collected from insect rearings of wood bolts cut from old and mature stands near Lac la Biche and Eureka River, Alberta. Data Source: Hammond 1996.

	Expected Number of Species	Subsample Size	Mean Standardized Abundance	Faunal Similarity (%)
Lac la Biche	108.3±3.8	550	230±23	57
Eureka River	77.7±3.3	550	217±23	
Old Stands	95.9±4.3	550	158±23	50
Mature Stands	95.5±1.9	550	289±23	
Decay Class 1	52.0±3.2	350	247±28	2 & 3=53
Decay Class 2	83.7±3.6	350	251±28	1 & 2 & 3=42
Decay Class 3	79.6±2.2	350	172±28	
Snags	88.0±3.8	550	242±23	59
Logs	99.3±3.3	550	205±23	

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Insects of Economic Interest to the Forest Sector

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Background

The Canadian Forest Service maintained a program of monitoring forest health since the mid-1930s. The Forest Insect and Disease Survey (FIDS) was begun in 1936 and was terminated, following program reviews, in 1996. FIDS was charged with the responsibility of monitoring and documenting the occurrence and impact of major forest pests. Two major components of FIDS were annual ground and aerial surveys, and a pest collection and identification service.

Historically, three major insect pests impact forests in the northwestern region of Alberta. In general, the insect pests tend to be cyclical in nature; epidemics occurring at somewhat irregular intervals and often persisting over consecutive years. A number of other noteworthy pest, such as the decay fungi, tend to be ubiquitous or pandemic.

Spruce Budworm

The most significant softwood pest is spruce budworm (*Choristoneura fumiferana* [Clem.]). The principle hosts of this pest are white spruce (*Picea glauca* [Moench] Voss) and balsam fir (*Abies balsamea* [L.] Mill), although it will also feed on tamarack (*Larix laracina* [Du Roi] Koch) and black spruce (*P. mariana* [Mill.] B.S.P.). The larvae of spruce budworm are voracious feeders often completely defoliating the current year's foliage. Consecutive years of defoliation lead to growth reduction, loss of flower production, top-kill and eventual tree mortality. A typical infestation, as exemplified by the recent infestation near the Chinchaga River, can encompass large areas and cause significant damage.

Forest Tent Caterpillar

The most significant hardwood pest is forest tent caterpillar (*Malacosoma disstria* Hubner). The principle host of this pest is trembling aspen (*Populus tremuloides* Michx.) although other hardwoods species may be attacked once the principle host has been defoliated. Although defoliation due to this caterpillar may be complete, mortality is not common because affected aspen usually produce a second flush of foliage. Generally, damage is limited to growth reduction.

Aspen Tortrix

Another significant hardwood pest is large aspen tortrix (*Choristoneura conflictana* [Wlk.]). The preferred host of the tortrix is trembling aspen (*Populus tremuloides* Michx.) although other deciduous trees such as balsam poplar (*P. balsamifera* L.) and white birch (*Betula papyrifera* Marsh.) may also be affected. The damage inflicted by this insect is similar to that of forest tent caterpillar although the severity and extent is typically less than that experienced with forest tent caterpillar. Rates of growth loss and mortality are likewise less than that attributed to forest tent caterpillar.

Other Species

Other noteworthy pests in the region include hypoxylon canker (*Hypoxylon mammatum* (Wahl.) J.H. Miller), the root rot fungus, armillaria root rot (*Armillaria* spp.), and the decay fungi such as *Phelinus tremulae* (Bond.) Bond. & Boriss and *Peniophora polygonia* (Pres.:Fr.). Although the impact of diseases is comparable to that of insect pests, accurate estimates of mortality and growth loss are lacking. This is due, in part, to the complexity of measuring decay losses and to the often ubiquitous nature of these pests.

Methodology

Aerial surveys, ground surveys and pheromone trap surveys constitute the monitoring and detection program. Aerial surveys for the detection of pest defoliation and/or damages have been completed by CFS and LFS since the early 1970's. As of 1996, these surveys have become the responsibility of LFS. Aerial surveys have been completed on an annual basis for spruce budworm, forest tent caterpillar and other aspen defoliators. Surveys for spruce beetle, dwarf mistletoe and other miscellaneous insects have also been completed but not on an annual basis. These surveys are typically followed by ground truthing to correctly identify the observed damage.

More recently, various ground surveys have been completed by LFS for the monitoring of spruce budworm and spruce beetle populations and associated damages. These surveys have been used to monitor populations (e.g., spruce budworm L2 surveys, spruce beetle trap log surveys) and their related damages (e.g., spruce budworm

defoliation assessment surveys, spruce beetle transect surveys). Pheromone trap surveys were started within the region by LFS in 1991 to monitor spruce budworm populations and in 1993 to monitor spruce beetle populations. In 1996, LFS and CFS began pheromone trap surveys for forest tent caterpillar populations. Also, since 1993, LFS has been participating with Agriculture Canada in pheromone trap surveys for Gypsy moth.

Control Programs

LFS has completed control programs within the region for spruce budworm and spruce beetle outbreaks. Beginning in 1989, aerial spray programs for spruce budworm control have been completed in the Eaglesham, Hawk Hills, Chinchaga River, Zama City and John D'or areas. Salvage harvesting programs have also been completed for spruce beetle damages areas in the mid 1980's and again in 1993.

LFS has been actively managing selected arthropod pest species within the region over the past 10–15 years. All of the above mentioned surveys are integral parts of the management of these pests. With the recent termination of the Forest Insect and Disease Survey (FIDS) group at CFS, LFS has taken over the responsibility of completing monitoring and detection surveys.

Fishes

Species Richness

Alberta's fish fauna (49 species) is relatively impoverished when compared to other Provinces or to States of the Ohio-Mississippi drainage that may have more than 160 native species (Nelson and Paetz 1992). Yet, species richness in northwest Alberta is relatively high for the province, with 35 species recorded (Table 13, Table 14, Figure 25). Of the 12 fish families occurring in Alberta, only 2 are not found in northwest Alberta — Acipenseridae (sturgeons) and Ictaluridae (catfish).

Of the 35 species, half are forage fish (minnows, sculpins, sticklebacks, and trout-perch) that provide food for larger predatory fish. Nine species of the salmon/trout family represent almost another one-quarter of the fish diversity, while other game fish and suckers constitute the remaining species. Thirty-two species of fish are native to northwest Alberta, while three species (rainbow trout, eastern brook trout, and brown trout) have been introduced to enhance sport fishing opportunities.

The diversity of fishes in northwest Alberta is related in part to the influence of three major drainage basins from which fish have dispersed into the area since the last glaciation: from the Peace/Fraser region, from the arctic, and from the Hudson Bay drainage to the east. Species richness is also affected by the diversity of habitat types in the many lakes and rivers found in this region. In particular, large river systems such as the Peace comprise a variety of habitats from the cold, relatively clear waters of its upper tributaries to the warm, turbid waters of lower portions and of the backwater channels and lakes of its active floodplain. Thus, cold-water fish — such as arctic grayling, trout, and mountain whitefish — spawn in upper reaches while other species spawn in lower reaches and in lakes.

Fish Distribution and Abundance in Lakes

Forage species tend to be the most abundant fish. For example, in a study on the lower Peace River (Boag *et al.* 1993), minnows, trout-perch, and sculpins dominated catch samples; the most abundant sport fish, in decreasing order, were goldeye, walleye, burbot, northern pike, and mountain whitefish. Grayling and trout occurred more often in the upper reaches.

Amongst sport fish in fish-bearing lakes in northwest Alberta, pike is most frequently found, followed by lake whitefish, rainbow trout, and walleye (Table 15). Except for lake trout, members of the salmon/trout family are rarely found unless introduced.

Fish Distribution and Abundance in Rivers and Streams

Based on censuses conducted by Natural Resources Service, the Alberta Conservation Association, and various consultants, observations of fish species in the Peace, Hay, Liard and Buffalo river systems in NW Alberta are compiled in Table 16, Table 17, and Table 18. The number of observations of fish species in rivers and their tributaries has been summarized in Figure 27. In order of descending frequency, the most commonly observed species (where observations exceeded 10) are arctic grayling, white sucker, lake chub, long nose sucker, northern pike, brook stickleback, trout perch, finescale dace, longnose dace, burbot, pearl dace and walleye. This may not be an accurate representation of actual abundance of fish species as many fish sampling techniques favor collection of data on larger fish species.

Fish Species of Special Management Concern

Two sport fish species in northwest Alberta are of special management concern. The bull trout is a threatened species; anglers are not permitted to keep any they catch. However, except for in the upper reaches of a few rivers, this fish does not occur in this part of the province. The walleye is a more prevalent species — and a most highly prized sport fish — in the rivers and lakes of the northwest boreal mixedwood forests; harvest of this species is strictly managed. Three non-sport species of the region are uncommon in Alberta. The largescale sucker is found only in the Peace River system, while two minnows — the northern squawfish and the redside shiner — are only in the Peace system and are rare in Alberta.

Fish Translocation History in northwest Alberta.

Fish species, three of them exotic and four native, have been recurrently introduced or translocated into numerous lakes, ponds, and dugouts in northwestern Alberta. Rainbow trout are the most commonly translocated fish in northwestern Alberta, with 22 waterbodies being stocked on at least one occasion. A total of 216 translocations of

rainbow trout have occurred between 1955 and 1997. Brook trout are the second most commonly introduced fish with 10 waterbodies receiving stock during a total of 59 translocations between 1964 and 1997. In declining order the remaining translocations include: grayling in 6 waterbodies, walleye in 4 waterbodies, yellow perch in 4 waterbodies, brown trout in two waterbodies, and northern pike in 2 waterbodies. The details of location of fish translocations and dates are compiled in Tables 19 and 20 and summarized in Figure 28 and Figure 30.

Table 13. Species richness in fish families in northwest Alberta (56–60 °N, 114–120 °W). Data Source: Nelson and Paetz 1992.

Common Family Name	Scientific Family Name	Total Species
Minnows	Cyprinidae	11
Salmon / Trout	Salmonidae	9
Perches	Percidae	3
Sculpins	Cottidae	3
Suckers	Catastomidae	3
Sticklebacks	Gasterosteidae	2
Cod	Gadidae	1
Goldeye	Hiodontidae	1
Pike	Esocidae	1
Trout-Perch	Percopsidae	1
Total		35

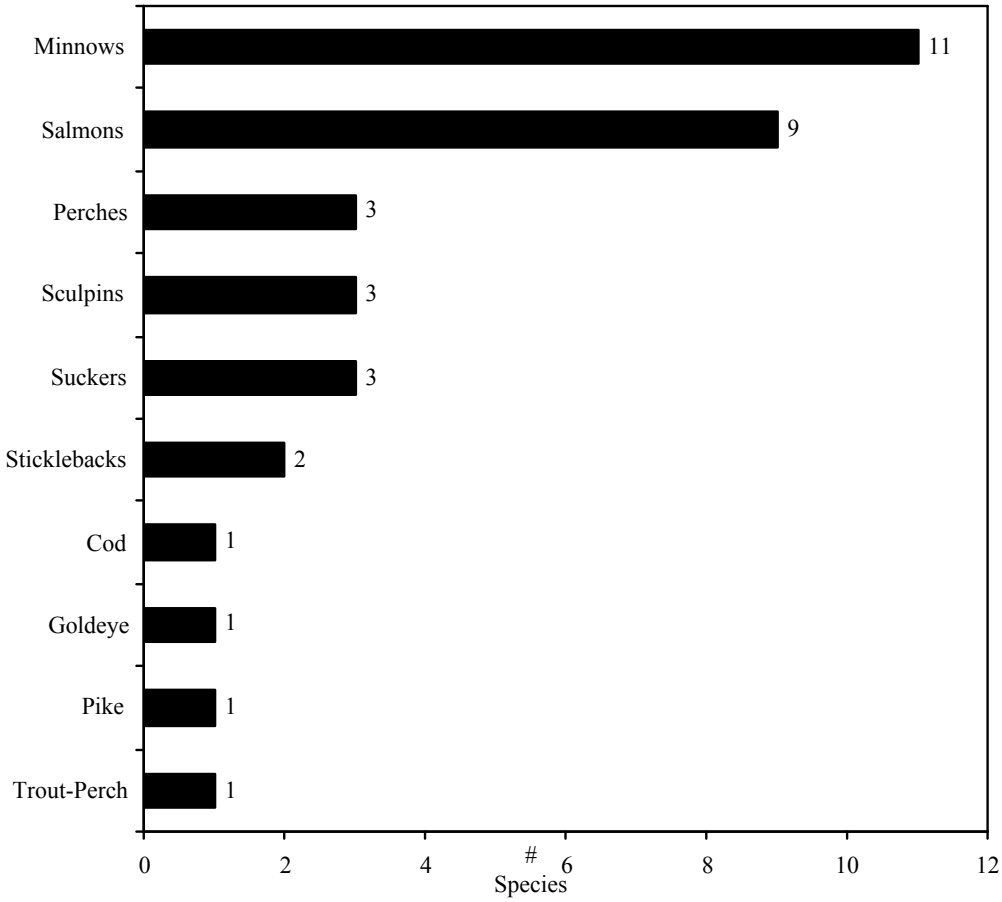

Figure 25. Species richness of fish families occurring in northwest Alberta. Data Source: Nelson and Paetz 1992.

Table 14. Taxonomy of fish species found in northwest Alberta (56–60 °N, 114–120 °W). Data Source: Nelson and Paetz 1992.

Order	Family	Common Name	Latin Name
Cypriniformes	Catostomidae	Longnose Sucker	*Catostomus catostomus*
Cypriniformes	Catostomidae	White Sucker	*Catostomus commersoni*
Cypriniformes	Catostomidae	Largescale Sucker	*Catostomus macrocheilus*
Cypriniformes	Cyprinidae	Lake Chub	*Couesius plumbeus*
Cypriniformes	Cyprinidae	Pearl Dace	*Margariscus margarita*
Cypriniformes	Cyprinidae	Emerald Shiner	*Notropis atherinoides*
Cypriniformes	Cyprinidae	Spottail Shiner	*Notropis hudsonius*
Cypriniformes	Cyprinidae	Northern Redbelly Dace	*Phoxinus eos*
Cypriniformes	Cyprinidae	Finescale Dace	*Phoxinus neogaeus Cope*
Cypriniformes	Cyprinidae	Flathead Chub	*Platygobio gracilis*
Cypriniformes	Cyprinidae	Northern Squawfish	*Ptychocheilus oregonensis*
Cypriniformes	Cyprinidae	Longnose Dace	*Rhinichthys cataractae*
Cypriniformes	Cyprinidae	Redside Shiner	*Richardsonius balteatus*
Cypriniformes	Cyprinidae	Fathead Minnow	*Pimephales promelas*
Gadiformes	Gadidae	Burbot	*Lota lota*
Gasterosteiformes	Gasterosteidae	Ninespine Stickleback	*Pungitius pungitius*
Gasterosteiformes	Gasterosteidae	Brook Stickleback	*Culaea inconstans*
Osteoglossiformes	Hiodontidae	Goldeye	*Hiodon alosoides*
Perciformes	Percidae	Iowa Darter	*Etheostoma exile*
Perciformes	Percidae	Yellow Perch	*Perca flavescens*
Perciformes	Percidae	Walleye	*Stizostedion vitreum*
Percopsiformes	Percopsidae	Trout-Perch	*Percopsis omiscomaycus*
Salmoniformes	Esocidae	Northern Pike	*Esox lucius Linnaeus*
Salmoniformes	Salmonidae	Cisco	*Coregonus artedi Lesueur*
Salmoniformes	Salmonidae	Lake Whitefish	*Coregonus clupeaformis*
Salmoniformes	Salmonidae	Mountain Whitefish	*Prosopium williamsoni*
Salmoniformes	Salmonidae	Arctic Grayling	*Thymallus arcticus*
Salmoniformes	Salmonidae	Rainbow Trout	*Oncorhynchus mykiss*
Salmoniformes	Salmonidae	Brook Trout	*Salvelinus fontinalis*
Salmoniformes	Salmonidae	Brown Trout	*Salvelinus trutta*
Salmoniformes	Salmonidae	Lake Trout	*Salvelinus namaycush*
Salmoniformes	Salmonidae	Bull Trout	*Salvelinus confluentus*
Scorpaeniformes	Cottidae	Slimy Sculpin	*Cottus cognatus*
Scorpaeniformes	Cottidae	Spoonhead Sculpin	*Cottus ricei*
Scorpaeniformes	Cottidae	Prickly Sculpin	*Cottus asper*

Table 15. Lakes, ponds and public dugouts in which sport or commercial fish are found in northwest Alberta (56–60 °N, 114–120 °W). Data Source: Fisheries Management, Natural Resource Services, Peace River.

Lake Name	Twp–Rge–Mer	Area (ha)	Northern Pike	Walleye	Lake Whitefish	Lake Trout	Rainbow Trout	Brook Trout	Brown Trout	Yellow Perch	Grayling	Tullibee
Beatty Lake	125-1-W6	2,424.0	X	X								
Bistcho Lake	124-6-W5	41,019.0	X	X	X							X
Cadotte Lake	86-16-W5	1,166.0	X									
Cardinal Lake	83-24-W5	4,429.0	X									
Caribou Lake	116-13-W5	1,428.0	X	X	X	X						X
Cranberry Lake	83-7-W5	622.0	X		X					X		X
Cummings Lake	10: 82-3-W5	24.0					X	X				
Driftwood Lake	85+86-2-W5	2,640.0	X									
East Twin Lake	29: 97-22-W5	28.0					X					
Equisetum Lake	89-5-W5	293.0	X	X	X					X		X
Eva Lake	114-7+8-W5	1,709.0	X		X							X
Fairview College Pond	27:81-3-W6	3.0					X				X	
Fairview Town Reserv.	34:81-3-W6	5.0					X					
Figure Eight Lake	20-84-25-W5	39.0					X	X	X			
Fleming	112-9-W5	162.0	X								X	
Footner Lake Pond	NW4:111-19-W5	1.0					X					
God's Lake	90-2-W5	680.0	X	X	X							
Goodfish Lake	89-5-W5	217.0	X	X	X					X		X
Goosegrass Lake	91-3-W5	239.0	X							X		
Graham Lake	87-4-W5	4,170.0	X	X	X	X				X		X
Haig Lake	91-14-W5	787.0	X	X	X							
Hebephrenic Lake	90-2-W5	220.0	X	X	X					X		X
High Level Dugout #1	7:110-20-W5	0.4					X					
High Level Dugout #3	11:109-20-W5	0.4					X					
Highway 686 Pond	NE17: 85-19-W5	1.0					X				X	
Hines Creek Dugout #3	14:85-7-W6	0.6					X	X				
Hines Creek Dugout #4	11:85-7-W6	0.5					X	X				
Hutch Lake	31:112-20-W5	120.0	X	X								
Joker Lake	25+35-86-13-W5	162.0	X							X		
Junction Pond	SW23: 83-21-W5	2.0					X					
Kidney	90-4-W5	231.0	X									
Long Lake #1	89-4-W5	539.0	X	X	X					X		
Long Lake #2	29: 81-12-W5	995.0	X		X							
Loon Lake	87-9-W5	1,954.0	X									
Machesis Lake	107-16-W5	25.5					X	X				
Margaret Lake	114-9-W5	8,158.0	X		X	X						X
Mink #1 Lake	81-11-W5	992.0	X									
Mink #2 Lake	82-11,12-W5									X		X
Muskwa Lake	82-4-W5	2,859.0	X	X	X							X
Ole's Lake	30: 84-12-W6	15.0					X	X		X		
Peace Pond	83-23-W5	2.5					X				X	
Peerless Lake	88-5-W5	8,259.0	X		X	X				X		X
Pitichimi Lake	115-5-W5	1,334.0	X		X	X						
Rainbow Lake	107-8-W5	395.0	X	X								
Rainbow Lake Pond	109-9-W6	1.0					X					
Rock Island Lake	116-7-W5	942.0	X		X	X						
Round Lake	89-4-W5	557.0	X	X	X							X
Royce's Dugout	25: 83-6-W6	0.4					X	X				
Running Lake	30: 88-7-W6	29.0					X	X				
Russell	93-12-W5	613.0	X							X		
Sawn Lake	92-12+13-W5	1,247.0	X		X				X			
Second Last/Long	90+91-2-W5	435.0	X		X					X		
Semo Lake	113-6+7-W5	478.0	X		X	X						
Shoal Lake	83-6-W5	430.0	X							X		X
Skunk Lake	90-3-W5	166.0								X		
Stony Lake	31: 86-3-W6	61.0					X	X		X		
Sucker Lake	114-6-W5	443.0	X		X							X
Sulphur Lake	7: 89-2-W6	53.4					X	X			X	
Talbot Lake	97-11-W5	650.0	X							X		

Lake Name	Twp–Rge–Mer	Area (ha)	Northern Pike	Walleye	Lake Whitefish	Lake Trout	Rainbow Trout	Brook Trout	Brown Trout	Yellow Perch	Grayling	Tullibee
Thurston Lake	125+126-1-W6	1,463.0	X	X								
Unnamed	118-12+13-W5	1,173.0	X									X
Unnamed	118-3-W5	295.0	X			X						
Unnamed/ Little Loon	85-10-W5	637.0	X									
Unnamed/Skunk	90-5-W5	700.0	X									
Vandersteene Lake	88-3-W5	2,073.0	X	X	X							
Wadlin Lake	101-10-W5	1,185.0	X		X					X		
Weberville Pond	NW7: 85-21-W5	1.3					X				X	
Wentzel Lake	115+116-3+4-W5	5,071.0	X	X	X	X						X
West Twin Lake	90+91-4-W5	337.0	X		X							X
Wilderness Park Pond #2	27: 83-23-W5	1.2									X	
Zama Lake Pond	13: 117-5-W6	0.5					X					

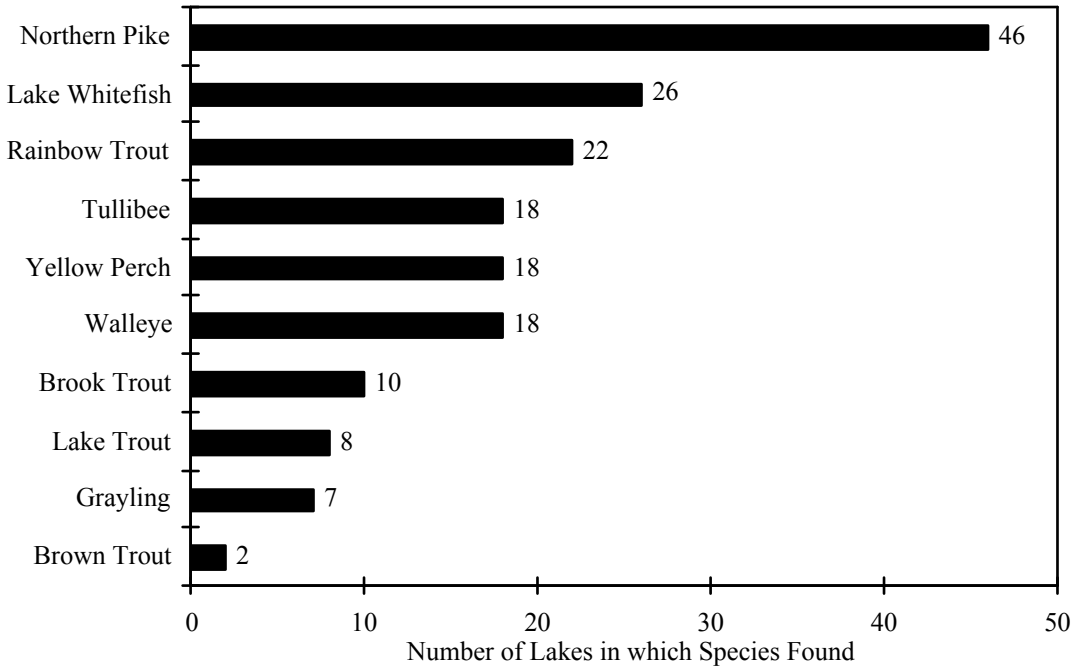

Figure 26. Number of lakes in northwest Alberta where different sport fish species occur. Data Source: Fisheries Management, Natural Resource Services, Peace River.

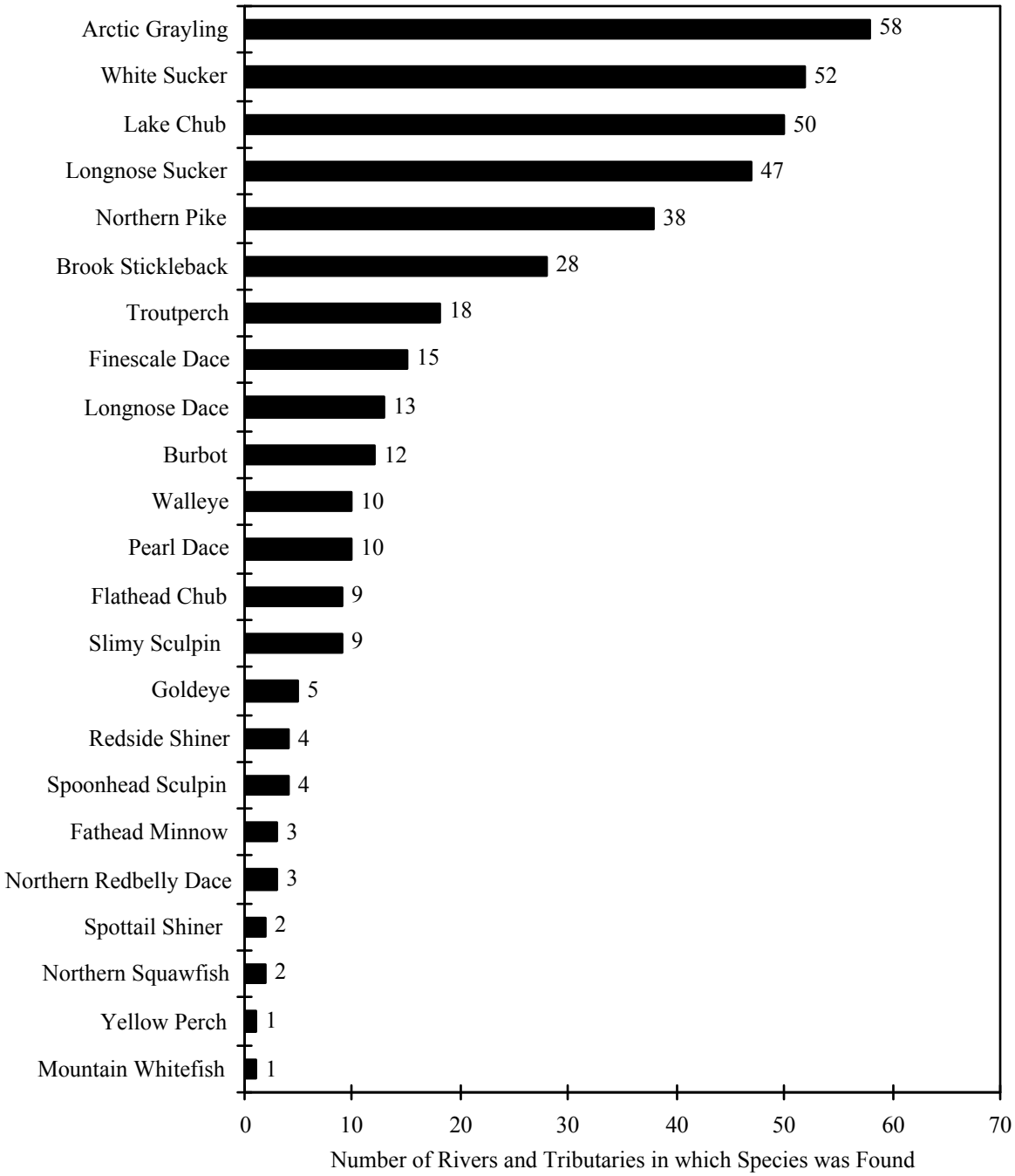

Figure 27. Number of stream and river reaches in northwest Alberta that different fish species have been observed during censuses. Data Source: Fisheries Management, Natural Resource Services, Peace River.

Table 16. River and creek systems of the Peace River drainage in which fish species have been recorded. Although documented sightings (indicated by X) are indicative of presence in that reach of stream or river, species not sighted are not necessarily absent from that region. Data extracted from the Cooperative Fisheries Inventory Program Database developed by the Alberta Conservation Association and Natural Resources Service. Fish species codes are described at bottom of Table 16. Distributional data refer to the smallest order creek or river name provided (i.e., column with text furthest to the right).

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	ARGR	BRST	BURB	FLCH	FNDC	FTMN	GOLD	LKCH	LNDC	LNSC	MNWH	NRDC
Peace River mainstem				X	X				X	X	X	X	X	
Beatton River	Doig River		X							X		X		
Beatton River	Doig River	Mearon Creek								X				
Beatton River	Doig River	Betts Creek		X			X							
Beatton River	Doig River	Unnamed Trib; NW11-91-12-W6	X	X						X				
Pouce Coupe R.														
Clear River						X				X		X		
Clear River	Eureka River			X			X			X	X	X		
Clear River	Lathrop Creek						X			X				
Clear River	Lathrop Creek	Un. Trib to Lathrop Cr.; SW21-87-10-W6		X			X			X				
Clear River		Un. Trib to Clear R.; NW21-87-11-W6		X		X				X				
Clear River	Little Clear River			X			X			X		X		
Clear River	Little Clear River	Sweeney Creek		X	X	X				X				
	Montagneuse River						X	X			X			
	Hines Creek			X			X	X				X		
Heart River	Bearhead Creek			X	X							X		
Heart River	North Heart River		X		X					X	X			
Whitemud R.			X	X						X		X		
Whitemud R.	Cardinal Creek		X	X			X			X		X		
Whitemud R.	Beaton Creek													
Whitemud R.		Wagon Creek		X			X							
Whitemud R.		Un. Trib to Whitemud R. NE11-88-3-W6	X	X		X		X				X		
Whitemud R.	South Whitemud R.		X							X				
Cadotte River			X		X	X			X	X	X	X		
Cadotte River	Little Cadotte River									X		X		
Cadotte River	Otter River		X									X		
		Un. Trib to Peace River SW36-91-21-W5		X						X				
	Keppler Creek									X				
Notikewin R.			X	X	X	X	X		X	X		X		
Notikewin R.		Gravina Creek		X			X							
Notikewin R.	Meikle River		X							X		X		
Notikewin R.	Meikle River	Slims Creek		X								X		
Notikewin R.	Meikle River	Goffit Creek												
Notikewin R.	Meikle River	Un. Trib to Meikle R. SE13-96-4-W6	X											
Notikewin R.	Hotchkiss River		X	X		X				X	X	X		
Notikewin R.	Hotchkiss River	Un. Trib to Hotchkiss R. NW20-95-4-W6	X	X						X				
Notikewin R.	Hotchkiss River	Un. Trib to Hotchkiss R. NW26-95-5-W6	X											
Notikewin R.	Hotchkiss River	Un. Trib to Hotchkiss R. SW28-95-5-W6	X											
Notikewin R.		Un. Trib to Notikewin R. SW27-91-1-W6		X			X			X		X		
Notikewin R.		Un. Trib to Notikewin R. NE24-91-2-W6	X	X			X			X	X	X		X
Notikewin R.	Lovet Creek			X						X	X	X		
Notikewin R.	Rambling Creek		X			X				X		X		
Notikewin R.	Alleman Creek		X	X										
Notikewin R.	Alleman Creek	Un. Trib to Alleman Cr. SW13-93-5-W6										X		
Notikewin R.		Un. Trib to Notikewin R. SE30-92-6-W6	X							X				
Notikewin R.		Un. Trib to Notikewin R. NE11-90-8-W6	X	X										
Wolverine R.					X	X				X	X	X		
Wolverine R.	Cache Creek									X				
Wolverine R.	Cache Creek	Chester Creek		X						X				
Wolverine R.	Cache Creek	Trib to Cache Creek SE6-96-17-W5												
Wolverine R.		Trib to Bison Lake NW21-94-14-W5	X									X		
Buffalo R.			X							X	X	X		
Buffalo R.	Rossbear Creek		X							X	X			
		Un. Trib to Peace R. NW21-102-19-W5								X	X	X		
	Un. Trib to Peace R. NW21-102-19-W5	Un. Trib SW24-101-17-W5								X				
Keg River										X				
Keg River	Kemp River		X							X				
Boyer River	Ponton River		X											

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	ARGR	BRST	BURB	FLCH	FNDC	FTMN	GOLD	LKCH	LNDC	LNSC	MNWH	NRDC
Boyer River	Ponton River	Unnamed Trib NW31-114-12-W5	X											
Boyer River	Ponton River	Unnamed Trib SE6-116-10-W5	X											
Boyer River	Ponton River	Trib to Margaret Lake SW13-115-10-W5	X											
Boyer River	Ponton River	Trib to Margaret Lake SW16-115-8-W5	X		X							X		
Boyer River	Ponton River	Trib to Margaret Lake NE34-114-8-W5	X									X		
Boyer River	Melito Creek			X										
Caribou River			X							X		X		
Caribou River	Carl Creek		X							X				
Wabasca River		Rat Creek	X											
Wabasca River	Senex Creek													
Wabasca River	Muddy River		X				X			X				
Wabasca River	Loon River								X			X		
Wabasca River	Loon River	Lafond Creek								X				
Wabasca River	Loon River	Redearth Creek												
Wabasca River	Panny River		X							X		X		
Wabasca River	Trout River	Hospital Creek	X											
Wabasca River	Muskwa River	Utikuma River												
Lawrence River			X		X									
Lawrence River		Trib to Lawrence R. NE28-112-8-W5	X											
Mikwa River			X						X					
Mikwa River	Owl Creek													
Mikwa River	Sputina Creek													
Wentzel River			X									X		
Wentzel River	Clements Creek		X									X		
Wentzel River	Clements Creek	Semo Lake outlet	X									X		
Wentzel River	Clements Creek	Eva Lake outlet	X		X									
Wentzel River		Un. Trib to Wentzel R. NE12-113-4-W5	X											
Wentzel River	Un. Trib Wentzel R. NE12-113-4-W5	Un. Trib to Wentzel R. SE23-113-4-W5	X									X		
Total Number of Occurrences where Fish Species was Observed			46	27	10	9	14	3	5	42	12	35	1	2

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	NRPK	NRSQ	PRDC	RDSH	SLSC	SPSC	SPSH	TRPR	WALL	WHSC	YLPR
Peace River mainstem				X			X	X	X	X	X	X	X
Beatton River	Doig River		X									X	
Beatton River	Doig River	Mearon Creek	X									X	
Beatton River	Doig River	Betts Creek										X	
Beatton River	Doig River	Unnamed Trib; NW11-91-12-W6	X								X		
Pouce Coupe R.			X										
Clear River							X		X	X		X	
Clear River	Eureka River											X	
Clear River	Lathrop Creek												
Clear River	Lathrop Creek	Un. Trib to Lathrop Cr.; SW21-87-10-W6										X	
Clear River		Un. Trib to Clear R.; NW21-87-11-W6										X	
Clear River	Little Clear River										X	X	
Clear River	Little Clear River	Sweeney Creek					X					X	
	Montagneuse River											X	
	Hines Creek				X							X	
Heart River	Bearhead Creek		X			X					X		
Heart River	North Heart River		X			X				X		X	X
Whitemud R.			X							X		X	
Whitemud R.	Cardinal Creek		X	X	X							X	
Whitemud R.	Beaton Creek		X										
Whitemud R.		Wagon Creek										X	
Whitemud R.		Un. Trib to Whitemud R. NE11-88-3-W6										X	
Whitemud R.	South Whitemud R.											X	
Cadotte River			X			X				X	X	X	
Cadotte River	Little Cadotte River											X	
Cadotte River	Otter River		X									X	
		Un. Trib to Peace River SW36-91-21-W5											
	Keppler Creek											X	
Notikewin R.			X		X					X	X	X	
Notikewin R.		Gravina Creek											
Notikewin R.	Meikle River		X							X		X	
Notikewin R.	Meikle River	Slims Creek										X	
Notikewin R.	Meikle River	Goffit Creek							X				
Notikewin R.	Meikle River	Un. Trib to Meikle R. SE13-96-4-W6											
Notikewin R.	Hotchkiss River		X		X		X	X		X	X	X	
Notikewin R.	Hotchkiss River	Un. Trib to Hotchkiss R. NW20-95-4-W6											
Notikewin R.	Hotchkiss River	Un. Trib to Hotchkiss R. NW26-95-5-W6											
Notikewin R.	Hotchkiss River	Un. Trib to Hotchkiss R. SW28-95-5-W6											
Notikewin R.		Un. Trib to Notikewin R. SW27-91-1-W6		X	X								
Notikewin R.		Un. Trib to Notikewin R. NE24-91-2-W6	X		X							X	
Notikewin R.	Lovet Creek		X										
Notikewin R.	Rambling Creek		X							X		X	
Notikewin R.	Alleman Creek		X		X							X	
Notikewin R.	Alleman Creek	Un. Trib to Alleman Cr. SW13-93-5-W6											
Notikewin R.		Un. Trib to Notikewin R. SE30-92-6-W6								X			
Notikewin R.		Un. Trib to Notikewin R. NE11-90-8-W6											
Wolverine R.			X									X	
Wolverine R.	Cache Creek		X									X	
Wolverine R.	Cache Creek	Chester Creek											
Wolverine R.	Cache Creek	Trib to Cache Creek SE6-96-17-W5										X	
Wolverine R.		Trib to Bison Lake NW21-94-14-W5	X									X	
Buffalo R.							X			X		X	
Buffalo R.	Rossbear Creek												
		Un. Trib to Peace R. NW21-102-19-W5					X			X			
	Un. Trib to Peace R. NW21-102-19-W5	Un. Trib SW24-101-17-W5										X	
Keg River			X										
Keg River	Kemp River		X		X							X	
Boyer River	Ponton River												
Boyer River	Ponton River	Unnamed Trib NW31-114-12-W5											
Boyer River	Ponton River	Unnamed Trib SE6-116-10-W5											
Boyer River	Ponton River	Trib to Margaret Lake SW13-115-10-W5	X										
Boyer River	Ponton River	Trib to Margaret Lake SW16-115-8-W5					X						
Boyer River	Ponton River	Trib to Margaret Lake NE34-114-8-W5	X										
Boyer River	Melito Creek												

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	NRPK	NRSQ	PRDC	RDSH	SLSC	SPSC	SPSH	TRPR	WALL	WHSC	YLPR
Caribou River													
Caribou River	Carl Creek												
Wabasca River		Rat Creek					X						
Wabasca River	Senex Creek											X	
Wabasca River	Muddy River											X	
Wabasca River	Loon River		X								X	X	
Wabasca River	Loon River	Lafond Creek	X									X	
Wabasca River	Loon River	Redearth Creek	X										
Wabasca River	Panny River											X	
Wabasca River	Trout River	Hospital Creek											
Wabasca River	Muskwa River	Utikuma River	X										
Lawrence River													
Lawrence River		Trib to Lawrence R. NE28-112-8-W5											
Mikwa River													
Mikwa River	Owl Creek									X		X	
Mikwa River	Sputina Creek											X	
Wentzel River			X										
Wentzel River	Clements Creek												
Wentzel River	Clements Creek	Semo Lake outlet											
Wentzel River	Clements Creek	Eva Lake outlet											
Wentzel River		Un. Trib to Wentzel R. NE12-113-4-W5											
Wentzel River	Un. Trib Wentzel R. NE12-113-4-W5	Un. Trib to Wentzel R. SE23-113-4-W5											
Total Number of Occurrences where Fish Species was Observed			46	27	31	2	8	4	8	2	2	13	8

Common Name	Species Abbreviations	Common Name	Species Abbreviations
Family Salmonidae		Family Gadidae	
arctic grayling	ARGR	burbot	BURB
mountain whitefish	MNWH		
Family Esocidae		Family Percopsidae	
northern pike	NRPK	trout-perch	TRPR
Family Hiodontidae		Family Gasterosteidae	
goldeye	GOLD	brook stickleback	BRST
Family Cyprinidae		Family Percidae	
longnose dace	LNDC	yellow perch	YLPR
flathead chub	FLCH	walleye	WALL
lake chub	LKCH		
pearl dace	PRDC	Family Cottidae	
northern squawfish	NRSQ	slimy sculpin	SLSC
redside shiner	RDSH	spoonhead sculpin	SPSC
northern redbelly dace	NRDC		
finescale dace	FNDC		
fathead minnow	FTMN		
spottail shiner	SPSH		
Family Catostomidae			
longnose sucker	LNSC		
white sucker	WHSC		

Table 17. Distribution of fish species in stream and river systems of the Hay River drainage of northwest Alberta. Although documented sightings (indicated by X) are indicative of presence in that reach of stream or river, species not sighted are not necessarily absent from that region. This table is based on data extracted from the Cooperative Fisheries Inventory Program Database developed by the Alberta Conservation Association and Natural Resources Service. Fish species codes are described at bottom of Table 16. Distributional data refer to the smallest order creek or river name provided (i.e., column with text furthest to the right).

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	ARGR	BRST	BURB	FLCH	FNDC	FTMN	GOLD	LKCH	LNDC	LNSC	MNWH	NRDC
Hay River					X									
	Amber River													
	Zama River			X			X							X
	Sousa Creek											X		
Chinchaga R.			X							X		X		
Chinchaga R.		Un Trib to Chinchaga R. NW30-102-1-W6								X				
Chinchaga R.	Haro R.													
Chinchaga R.	Waniandy Creek									X				
Chinchaga R.	Sloat Creek		X		X						X	X		
Chinchaga R.	Werniuk Creek		X							X		X		
Chinchaga R.	Tanghe Creek		X									X		
Chinchaga R.	Tanghe Creek	Un Trib to Tanghe Cr. NW28-98-11-W6												
	Meander River		X									X		
	Rapids Creek		X									X		
Steen River										X		X		
	Dizzy Creek		X									X		
	James Creek									X		X		
	Jackpot Creek													
	Jackpot Creek	Un Trib to Jackpot Cr. SE15-124-18-W5	X											
Total Number of Occurrences where Fish Species were Observed			8	1	2	0	1	0	0	6	1	10	0	1

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	NRPK	NRSQ	PRDC	RDSH	SLSC	SPSC	SPSH	TRPR	WALL	WHSC	YLPR
Hay River			X				X						
	Amber River											X	
	Zama River												
	Sousa Creek												
Chinchaga R.			X		X			X		X	X	X	
Chinchaga R.		Un Trib to Chinchaga R. NW30-102-1-W6										X	
Chinchaga R.	Haro R.		X		X								
Chinchaga R.	Waniandy Creek											X	
Chinchaga R.	Sloat Creek		X									X	
Chinchaga R.	Werniuk Creek		X							X	X	X	
Chinchaga R.	Tanghe Creek									X		X	
Chinchaga R.	Tanghe Creek	Un Trib to Tanghe Cr. NW28-98-11-W6								X			
	Meander River												
	Rapids Creek												
Steen River													
	Dizzy Creek												
	James Creek												
	Jackpot Creek		X										
	Jackpot Creek	Un Trib to Jackpot Cr. SE15-124-18-W5											
Total Number of Occurrences where Fish Species were Observed			8	1	6	0	2	0	1	1	0	4	2

Table 18. Distribution of fish species in stream and river systems of the Buffalo and Liard River drainages of northwest Alberta. Although documented sightings (indicated by X) are indicative of presence in that reach of stream or river, species not sighted are not necessarily absent from that region. This table is based on data extracted from the Cooperative Fisheries Inventory Program Database developed by the Alberta Conservation Association and Natural Resources Service. Fish species codes are described at bottom of Table 16. Distributional data refer to the smallest order creek or river name provided (i.e., column with text furthest to the right).

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	ARGR	BRST	BURB	FLCH	FNDC	FTMN	GOLD	LKCH	LNDC	LNSC	MNWH	NRDC
Buffalo River														
Whitesand R.			X											
Yates River			X							X		X		
Yates River		Un. Trib to Yates R. SE1-120-11-W5	X											
Liard River														
Fort Nelson R.	Fontas R.		X							X		X		
Fort Nelson R.	Fontas R.	Foulwater Creek												
Total Number of Occurrences where Fish Species were Observed			4	0	0	0	0	0	0	2	0	2	0	0

Larger System	Tertiary River / Creek	Tributary System (legal description refers to the confluence of the tributary with the next larger system)	NRPK	NRSQ	PRDC	RDSH	SLSC	SPSC	SPSH	TRPR	WALL	WHSC	YLPR
Buffalo River													
Whitesand R.													
Yates River			X										
Yates River		Un. Trib to Yates R. SE1-120-11-W5											
Liard River													
Fort Nelson R.	Fontas R.							X		X		X	
Fort Nelson R.	Fontas R.	Foulwater Creek										X	
Total Number of Occurrences where Fish Species were Observed			1	0	0	0	0	1	0	1	0	2	0

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Table 19. Lakes, ponds, and public dugouts in northwest Alberta into which walleye, rainbow trout, or brook trout have been translocated between 1955 and 1997. Data Source: Natural Resources Service, Peace River.

Lake Name	Twp–Rge-Mer.	Area (ha)	Walleye	Rainbow Trout	Brook Trout
Bistcho Lake	124-6-W5	41,019.0	1987-88, 1990-92		
Cummings Lake	10: 82-3-W5	24.0		1988-89,1991, 1994-97	1987, 1991-93
East Twin Lake	29: 97-22-W5	28.0		1955-56,1963-67, 1971-88,1991-97	
Fairview College Pond	27: 81-3-W6	3.0		1985-89,1994-96	
Fairview Town Reservoir	34: 81-3-W6	5.0		1967-81,1985	
Figure 8 Lake	20: 84-25-W5	38.6		1971-89,1992-97	1981,1990
Footner Lake Pond	NW4: 111-19-W5	1.0		1991-93	
Haig Lake	91-14-W5	787.0	1990-93		
High Level Dugout #1	7: 110-20-W5	0.4		1978-84	
High Level Dugout #2	11: 109-20-W5	0.4		1980-84	
Highway 686 Pond	NE17: 85-19-W5	1.0		1987-88,93,95,97	
Hines Creek Dugout #3	14: 85-7-W6	0.56		1974,1983-84	1971-72,1975-78
Hines Creek Dugout #4	11: 85-7-W6	0.48		1974,1983-84	1975-78
Hutch Lake	31: 112-20-W5	120.0	1994		
Joker Lake	35: 86-13-W5	162.0			
Junction Pond	SW23: 83-21-W5	2.0		1988-89,1992, 1994-97	
Machesis Lake	27: 107-16-W5	25.5		1980-88,1992-96	1991
MD Peace Pond #2	27: 83-23-5	1.2			
Ole's Lake	30: 84-12-W6	15.0		1975-76,1978,1980-82,1986-89,1992-97	1981-85,1988-91
Peace Pond	SW27: 83-23-W5	1.0		1981-86, 97	
Rainbow Lake Pond	NE25: 109-9-W6	1.0		1987-89,1991-97	
Royce's Dugout	25: 83-6-W6	0.4		1978-80	1985,1987-88
Running Lake	30: 88-7-W6	29.0		1970,1973,1979, 1982-83,1985-86, 1994,1996	1964-67,1971-72, 1975-78,1981,1984, 1987-93,1995
Sawn Lake	92-12-W5	1247.0			
Stony Lake	31: 86-3-W6	61.0		1974,79-81,95,97	1975,1982-93,1996
Sulphur Lake	7: 89-2-W6	53.4		1960-61,1979,1983-88, 1992-93,96,97	1975-78,1989-91, 1995
Wadlin Lake	101-10-W5	1185.0	1990-91,1996		
Weberville Pond	NW7: 85-21-W5	1.3		1987-89,1992-97	
Zama Lake Pond	13: 117-5-W6	0.5		1988,1990-91, 1993-96	
Total Translocations			13	216	59

Table 20. Lakes, ponds, and public dugouts in northwest Alberta into which brown trout, yellow perch, grayling or northern pike have been translocated between 1960 and 1997. Data Source: Natural Resources Service, Peace River.

Lake Name	Twp–Rge-Meridian	Area (ha)	Brown Trout	Yellow Perch	Grayling	Northern Pike
Bistcho Lake	124-6-W5	41,019.0				
Cummings Lake	10: 82-3-W5	24.0		1985-87		
East Twin Lake	29: 97-22-W5	28.0				
Fairview College Pond	27: 81-3-W6	3.0			1985	
Fairview Town Reserve	34: 81-3-W6	5.0		1958		
Figure 8 Lake	20: 84-25-W5	38.6	1991, 1997			1956
Footner Lake Pond	NW4: 111-19-W5	1.0				
Haig Lake	91-14-W5	787.0				
High Level Dugout #1	7: 110-20-W5	0.4				
High Level Dugout #3	11: 109-20-W5	0.4				
Highway 686 Pond	NE17: 85-19-W5	1.0			1986	
Hines Creek Dugout #3	14: 85-7-W6	0.6				
Hines Creek Dugout #4	11: 85-7-W6	0.5				
Hutch Lake	31: 112-20-W5	120.0				
Joker Lake	35: 86-13-W5	162.0		1983-84		
Junction Pond	SW23: 83-21-W5	2.0				
Machesis Lake	27: 107-16-W5	25.5				
MD Peace Pond #2	27: 83-23-5	1.2			1985	
Ole's Lake	30: 84-12-W6	15.0				
Peace Pond	SW27: 83-23-W5	1.0			1985-86	
Rainbow Lake Pond	NE25: 109-9-W6	1.0				
Royce's Dugout	25: 83-6-W6	0.4				
Running Lake	30: 88-7-W6	29.0				
Sawn Lake	92-12-W5	1247.0	1987-90			
Stony Lake	31: 86-3-W6	61.0				
Sulphur Lake	7: 89-2-W6	53.4		1958, 1965	1987	1966
Wadlin Lake	101-10-W5	1185.0				
Weberville Pond	NW7: 85-21-W5	1.3			1990-91	
Zama Lake Pond	13: 117-5-W6	0.5				
Total Translocations			6	8	8	2

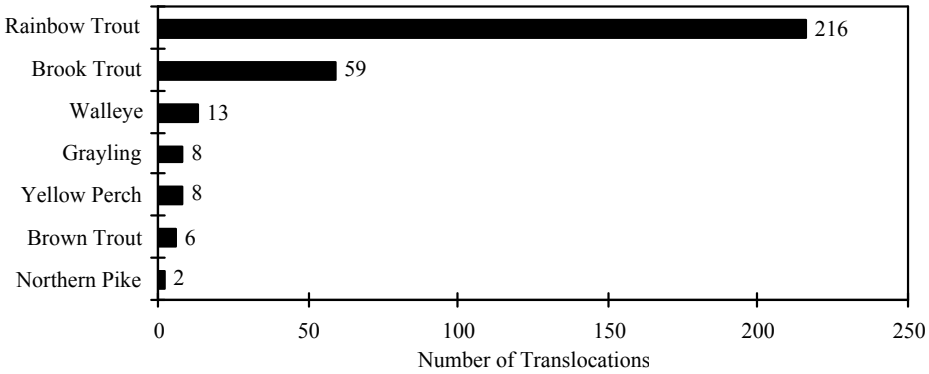

Figure 28. Number of occurrences of translocations for each sport fish species in northwest Alberta (1955–1997). Data Source: Natural Resources Service, Peace River.

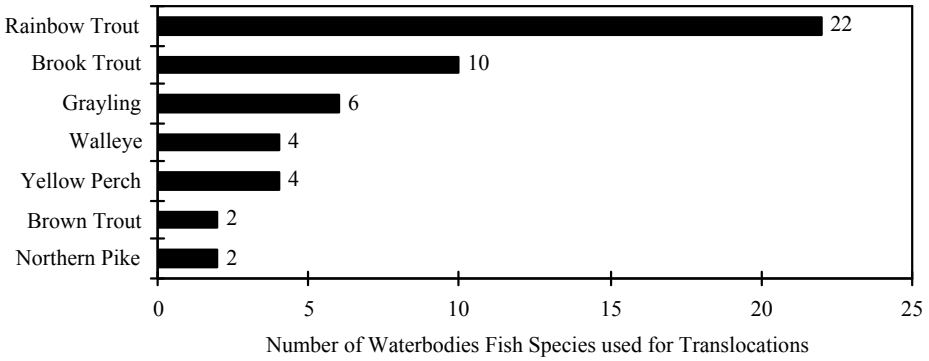

Figure 29. Number of waterbodies used for translocations for each sport fish species in northwest Alberta (1955–1997). Data Source: Natural Resources Service, Peace River.

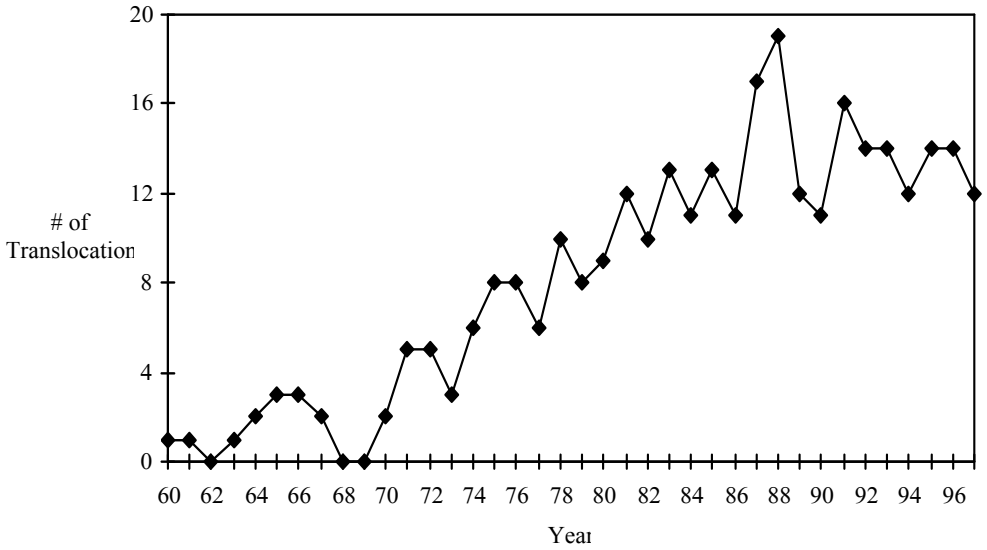

Figure 30. Annual variation in fish translocation in northwest Alberta (1960–1997). Data Source: Natural Resources Service, Peace River.

Amphibians and Reptiles

Species Richness

Species richness of amphibians is low in northwest Alberta (Table 21) but comparable to most of the province. The mixedwood boreal forest contains an abundance of small water bodies with riparian vegetation and changing water levels that provide good breeding and molting habitat for amphibians, and the same areas provide good breeding habitat for the many insects on which amphibians feed. The Peace River is also an important distribution route for amphibians (Roberts *et al.* 1987). However, the boreal forest generally lacks the hot, dry environment that is preferred by most reptiles; consequently, only two species (both garter snakes) are found (Table 22). The red-sided garter snake is particularly abundant along the Peace River where there is good overwintering habitat and abundant amphibians, a preferred food (Roberts *et al.* 1987). Species richness of amphibians and reptiles in northwest Alberta is summarized in Figure 31.

Special Concerns

According to The Status of Alberta Wildlife (Anonymous 1996), two of the amphibians — the Canadian toad and the northern leopard frog — are currently at risk in Alberta (red status), and the long-toed salamander requires special management attention (Yellow B status). Both garter snakes are sensitive species that are not currently at risk but have shown long-term declines (Yellow A status, Table 23).

Table 21. Species richness in amphibian families in northwest Alberta. Data Source: Russell and Bauer 1993.

Common Family	Scientific Family Name	Total Species
Salamanders	Ambystomatidae	2
Toads	Bufonidae	2
Tree Frogs	Hylidae	1
True Frogs	Ranidae	2
Total		7

Table 22. Species richness in reptile families in northwest Alberta. Data Source: Russell and Bauer 1993.

Common Family	Scientific Family Name	Total Species
Garter Snakes	Colubridae	2
Total		2

Table 23. Amphibian and reptile species found in northwest Alberta and their conservation status as indicated in The Status of Alberta Wildlife (1996).

Order	Family	Common Name	Latin Name	Status
Caudata	Ambystomatidae	Tiger Salamander	*Ambystoma tigrinium*	Green
Caudata	Ambystomatidae	Long-toed Salamander	*Ambystoma macrodactylum*	Yellow B
Anura	Bufonidae	Boreal Toad	*Bufo boreas*	Green
Anura	Bufonidae	Canadian Toad	*Bufo hemiophrys*	Red
Anura	Ranidae	Wood Frog	*Rana sylvatica*	Green
Anura	Ranidae	Northern Leopard Frog	*Rana pipiens*	Red
Anura	Hylidae	Boreal Chorus Frog	*Pseudacris triseriata*	Green
Squamata	Colubridae	Wandering Garter Snake	*Thamnophis elegans*	Yellow A
Squamata	Colubridae	Red-sided Garter Snake	*Thamnophis sirtalis*	Yellow A

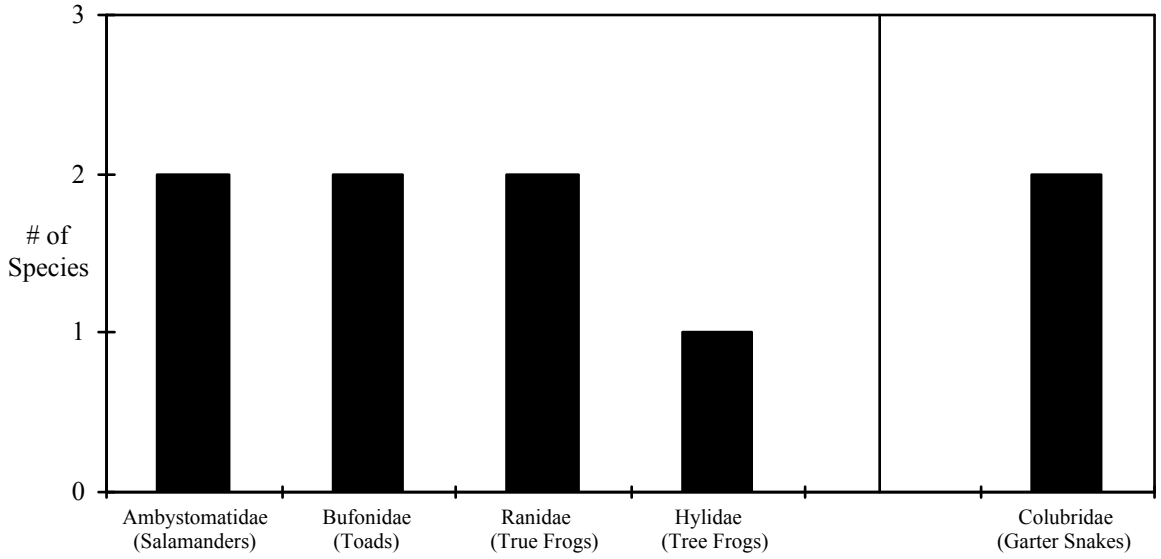

Figure 31. Species richness in amphibian and reptile families in northwest Alberta. Data Source: Russell and Bauer 1993.

Birds

Species Richness

The heterogeneous boreal forest landscape of northwest Alberta contains an equally diverse breeding avifauna. This high bird diversity of northwest Alberta is illustrated in a continental comparison of bird species richness based on data collected by the Breeding Bird Survey Program (Figure 37, Robbins et al. 1986). Based on BBS surveys conducted on all but the northern reaches of the study area, 50-60 bird species are typically encountered in a 40 km 50-stop survey route (Figure 37).

A full understanding of why boreal forests contain such a rich breeding bird community is not complete, but it is likely related to such factors as high primary productivity associated with the long, sunny summer days, a rich forage base including insects, seeds, herbaceous foliage, and a diverse set of plant communities that differ in their tree species composition, age class composition, structural components (snags, down wood, canopy gaps, etc.), and nesting opportunities.

The composition of the bird community of northwest Alberta is presented at the taxonomic level of the Family (

Table 27, Figure 38) and the species (Table 24). These tables include both the common and scientific names. Thirty-seven different bird families are represented in northwest Alberta and are comprised of 239 different bird species. Those families containing the most bird species in northwest Alberta [i.e., Warblers (n=50), Ducks/Geese (n=31), Sandpipers (n=22), Gulls/Terns (n=15)] are comprised of species that breed in North America but winter in more equatorial latitudes. Clearly, the boreal forest is a major contributor to bird communities found elsewhere in North, Central and South America. Equally clearly, unraveling changes in abundance of these migratory species will be confounded by human landuse practices and habitat quality elsewhere.

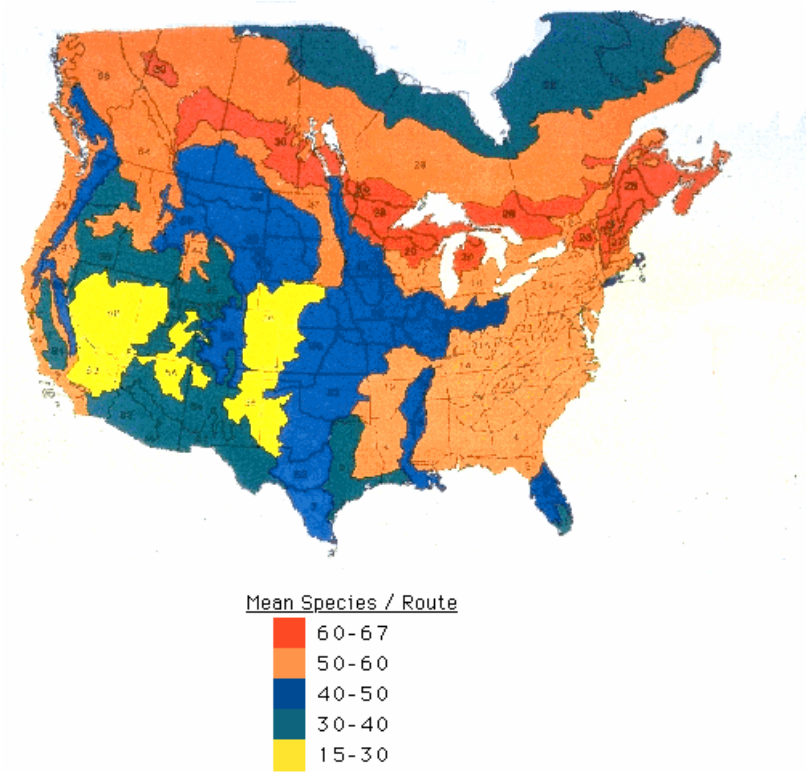

Figure 32. Mean bird species richness for portion of North America as recorded on a 5–stop BBS route. Northern portion of study area is not represented because of lack of completed surveys in this region. Data Source: web site of the North American Breeding Bird Program (BBS).

Table 24. Species richness in bird families (common family names provided) in northwest Alberta. Data Source: Semenchuk 1992.

Common Family Name	Scientific Family Name	Total Species
Warblers	Emberizidae	50
Ducks / Geese	Anatidae	31
Sandpipers	Scolopacidae	22
Gulls/Terns	Laridae	15
Hawks / Eagles	Acciptridae	10
Thrushes	Muscicapidae	10
Owls	Strigidae	10
Finches	Fringillidae	8
Flycatchers	Tyrannidae	8
Woodpeckers	Picidae	7
Grouses	Phasianidae	6
Jays	Corvidae	5
Swallows	Hirundinidae	5
Grebes	Podocipidae	5
Plovers	Charadriidae	4
Falcons	Falconidae	4
Vireos	Vireonidae	4
Loons	Gaviidae	3
Chickadees	Paridae	3
Wrens	Troglodytidae	3
Herons	Ardeidae	2
Waxwings	Bombycillidae	2
Doves	Columbidae	2
Cranes	Gruidae	2
Shrikes	Lanidae	2
Pelicans	Pelicanidae	2
Phalaropes	Phalaropidae	2
Rails	Rallidae	2
Hummingbirds	Trochilidae	2
Larks	Alaudidae	1
Kingfishers	Alcedinidae	1
Nighthawks	Caprimulgidae	1
Creepers	Certhiidae	1
Old World Sparrows	Passeridae	1
Avocets	Recurvirostridae	1
Nuthatches	Sittidae	1
Starlings	Sternidae	1
Total Number of Families (37)		
Total Number of Species (239)		

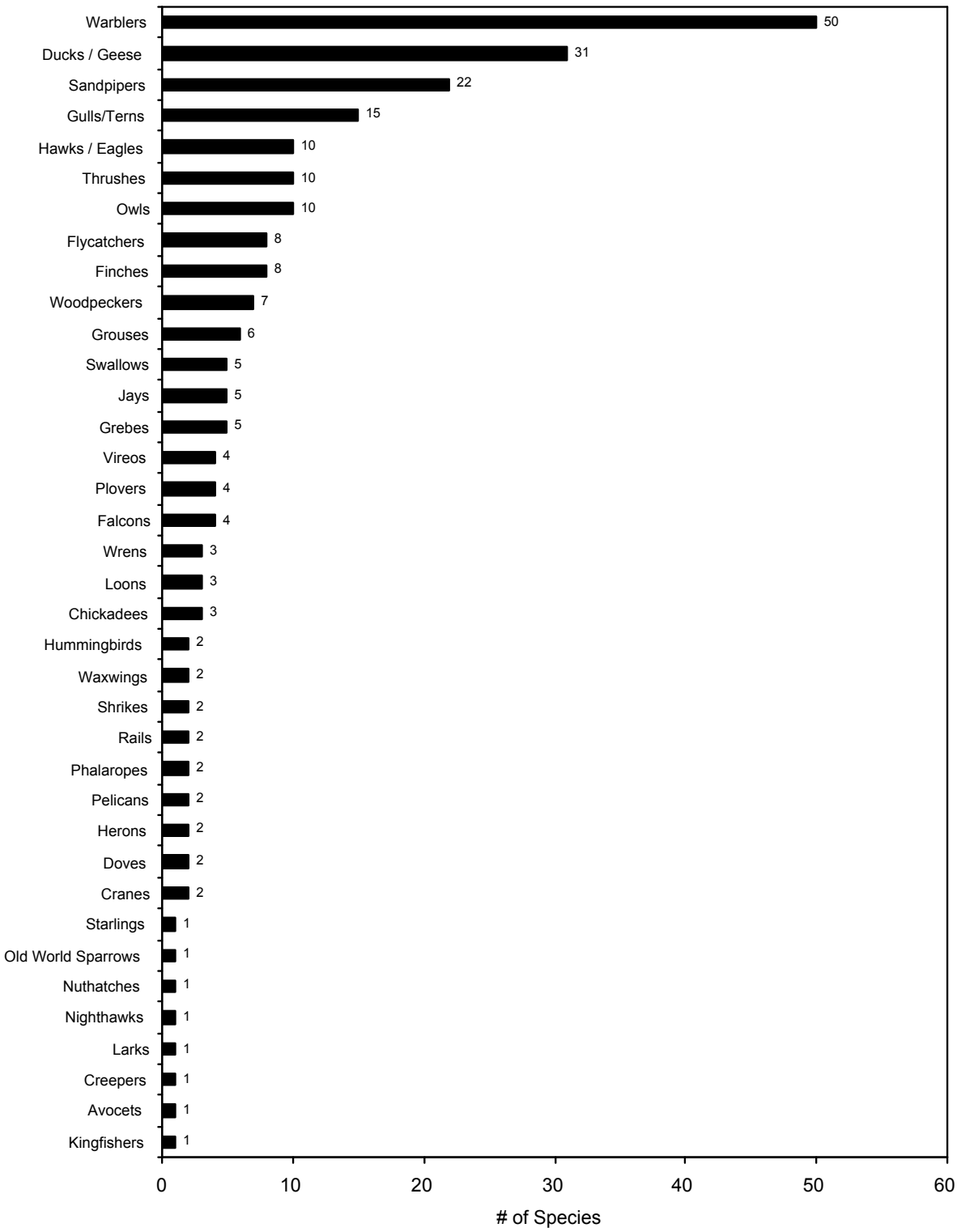

Figure 33. Species richness of bird families in northwest Alberta. Data Source: Semenchuk 1992.

Table 25. Bird species found in northwest Alberta and their conservation status as indicated in The Status of Alberta Wildlife (1996). List compiled by Doug Collister.

Order	Family	Common Name	Latin Name	Status
Gaviiformes	Gaviidae	Red-throated Loon	*Gavia stellata*	Green
Gaviiformes	Gaviidae	Pacific Loon	*Gavia pacifica*	Green
Gaviiformes	Gaviidae	Common Loon	*Gavia immer*	Green
Podicipediformes	Podocipidae	Pied-billed Grebe	*Podilymbus podiceps*	Yellow A
Podicipediformes	Podocipidae	Horned Grebe	*Podiceps auritus*	Yellow A
Podicipediformes	Podocipidae	Red-necked Grebe	*Podiceps grisegena*	Yellow A
Podicipediformes	Podicipedidae	Eared Grebe	*Podiceps nigricollis*	Green
Podicipediformes	Podicipedidae	Western Grebe	*Aechmophorus occidentalis*	Yellow B
Pelicaniformes	Pelicanidae	American White Pelican	*Pelecanus erythrorhynchos*	Yellow B
Pelicaniformes	Pelicanidae	Double-crested Cormorant	*Phalacrocorax auritus*	Yellow B
Ciconiiformes	Ardeidae	American Bittern	*Botaurus lentigenosis*	Yellow B
Ciconiiformes	Ardeidae	Great Blue Heron	*Ardea herodeus*	Yellow B
Anseriformes	Anatidae	Tundra Swan	*Cygnus columbianus*	Green
Anseriformes	Anatidae	Trumpeter Swan	*Cygnus buccinator*	Blue
Anseriformes	Anatidae	Greater White-fronted Goose	*Anser albifrons*	Green
Anseriformes	Anatidae	Snow Goose	*Anser caerulescens*	Green
Anseriformes	Anatidae	Ross' Goose	*Anser rossii*	Green
Anseriformes	Anatidae	Canada Goose	*Branta canadensis*	Green
Anseriformes	Anatidae	Green-winged Teal	*Anas crecca*	Green
Anseriformes	Anatidae	Mallard	*Anas platyrhynchos*	Green
Anseriformes	Anatidae	Northern Pintail	*Anas acuta*	Green
Anseriformes	Anatidae	Blue-winged Teal	*Anas discors*	Green
Anseriformes	Anatidae	Cinnamon Teal	*Anas cynaoptera*	Green
Anseriformes	Anatidae	Northern Shoveler	*Anas clypeata*	Green
Anseriformes	Anatidae	Gadwall	*Anas strepera*	Green
Anseriformes	Anatidae	Eurasian Wigeon	*Anas penelope*	Green
Anseriformes	Anatidae	American Wigeon	*Anas americana*	Green
Anseriformes	Anatidae	Canvasback	*Aythya valisineria*	Green
Anseriformes	Anatidae	Redhead	*Aythya american*	Green
Anseriformes	Anatidae	Ring-necked Duck	*Aythya collaris*	Green
Anseriformes	Anatidae	Greater Scaup	*Aythya marila*	Green
Anseriformes	Anatidae	Lesser Scaup	*Aythya affinis*	Green
Anseriformes	Anatidae	Harlequin Duck	*Histrionicus histrionicus*	Yellow A
Anseriformes	Anatidae	Oldsquaw	*Clangula hyemalis*	Green
Anseriformes	Anatidae	Surf Scoter	*Melanitta perspicillata*	Green
Anseriformes	Anatidae	White-winged Scoter	*Melanitta fusca*	Green
Anseriformes	Anatidae	Common Goldeneye	*Bucephala clangula*	Green
Anseriformes	Anatidae	Barrow's Goldeneye	*Bucephala islandica*	Green
Anseriformes	Anatidae	Bufflehead	*Bucephala albeola*	Green
Anseriformes	Anatidae	Hooded Merganser	*Lophodytes cucullatus*	Green
Anseriformes	Anatidae	Common Merganser	*Mergus merganser*	Green
Anseriformes	Anatidae	Red-breasted Merganser	*Mergus serrator*	Green
Anseriformes	Anatidae	Ruddy Duck	*Oxyura jamaicensis*	Green
Falconiformes	Acciptridae	Osprey	*Pandion haliaetus*	Yellow B
Falconiformes	Acciptridae	Bald Eagle	*Haliaeetus leucocephalus*	Yellow B
Falconiformes	Acciptridae	Northern Harrier	*Circus cyaneus*	Yellow A
Falconiformes	Acciptridae	Sharp-shinned Hawk	*Accipiter striatus*	Green
Falconiformes	Acciptridae	Cooper's Hawk	*Accipiter cooperii*	Yellow B
Falconiformes	Acciptridae	Northern Goshawk	*Accipiter gentilis*	Yellow B
Falconiformes	Acciptridae	Broad-winged Hawk	*Buteo platypterus*	Yellow B
Falconiformes	Acciptridae	Red-tailed Hawk	*Buteo jamaicensis*	Green
Falconiformes	Acciptridae	Rough-legged Hawk	*Buteo lagopus*	Green
Falconiformes	Acciptridae	Golden Eagle	*Aquila chrysaetos*	Yellow B
Falconiformes	Falconidae	American Kestrel	*Falco sparverius*	Green

Order	Family	Common Name	Latin Name	Status
Falconiformes	Falconidae	Merlin	*Falco columbarius*	Green
Falconiformes	Falconidae	Peregrine Falcon	*Falco peregrinus*	Red
Falconiformes	Falconidae	Gyrfalcon	*Falco rusticolus*	Green
Galliformes	Phasianidae	Gray Partridge	*Perdix perdix*	Green
Galliformes	Phasianidae	Ring-necked Pheasant	*Phasianus colchicus*	Yellow A
Galliformes	Phasianidae	Spruce Grouse	*Dendragapus canadensis*	Green
Galliformes	Phasianidae	Willow Ptarmigan	*Lagopus lagopus*	Green
Galliformes	Phasianidae	Ruffed Grouse	*Bonas umbellus*	Green
Galliformes	Phasianidae	Sharp-tailed Grouse	*Tympanuchus phasianellus*	Yellow A
Gruiformes	Rallidae	Sora	*Porzan carolina*	Green
Gruiformes	Rallidae	American Coot	*Fulica americana*	Green
Gruiformes	Gruidae	Sandhill Crane	*Grus canadensis*	Yellow B
Gruiformes	Gruidae	Whooping Crane	*Grus americana*	Red
Charadriiformes	Charadriidae	Black-bellied Plover	*Pluvialis squatarola*	Green
Charadriiformes	Charadriidae	Lesser Golden-Plover	*Pluvialis dominica*	Green
Charadriiformes	Charadriidae	Semipalmated Plover	*Charadrius sempalmatus*	Green
Charadriiformes	Charadriidae	Killdeer	*Charadrius vociferus*	Green
Charadriiformes	Recurvirostridae	American Avocet	*Recurvirostra america*	Yellow B
Charadriiformes	Scolopacidae	Greater Yellowlegs	*Tringa melanoleuca*	Green
Charadriiformes	Scolopacidae	Lesser Yellowlegs	*Tringa flavipes*	Green
Charadriiformes	Scolopacidae	Solitary Sandpiper	*Tringa solitaria*	Green
Charadriiformes	Scolopacidae	Spotted Sandpiper	*Actitis macularia*	Green
Charadriiformes	Scolopacidae	Upland Sandpiper	*Bartramia longicauda*	Yellow A
Charadriiformes	Scolopacidae	Whimbrel	*Numenius phaeopus*	Green
Charadriiformes	Scolopacidae	Hudsonian Godwit	*Limosa haemastica*	Green
Charadriiformes	Scolopacidae	Ruddy Turnstone	*Arenaria interpres*	Green
Charadriiformes	Scolopacidae	Red Knot	*Calidris canutus*	Green
Charadriiformes	Scolopacidae	Sanderling	*Calidris alba*	Green
Charadriiformes	Scolopacidae	Semipalmated Sandpiper	*Calidris pusilla*	Green
Charadriiformes	Scolopacidae	Western Sandpiper	*Calidris mauri*	Green
Charadriiformes	Scolopacidae	Least Sandpiper	*Calidris minutilla*	Green
Charadriiformes	Scolopacidae	White-rumped Sandpiper	*Calidris fuscicollis*	Green
Charadriiformes	Scolopacidae	Baird's Sandpiper	*Calidris bairdii*	Green
Charadriiformes	Scolopacidae	Pectoral Sandpiper	*Calidris melanotos*	Green
Charadriiformes	Scolopacidae	Dunlin	*Calidris alpina*	Green
Charadriiformes	Scolopacidae	Stilt Sandpiper	*Calidris himantopus*	Green
Charadriiformes	Scolopacidae	Buff-breasted Sandpiper	*Tryngites subrificollis*	Green
Charadriiformes	Scolopacidae	Short-billed Dowitcher	*Limnodromus griseus*	Green
Charadriiformes	Scolopacidae	Long-billed Dowitcher	*Limnodramus scolopaceus*	Green
Charadriiformes	Scolopacidae	Common Snipe	*Gallinago gallinago*	Green
Charadriiformes	Phalaropidae	Wilson's Phalarope	*Phalaropus tricolor*	Green
Charadriiformes	Phalaropidae	Red-necked Phalarope	*Phalaropus lobatus*	Green
Charadriiformes	Laridae	Parasitic Jaeger	*Stercorarius parasiticus*	Green
Charadriiformes	Laridae	Franklin's Gull	*Larus pipixcan*	Green
Charadriiformes	Laridae	Bonaparte's Gull	*Larus philadelphia*	Green
Charadriiformes	Laridae	Mew Gull	*Larus canus*	Green
Charadriiformes	Laridae	Ring-billed Gull	*Larus delawarensis*	Green
Charadriiformes	Laridae	California Gull	*Larus californicus*	Green
Charadriiformes	Laridae	Herring Gull	*Larus argentatus*	Yellow B
Charadriiformes	Laridae	Thayer's Gull	*Larus thayeri*	Green
Charadriiformes	Laridae	Glaucus Gull	*Larus hyperboreus*	Green
Charadriiformes	Laridae	Sabine's Gull	*Xema sabini*	Green
Charadriiformes	Laridae	Caspian Tern	*Sterna caspia*	Yellow B
Charadriiformes	Laridae	Common Tern	*Sterna hirundo*	Green
Charadriiformes	Laridae	Arctic Tern	*Sterna paradisaea*	Green
Charadriiformes	Laridae	Forster's Tern	*Sterna forsteri*	Yellow B
Charadriiformes	Laridae	Black Tern	*Chlidonias niger*	Yellow A

Order	Family	Common Name	Latin Name	Status
Columbriformes	Columbidae	Rock Dove	*Columba livia*	Green
Columbriformes	Columbidae	Mourning Dove	*Zenaida macroura*	Green
Strigiformes	Strigidae	Great Horned Owl	*Bubo virginianus*	Green
Strigiformes	Strigidae	Snowy Owl	*Nyctea scandiaca*	Green
Strigiformes	Strigidae	Northern Hawk Owl	*Surnia ulula*	Green
Strigiformes	Strigidae	Northern Pygmy-Owl	*Glaucidium gnoma*	Green
Strigiformes	Strigidae	Barred Owl	*Strix varia*	Yellow B
Strigiformes	Strigidae	Great Gray Owl	*Strix nebulosa*	Yellow B
Strigiformes	Strigidae	Long-eared Owl	*Asio otus*	Green
Strigiformes	Strigidae	Short-eared Owl	*Asio flammeus*	Blue
Strigiformes	Strigidae	Boreal Owl	*Aegolius funereus*	Green
Strigiformes	Strigidae	Northern Saw-whet Owl	*Aegolius acadicus*	Green
Caprimulgiformes	Caprimulgidae	Common Nighthawk	*Chordeiles minor*	Green
Apodiformes	Trochilidae	Ruby-throated Hummingbird	*Archilochus clubris*	Green
Apodiformes	Trochilidae	Rufous Hummingbird	*Selasphorus rufus*	Green
Coraciiformes	Alcedinidae	Belted Kingfisher	*Ceryle alcyon*	Green
Piciformes	Picidae	Yellow-bellied Sapsucker	*Aphyrapicus varius*	Green
Piciformes	Picidae	Downy Woodpecker	*Picoides pubescens*	Green
Piciformes	Picidae	Hairy Woodpecker	*Picoides villosus*	Green
Piciformes	Picidae	Three-toed Woodpecker	*Picoides tridactylus*	Green
Piciformes	Picidae	Black-backed Woodpecker	*Picoides arcticus*	Yellow B
Piciformes	Picidae	Northern Flicker	*Colaptes auratus*	Green
Piciformes	Picidae	Pileated Woodpecker	*Dryocopus pileatus*	Yellow B
Passeriformes	Tyrannidae	Olive-sided Flycatcher	*Contopus borealis*	Green
Passeriformes	Tyrannidae	Western Wood-Pewee	*Contopus sordidulus*	Green
Passeriformes	Tyrannidae	Yellow-bellied Flycatcher	*Empidonax flaviventris*	Unknown
Passeriformes	Tyrannidae	Alder Flycatcher	*Empidonax alnorum*	Green
Passeriformes	Tyrannidae	Least Flycatcher	*Empidonax minimus*	Green
Passeriformes	Tyrannidae	Eastern Phoebe	*Sayornis phoebe*	Green
Passeriformes	Tyrannidae	Say's Phoebe	*Sayornis saya*	Green
Passeriformes	Tyrannidae	Eastern Kingbird	*Tyrannus tyrannus*	Green
Passeriformes	Alaudidae	Horned Lark	*Eremophila alpestris*	Green
Passeriformes	Hirundinidae	Purple Martin	*Progne subis*	Green
Passeriformes	Hirundinidae	Tree Swallow	*Tachycineta bicolor*	Green
Passeriformes	Hirundinidae	Bank Swallow	*Riparia riparia*	Green
Passeriformes	Hirundinidae	Cliff Swallow	*Hirundo pyrrhonota*	Green
Passeriformes	Hirundinidae	Barn Swallow	*Hirundo rustica*	Green
Passeriformes	Corvidae	Gray Jay	*Perisoreus canadensis*	Green
Passeriformes	Corvidae	Blue Jay	*Cyanocitta cristata*	Green
Passeriformes	Corvidae	Black-billed Magpie	*Pica pica*	Green
Passeriformes	Corvidae	American Crow	*Corvus brachyrhynchos*	Green
Passeriformes	Corvidae	Common Raven	*Corvus corax*	Green
Passeriformes	Paridae	Black-capped Chickadee	*Parus atricapillus*	Green
Passeriformes	Paridae	Mountain Chickadee	*Parus gambeli*	Green
Passeriformes	Paridae	Boreal Chickadee	*Parus hudsonicus*	Green
Passeriformes	Sittidae	Red-breasted Nuthatch	*Sitta canadensis*	Green
Passeriformes	Certhiidae	Brown Creeper	*Certhia americana*	Yellow B
Passeriformes	Troglodytidae	House Wren	*Troglodytes aedon*	Green
Passeriformes	Troglodytidae	Winter Wren	*Troglodytes troglodytes*	Green
Passeriformes	Troglodytidae	Marsh Wren	*Cistothorus palustris*	Yellow B
Passeriformes	Muscicapidae	Golden-crowned Kinglet	*Regulus satrapa*	Green
Passeriformes	Muscicapidae	Ruby-crowned Kinglet	*Regulus calendula*	Green
Passeriformes	Muscicapidae	Mountain Bluebird	*Sialia currocoides*	Green
Passeriformes	Muscicapidae	Townsend's Solitaire	*Myadestes townsendi*	Green
Passeriformes	Muscicapidae	Gray-cheeked Thrush	*Catharus minimus*	Green
Passeriformes	Muscicapidae	Swainson's Thrush	*Catharus ustulatus*	Green
Passeriformes	Muscicapidae	Hermit Thrush	*Catharus guttatus*	Green

Order	Family	Common Name	Latin Name	Status
Passeriformes	Muscicapidae	American Robin	*Turdus migratorius*	Green
Passeriformes	Muscicapidae	Varied Thrush	*Ixoreus naevius*	Green
Passeriformes	Muscicapidae	American Pipit	*Anthus rubescens*	Green
Passeriformes	Bombycillidae	Bohemian Waxwing	*Bombycilla garrulus*	Green
Passeriformes	Bombycillidae	Cedar Waxwing	*Bombycilla cedorum*	Green
Passeriformes	Lanidae	Northern Shrike	*Lanius excubitor*	Green
Passeriformes	Lanidae	Loggerhead Shrike	*Lanius ludovicianus*	Yellow A
Passeriformes	Sternidae	European Starling	*Sturnus vulgaris*	Green
Passeriformes	Vireonidae	Solitary Vireo	*Vireo solitarius*	Green
Passeriformes	Vireonidae	Warbling Vireo	*Vire gilvus*	Green
Passeriformes	Vireonidae	Philadelphia Vireo	*Vireo philadelphicus*	Green
Passeriformes	Vireonidae	Red-eyed Vireo	*Vireo olivaceus*	Green
Passeriformes	Emberizidae	Tennessee Warbler	*Vermivora peregrina*	Green
Passeriformes	Emberizidae	Orange-crowned Warbler	*Vermivora celata*	Green
Passeriformes	Emberizidae	Yellow Warbler	*Dendrica petechia*	Green
Passeriformes	Emberizidae	Magnolia Warbler	*Dendrica magnolia*	Green
Passeriformes	Emberizidae	Cape May Warbler	*Dendrica carulescens*	Blue
Passeriformes	Emberizidae	Yellow-rumped Warbler	*Dendrica coronata*	Green
Passeriformes	Emberizidae	Black-throated Green Warbler	*Dendroica virens*	Blue
Passeriformes	Emberizidae	Blackburnian Warbler	*Dendroica fusca*	Green
Passeriformes	Emberizidae	Palm Warbler	*Dendrica palmarum*	Green
Passeriformes	Emberizidae	Bay-breasted Warbler	*Dendroica castanea*	Blue
Passeriformes	Emberizidae	Blackpoll Warbler	*Dendrica striata*	Yellow B
Passeriformes	Emberizidae	Black-and-white Warbler	*Mniotilta varia*	Yellow B
Passeriformes	Emberizidae	American Redstart	*Setophaga ruticilla*	Green
Passeriformes	Emberizidae	Ovenbird	*Seirus aurocapillus*	Green
Passeriformes	Emberizidae	Northern Waterthrush	*Seirus noveboracensis*	Green
Passeriformes	Emberizidae	Connecticut Warbler	*Oporornis agilis*	Green
Passeriformes	Emberizidae	Mourning Warbler	*Oporornis philadelphia*	Green
Passeriformes	Emberizidae	Common Yellowthroat	*Geothlypis trichas*	Green
Passeriformes	Emberizidae	Wilson's Warbler	*Wilsonia pusilla*	Green
Passeriformes	Emberizidae	Canada Warbler	*Wilsonia canadensis*	Yellow B
Passeriformes	Emberizidae	Western Tanager	*Piranga ludoviciana*	Yellow B
Passeriformes	Emberizidae	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Green
Passeriformes	Emberizidae	American Tree Sparrow	*Spizella arborea*	Green
Passeriformes	Emberizidae	Chipping Sparrow	*Spizella passerina*	Green
Passeriformes	Emberizidae	Clay-coloured Sparrow	*Spizella pallida*	Yellow A
Passeriformes	Emberizidae	Vesper Sparrow	*Pooecetes gramineus*	Green
Passeriformes	Emberizidae	Savannah Sparrow	*Passerculus sandwichensis*	Green
Passeriformes	Emberizidae	Le Conte's Sparrow	*Ammodramus leconteii*	Green
Passeriformes	Emberizidae	Sharp-tailed Sparrow	*Ammodramus caudacutus*	Green
Passeriformes	Emberizidae	Fox Sparrow	*Passerella iliaca*	Green
Passeriformes	Emberizidae	Song Sparrow	*Melospiza melodia*	Green
Passeriformes	Emberizidae	Lincoln's Sparrow	*Melospiza lincolnii*	Green
Passeriformes	Emberizidae	Swamp Sparrow	*Melospiza georgiana*	Green
Passeriformes	Emberizidae	White-throated Sparrow	*Zonotrichia albicollis*	Green
Passeriformes	Emberizidae	White-crowned Sparrow	*Zonotrichia leucophrys*	Green
Passeriformes	Emberizidae	Harris' Sparrow	*Zonotrichia querula*	Green
Passeriformes	Emberizidae	Dark-eyed Junco	*Junco hyemalis*	Green
Passeriformes	Emberizidae	Lapland Longspur	*Calcarius lapponicus*	Green
Passeriformes	Emberizidae	Smith's Longspur	*Calcarius pictus*	Green
Passeriformes	Emberizidae	Snow Bunting	*Plectrophenax nivalis*	Green
Passeriformes	Emberizidae	Red-winged Blackbird	*Agelaius phoeniceus*	Green
Passeriformes	Emberizidae	Western Meadowlark	*Sturnella neglecta*	Yellow A
Passeriformes	Emberizidae	Yellow-headed Blackbird	*Xanthocephalus xanthocephalu*	Green
Passeriformes	Emberizidae	Rusty Blackbird	*Euphagus carolinus*	Green
Passeriformes	Emberizidae	Brewer's Blackbird	*Euphagus cyanocephalus*	Green

Order	Family	Common Name	Latin Name	Status
Passeriformes	Emberizidae	Common Grackle	*Quiscalus quiscula*	Green
Passeriformes	Emberizidae	Brown-headed Cowbird	*Molothrus ater*	Green
Passeriformes	Emberizidae	Northern Oriole	*Icterus galbula*	Green
Passeriformes	Emberizidae	Gray-crowned Rosy Finch	*Leucosticte tephrocotis*	Green
Passeriformes	Emberizidae	Pine Grosbeak	*Pinicola enucleator*	Green
Passeriformes	Fringillidae	Purple Finch	*Carpodacus pupureus*	Unknown
Passeriformes	Fringillidae	Red Crossbill	*Loxia curvirostra*	Green
Passeriformes	Fringillidae	White-winged Crossbill	*Loxia leucoptera*	Green
Passeriformes	Fringillidae	Common Redpoll	*Carduelis flammea*	Green
Passeriformes	Fringillidae	Hoary Redpoll	*Carduelis hornemmani*	Green
Passeriformes	Fringillidae	Pine Siskin	*Carduelis pinus*	Green
Passeriformes	Fringillidae	American Goldfinch	*Carduelis tristis*	Green
Passeriformes	Fringillidae	Evening Grosbeak	*Coccothraustes vespertinus*	Green
Passeriformes	Passeridae	House Sparrow	*Passer domesticus*	Green

Trends in Relative Abundance of Bird Species

Systematic longterm (e.g., multi-decade) monitoring of the bird community does not exist in northwest Alberta. Some temporal data, however, exists for migratory waterfowl as provided by joint monitoring by the Canadian and U.S. federal governments and Ducks Unlimited (see section on migratory waterfowl). Citizen-based Christmas bird counts provide local information that might be useful in detecting changes in populations of some winter resident birds. The Atlas of Breeding Birds of Alberta (Semenchuk 1992) is the most detailed systematic assessment of breeding birds in Alberta but can not be used to assess temporal changes as it has been conducted once.

From a continental, national, or provincial scale, however, the most expansive program is the North American Breeding Bird Program (BBS) (Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, and B. G. Peterjohn 1997). This geographically extensive survey, which provides estimates of population change of songbirds, is based on visual and acoustic counts of birds on over 3,500 routes surveyed in June throughout North America by experienced birders. Unfortunately, this inventory program does not cover all of northwest Alberta. Notwithstanding, the BBS program does allow us to examine relative changes in provincial population density of those bird species known to occur in northwest Alberta. This information, in turn, can be used to assist forest companies in identifying bird species which may be currently declining and therefore may require specific attention or management action. Table 25 provide estimates of temporal trends in provincial bird species found in northwest Alberta. These data were used to create graphics indicating those bird species whose relative abundance index from 1966–1996 is negative (<0%; Figure 34), slightly positive (0-3%; Figure 35) or moderately positive (>3%; Figure 36). Of the bird species monitored by the BBS, 31 species exhibited a significant (p=0.05) increase in relative abundance whereas 15 species exhibited a significant decline in relative abundance.

The findings of the BBS surveys may not accurately reflect bird abundances across the full spectrum of plant communities as it is likely weighted towards those plant community types proximal to human settlements or those found along the transportation networks. For example, the increasing abundance of cedar waxwings and merlins shown in Alberta may partly reflect the plantings of mountain ash and spruce seedlings in towns and cities throughout Alberta (Susan Hannon, personal communication). Mountain ash and spruce are important as forage and nesting sites for waxwings and merlins, respectively. Despite the potential biases of this database, it is the best available to examine temporal trends, and its biases are likely minor in relation to the composition, scope, and sampling years of the BBS surveys.

Table 26. Population trends (1966–96) of bird species found in northwest Alberta that were monitored by the Breeding Bird Survey Program. Those species that exhibited a significant positive (+) or negative (–) trend are highlighted. Data Source: Breeding Bird Survey Program.

Species	Mean Population Trend	Probability of Significance	Number of Survey Routes	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Route Average
Red-necked Grebe	-0.5	0.80	21	-4.4	3.4	1.49
Horned Grebe (–)	-4.9	0.00	24	-7.8	-2.0	0.38
Eared Grebe	-7.8	0.35	16	-23.4	7.8	0.78
Pied-billed Grebe (–)	-9.2	0.00	19	-13.0	-5.4	0.22
Common Loon (+)	5.7	0.04	20	0.7	10.6	0.19
California Gull (+)	10.8	0.01	27	3.4	18.3	1.11
Ring-billed Gull (+)	7.3	0.01	53	2.1	12.6	16.00
Franklin's Gull	15.1	0.12	43	-3.5	33.6	22.25
Black Tern	-0.3	0.93	47	-7.9	7.3	5.58
Double-crest. Cormorant	-0.3	0.97	15	-15.0	14.3	1.47
Mallard (+)	2.7	0.00	76	1.0	4.4	21.56
Gadwall (+)	2.8	0.04	54	0.2	5.4	4.35
American Wigeon	-0.7	0.65	43	-3.7	2.3	2.30
Green-winged Teal	-0.3	0.89	43	-4.9	4.2	1.70
Blue-winged Teal	-1.5	0.25	60	-4.1	1.0	4.96
Northern Shoveler	0.9	0.75	52	-4.5	6.2	3.98
Northern Pintail (–)	-4.3	0.00	44	-7.0	-1.6	4.21
Redhead	5.7	0.15	31	-1.9	13.2	1.37
Canvasback	-1.2	0.70	20	-7.1	4.7	0.29
Lesser Scaup	0.5	0.73	55	-2.1	3.0	6.15
Ring-necked Duck	11.6	0.43	14	-15.9	39.1	0.25
Common Goldeneye	8.8	0.17	18	-3.3	20.9	0.53
Bufflehead (+)	8.2	0.04	24	1.0	15.5	0.48
Ruddy Duck	1.3	0.60	33	-3.4	5.9	1.31
Canada Goose (+)	8.9	0.02	51	1.8	16.0	7.14
American Bittern (–)	-8.7	0.01	17	-14.4	-3.0	0.48
Great Blue Heron (+)	6.3	0.00	26	3.0	9.5	0.21
Sora (–)	-2.4	0.05	58	-4.8	-0.1	2.63
American Coot (–)	-2.9	0.03	52	-5.5	-0.3	3.40
Wilson's Phalarope	-1.5	0.28	30	-4.3	1.2	0.89
American Avocet	1.2	0.81	25	-8.4	10.7	0.83
Common Snipe	0.5	0.67	69	-1.8	2.8	6.37
Marbled Godwit	1.0	0.62	50	-2.9	4.9	5.84
Lesser Yellowlegs (–)	-9.2	0.01	14	-15.0	-3.3	0.46
Willet	-1.2	0.19	37	-3.0	0.6	3.05
Spotted Sandpiper	3.0	0.23	39	-1.8	7.8	0.79
Long-billed Curlew	-0.5	0.79	20	-4.1	3.1	2.61
Killdeer (–)	-2.1	0.00	77	-3.2	-1.0	5.03
Gray Partridge	3.6	0.27	33	-2.7	10.0	0.66
Ruffed Grouse	-5.2	0.11	15	-11.1	0.8	0.34
Ring-necked Pheasant	-1.4	0.34	34	-4.3	1.5	1.55
Rock Dove	2.0	0.14	55	-0.6	4.7	7.58
Mourning Dove (–)	-3.7	0.03	50	-6.8	-0.5	1.29
Northern Harrier	-3.1	0.08	55	-6.5	0.2	1.00
Red-tailed Hawk (+)	3.9	0.00	66	2.1	5.8	2.44
Swainson's Hawk	0.8	0.67	49	-2.7	4.2	2.35
Merlin (+)	18.0	0.01	16	6.7	29.3	0.07
American Kestrel	0.6	0.70	44	-2.5	3.7	0.63

Species	Mean Population Trend	Probability of Significance	Number of Survey Routes	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Route Average
Short-eared Owl (–)	-12.7	0.00	17	-20	-5.4	0.18
Great Horned Owl	3.5	0.25	31	-2.3	9.3	0.25
Hairy Woodpecker (+)	6.7	0.02	26	1.3	12	0.20
Downy Woodpecker	2.7	0.46	14	-4.2	9.6	0.14
Yellow-bellied Sapsucker	-1.0	0.77	27	-7.9	5.9	0.52
Yellow-shafted Flicker	-2.3	0.36	46	-7.1	2.5	1.32
Common Nighthawk (–)	-5.8	0.01	18	-9.6	-1.9	0.11
Eastern Kingbird	-2.1	0.13	65	-4.8	0.6	2.36
Western Kingbird	1.6	0.22	22	-0.9	4	0.65
Eastern Phoebe (–)	-4.6	0.04	39	-9.0	-0.3	0.96
Olive-sided Flycatcher (+)	6.1	0.02	24	1.2	11.0	0.37
Western Wood-Pewee	0.3	0.87	51	-3.1	3.7	2.58
Alder Flycatcher	-0.4	0.81	46	-3.3	2.6	4.62
Least Flycatcher (+)	1.3	0.00	64	0.6	2.0	9.20
Horned Lark	0.2	0.63	45	-0.7	1.1	30.65
Black-billed Magpie	-0.3	0.73	79	-2.1	1.5	17.41
Blue Jay	2.8	0.25	22	-1.8	7.5	0.49
Gray Jay	-2.2	0.48	18	-8.0	3.7	0.89
Common Raven (+)	11.8	0.00	38	4.1	19.4	1.45
American Crow	0.2	0.82	81	-1.4	1.8	33.49
European Starling	-0.8	0.38	72	-2.7	1.0	35.14
Brown-headed Cowbird	-0.7	0.41	78	-2.2	0.9	12.55
Yellow-head. Blackbird	-1.4	0.25	56	-3.7	1.0	8.78
Red-winged Blackbird	-0.6	0.42	79	-2.2	0.9	52.88
Western Meadowlark	-0.8	0.16	63	-1.8	0.3	23.06
Baltimore Oriole	0.6	0.43	53	-0.9	2.1	4.88
Brewer's Blackbird	-0.4	0.69	76	-2.2	1.5	21.76
Common Grackle (–)	-7.8	0.03	29	-14.6	-1.0	0.88
American Goldfinch (+)	5.3	0.00	60	3.0	7.6	4.26
Pine Siskin	3.6	0.12	35	-0.8	8.0	5.72
Chestnut-col. Longspur	2.1	0.63	21	-6.1	10.2	12.71
Vesper Sparrow	1.7	0.22	73	-1.0	4.4	16.4
Savannah Sparrow (+)	1.6	0.03	79	0.2	3.1	35.91
Baird's Sparrow	-0.4	0.90	23	-6.1	5.4	2.10
Le Conte's Sparrow	2.2	0.24	43	-1.4	5.7	2.33
White-crown. Sparrow (+)	5.3	0.02	15	1.3	9.4	2.12
White-throated Sparrow	-0.9	0.64	40	-4.7	2.9	6.00
Chipping Sparrow	-0.8	0.48	58	-2.9	1.3	5.55
Clay-colored Sparrow (–)	-1.4	0.00	81	-1.9	-0.8	27.51
Slate-colored Junco (+)	3.3	0.02	32	0.8	5.8	3.42
Song Sparrow (–)	-2.9	0.02	56	-5.3	-0.4	11.30
Lincoln's Sparrow (+)	7.1	0.00	39	4.7	9.5	4.91
Swamp Sparrow	13.7	0.07	18	0.0	27.3	0.44
Rose-breasted Grosbeak	2.1	0.49	28	-3.7	7.8	1.40
Cliff Swallow	3.5	0.18	48	-1.6	8.6	23.55
Barn Swallow (+)	1.6	0.00	80	0.6	2.6	9.36
Tree Swallow (+)	6.3	0.01	60	1.7	10.8	6.60
Bank Swallow	5.4	0.24	28	-3.4	14.2	2.60
Cedar Waxwing (+)	11.7	0.00	40	5.4	18.0	2.27
Loggerhead Shrike	-6.0	0.20	14	-14.7	2.7	0.30
Red-eyed Vireo	0.8	0.50	48	-1.4	3.0	6.94

Species	Mean Population Trend	Probability of Significance	Number of Survey Routes	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Route Average
Warbling Vireo (+)	5.3	0.00	54	2.2	8.4	3.18
Solitary Vireo (+)	10.2	0.02	14	2.8	17.6	0.25
Orange-cr. Warbler (+)	16.8	0.03	15	3.6	30.0	0.39
Tennessee Warbler	2.3	0.65	26	-7.6	12.1	0.60
Yellow Warbler (+)	1.6	0.01	73	0.5	2.8	9.63
Myrtle Warbler (+)	6.2	0.04	25	0.7	11.8	3.10
Ovenbird	-0.4	0.92	20	-7.9	7.1	0.43
Connecticut Warbler	11.1	0.09	14	-1.0	23.2	0.28
Mourning Warbler	4.7	0.44	14	-6.9	16.3	0.30
Common Yellowthroat	-0.1	0.96	60	-2.3	2.2	2.84
House Sparrow	-0.1	0.91	66	-2.1	1.8	29.89
Sprague's Pipit (–)	-9.4	0.00	34	-15.4	-3.3	3.37
Gray Catbird	2.7	0.36	27	-3.0	8.4	0.20
House Wren (+)	2.9	0.00	69	1.2	4.6	14.03
Red-breast. Nuthatch (+)	13.3	0.01	29	4.1	22.6	0.56
Black-capped Chickadee	1.8	0.24	52	-1.2	4.8	2.01
Boreal Chickadee	2.9	0.61	14	-8.0	13.8	0.23
Ruby-crown. Kinglet (+)	6.7	0.03	29	0.9	12.5	3.82
Swainson's Thrush (+)	3.4	0.03	33	0.5	6.4	4.61
Hermit Thrush	-3.3	0.42	28	-11.4	4.7	1.01
American Robin (+)	1.7	0.01	82	0.5	2.9	21.27
Mountain Bluebird	9.7	0.15	35	-3.1	22.4	1.40

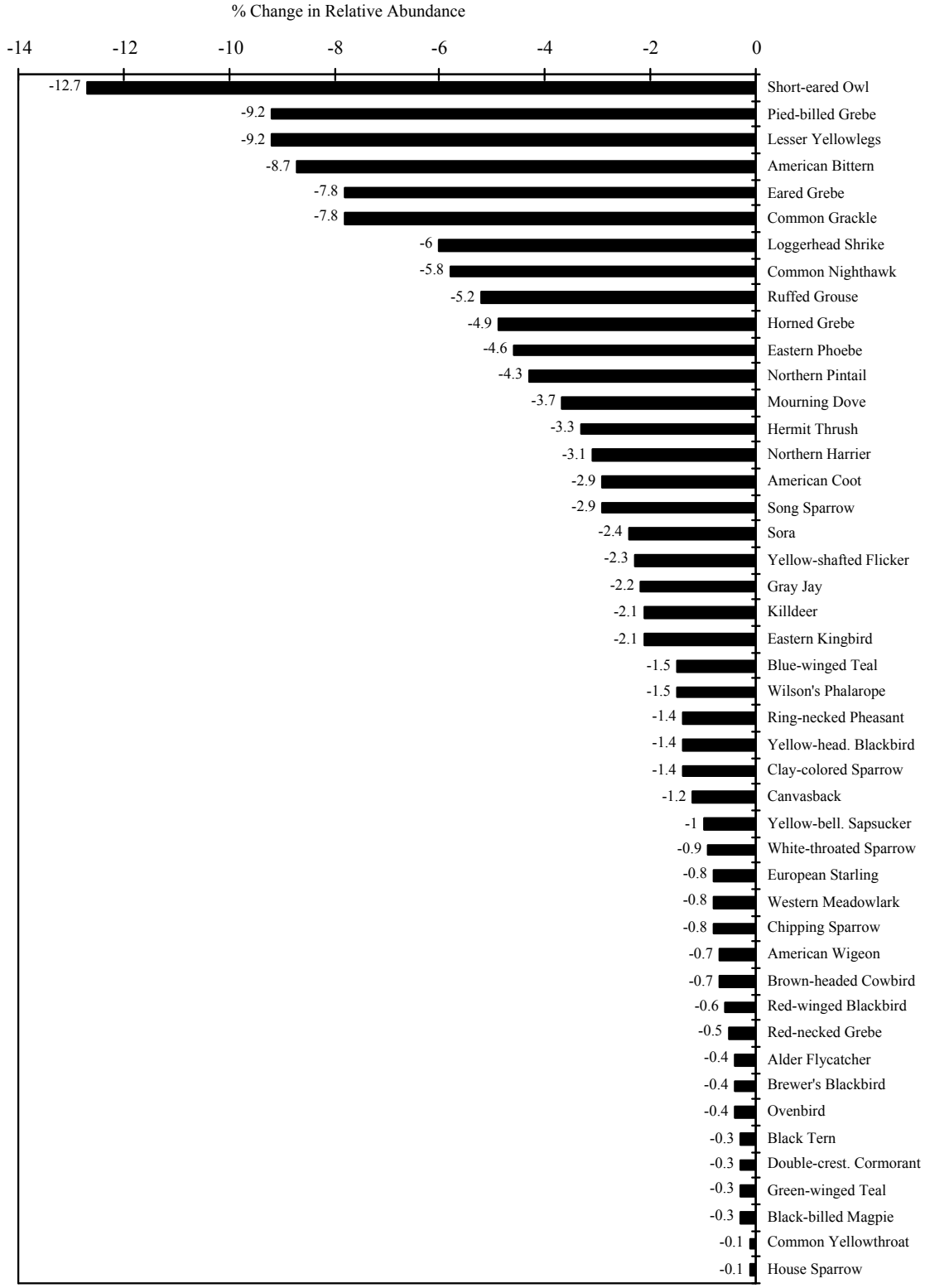

Figure 34. Bird species in northwest Alberta whose provincial populations have apparently decreased (-14–0%) between 1966–1996 based on data of the North American Breeding Bird Surveys. Data Source: web site: http://www.mbr.nbs.gov/bbs/bbs.html.

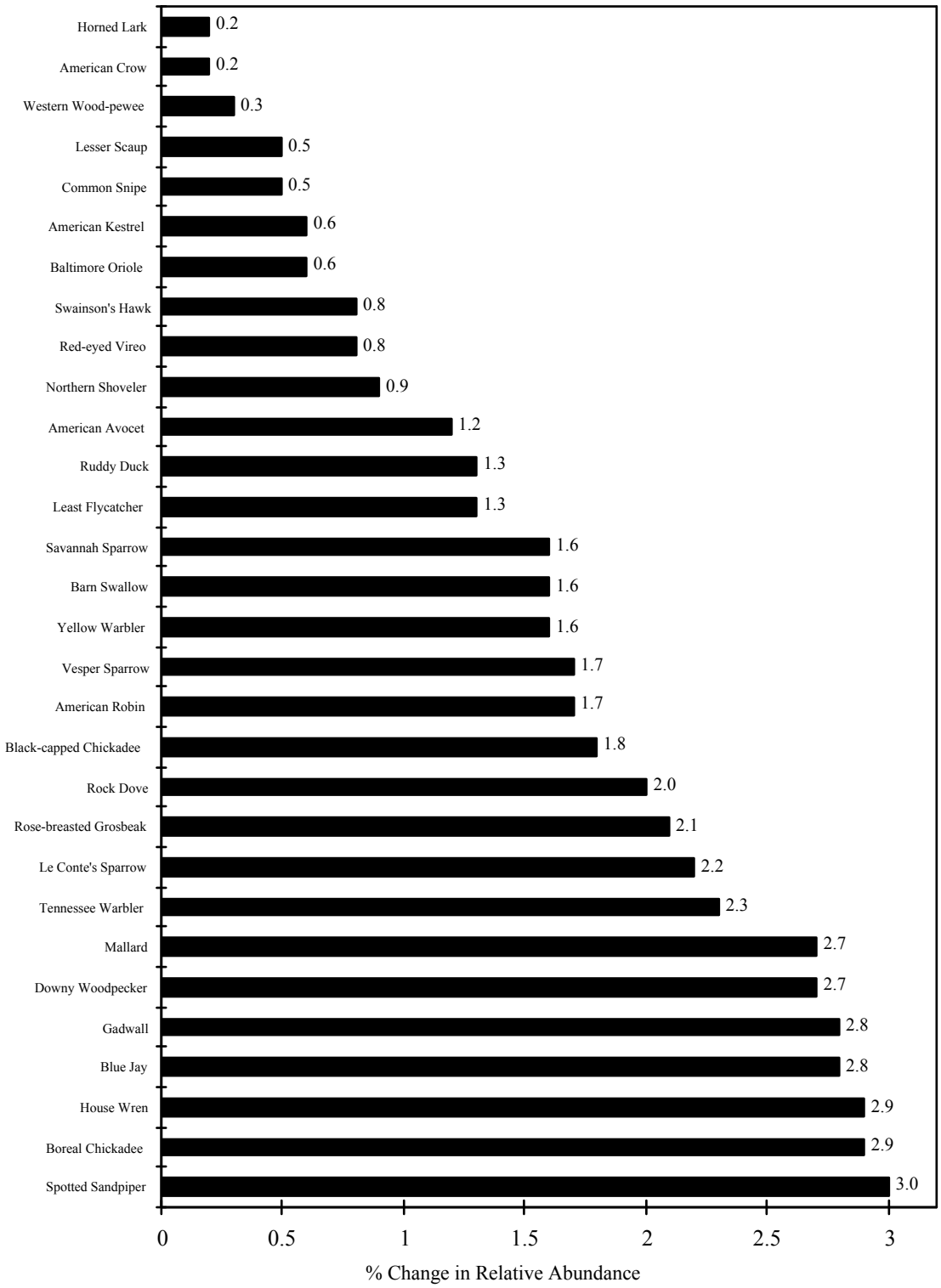

Figure 35. Bird species in northwest Alberta whose provincial population has apparently increased (0–3%) based on data of the North American Breeding Bird Surveys (1966–1996). Data Source: http://www.mbr.nbs.gov/bbs/bbs.html.

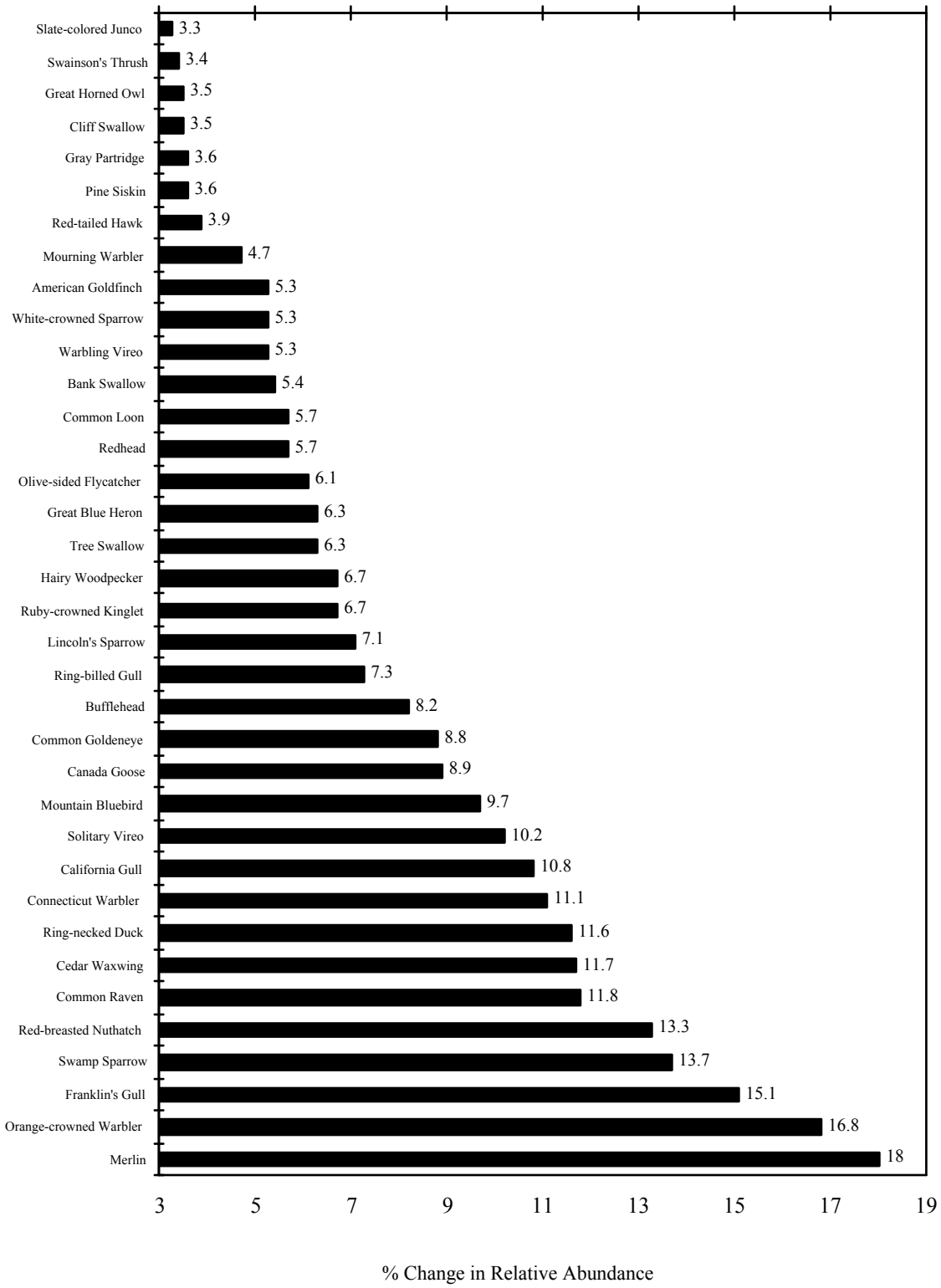

Figure 36. Bird species in northwest Alberta whose provincial population has apparently increased (>3%) between 1966–1996 based on data of the North American Breeding Bird Surveys. Data Source: web site: http://www.mbr.nbs.gov/bbs/bbs.html.

Patterns of Habitat Use

Table 27 indicates the habitat preferences, nest site preferences, migratory patterns, foraging guilds, and geographic origin of 128 of the 239 species of birds in northwest Alberta. These are generally species that depend on the forest for at least part of their life cycle. These data were used to create Figures 36, 37, 38, 39 and 40 that indicate the number of species with the various habitat, nesting or foraging preferences, migratory patterns or geographic origin.

Table 27. Description of migratory patterns, geographic origin, foraging guild, nest site and habitat preference of selected birds found in northwest Alberta. Data Source: Smith 1993.

Species	Migratory Pattern	Geographic Origin	Foraging Guild	Nest Site	Habitat Preference
*Great Blue Heron	SD	PA	PI	TR	AQ
*Common Goldeneye	SD	NO	AI	CT	AQ
*Bufflehead	SD	NO	AI	CT	AQ
*Hooded Merganser	SD	EA	PI	CT	AQ
*Common Merganser	SD	NO	PI	CT	AQ
*Osprey	LD	PA	PI	TR	AQ
*Bald Eagle	PR	NO	PI	TR	AQ
Northern Harrier	SD	PA	CA	GR	RE
Sharp-shinned Hawk	SD	PA	CA	TR	ME
Cooper's Hawk	SD	PA	CA	TR	ME
Northern Goshawk	PR	NO	CA	TR	ME
Broad-winged Hawk	LD	EA	CA	TR	MO
Red-tailed Hawk	SD	PA	CA	TR	ME
Golden Eagle	SD	WE	CA	CO	RE
American Kestrel	SD	PA	CA	CT	ME
Merlin	SD	NO	CA	TR	ME
Peregrine Falcon	LD	PA	CA	CO	RE
Spruce Grouse	PR	NO	OM	CT	MO
Ruffed Grouse	PR	EA	OM	TR	MO
Sharp-tailed Grouse	PR	CE	OM	CO	RE
Killdeer	SD	PA	OM	GR	RE
*Greater Yellowlegs	SD	NO	AI	GR	AQ
*Lesser Yellowlegs	SD	NO	AI	GR	AQ
*Solitary Sandpiper	SD	NO	AI	GR	AQ
Upland Sandpiper	SD	CE	AI	GR	RE
*Short-billed Dowitcher	SD	NO	AI	GR	AQ
*Bonaparte's Gull	LD	NO	AI	TR	AQ
Rock Dove	PR	IN	OM	CO	OT
Mourning Dove	SD	PA	OM	GR	YI
Great Horned Owl	PR	PA	CA	TR	ME
Northern Hawk-Owl	PR	NO	CA	CT	ME
Barred Owl	PR	EA	CA	CT	MO
Great Gray Owl	PR	NO	CA	TR	ME
Long-eared Owl	SD	PA	CA	TR	YI
Short-eared Owl	PR	PA	CA	GR	RE
Boreal Owl	PR	NO	CA	CT	MO
Northern Saw-whet Owl	PR	NO	CA	CT	MO
Common Nighthawk	LD	PA	IA	GR	RE
Ruby-throated Hummingbird	LD	EA	NE	TR	ME
*Belted Kingfisher	SD	PA	PI	CO	AQ
Yellow-bellied Sapsucker	SD	NO	IE	CT	MO
Downy Woodpecker	PR	PA	IE	CT	MO
Hairy Woodpecker	PR	NO	IE	CT	MO
Three-toed Woodpecker	PR	NO	IE	CT	MO

Species	Migratory Pattern	Geographic Origin	Foraging Guild	Nest Site	Habitat Preference
Black-backed Woodpecker	PR	NO	IE	CT	MO
Northern Flicker	PR	PA	IE	CT	MO
Pileated Woodpecker	SD	EA	IE	CT	ME
Olive-sided Flycatcher	PR	NO	IE	CT	MO
Western Wood-Pewee	LD	WE	IA	TR	ME
Yellow-bellied Flycatcher	LD	NO	IA	TR	ME
Alder Flycatcher	LD	NO	IA	GR	ME
Least Flycatcher	LD	EA	IA	SH	YI
Eastern Phoebe	SD	EA	IA	TR	MO
Say's Phoebe	LD	WE	IA	CO	OT
Eastern Kingbird	LD	EA	IA	CT	ME
Purple Martin	LD	PA	IA	CT	YI
Tree Swallow	SD	NO	IA	CT	ME
Bank Swallow	LD	PA	IA	CT	ME
Cliff Swallow	LD	PA	IA	CO	OT
Barn Swallow	LD	PA	IA	CO	OT
Gray Jay	PR	NO	OM	TR	MO
Blue Jay	PR	EA	OM	TR	ME
Black-billed Magpie	PR	WE	OM	TR	YI
American Crow	SD	PA	OM	TR	ME
Common Raven	PR	NO	OM	TR	ME
Black-capped Chickadee	PR	PA	IT	CT	MO
Boreal Chickadee	PR	NO	IT	CT	MO
Red-breasted Nuthatch	PR	NO	IT	CT	MO
Brown Creeper	PR	NO	IT	TR	MO
House Wren	LD	PA	IL	CT	YI
Winter Wren	SD	NO	IL	CO	MO
Golden-crowned Kinglet	PR	NO	IL	TR	MO
Ruby-crowned Kinglet	SD	NO	IL	TR	MO
Mountain Bluebird	SD	WE	IA	CT	ME
Swainson's Thrush	LD	NO	OM	GR	MO
Hermit Thrush	SD	NO	OM	GR	MO
American Robin	SD	PA	OM	SH	ME
Bohemian Waxwing	PR	WE	OM	TR	ME
Cedar Waxwing	SD	PA	OM	TR	YI
European Starling	SD	IN	OM	CT	ME
Solitary Vireo	SD	NO	IL	TR	ME
Warbling Vireo	LD	WE	IL	TR	ME
Philadelphia Vireo	LD	NO	IL	TR	YI
Red-eyed Vireo	LD	EA	IL	TR	MO
Tennessee Warbler	LD	NO	IL	GR	MO
Orange-crowned Warbler	SD	NO	IL	GR	YI
Yellow Warbler	LD	PA	IL	SH	YI
Magnolia Warbler	LD	NO	IL	SH	YI
Cape May Warbler	LD	NO	IL	TR	MO
Yellow-rumped Warbler	SD	NO	IL	TR	MO
Black-throated Green Warbler	LD	EA	IL	TR	MO
Blackburnian Warbler	LD	NO	IL	TR	MO
Palm Warbler	LD	NO	IL	GR	YI
Bay-breasted Warbler	LD	NO	IL	TR	MO
Blackpoll Warbler	LD	NO	IL	SH	YI
Black-and-White Warbler	LD	EA	IT	GR	ME
American Redstart	LD	EA	IA	TR	YI
Ovenbird	LD	EA	IL	GR	MO
Northern Waterthrush	LD	NO	IL	GR	ME
Connecticut Warbler	LD	NO	IL	GR	MO

Species	Migratory Pattern	Geographic Origin	Foraging Guild	Nest Site	Habitat Preference
Mourning Warbler	LD	NO	IL	GR	YI
Wilson's Warbler	LD	NO	IL	GR	YI
Canada Warbler	LD	NO	IL	GR	ME
Western Tanager	LD	WE	IL	TR	MO
Rose-breasted Grosbeak	LD	EA	OM	SH	MO
Chipping Sparrow	LD	PA	OM	SH	MO
Clay-coloured Sparrow	LD	CE	OM	SH	YI
Vesper Sparrow	SD	PA	OM	SH	RE
Savannah Sparrow	SD	PA	OM	SH	RE
Fox Sparrow	SD	NO	OM	SH	YI
Song Sparrow	SD	PA	OM	SH	YI
Lincoln's Sparrow	LD	NO	OM	GR	YI
Swamp Sparrow	SD	NO	OM	GR	YI
White-throated Sparrow	SD	NO	OM	GR	YI
Dark-eyed Junco	SD	NO	OM	GR	ME
Western Meadowlark	SD	CE	OM	GR	RE
Rusty Blackbird	SD	NO	OM	SH	MI
Brewer's Blackbird	SD	WE	OM	SH	RE
Common Grackle	SD	EA	OM	TR	ME
Brown-headed Cowbird	SD	CE	OM	NN	OT
Northern Oriole	LD	EA	OM	TR	ME
Purple Finch	SD	NO	OM	TR	MO
Red Crossbill	PR	NO	OM	TR	MO
White-winged Crossbill	PR	NO	OM	TR	MO
Pine Siskin	SD	NO	OM	TR	MO
American Goldfinch	SD	EA	OM	SH	YI
Evening Grosbeak	PR	WE	OM	TR	MO
House Sparrow	PR	IN	OM	CO	OT

Key to Abbreviations:

Migratory Pattern

SD	Short -distance Migrant
LD	Long-distance Migrant
PR	Permanent Resident

Geographic Origin

EA	Eastern
CE	Central
NO	Northern
PA	Pandemic
WE	Western
IN	Introduced

Foraging Guild

AI	Aquatic Invertebrates
CA	Carnivores
NE	Nectivores
IF	Insectivores (flying insects (aerial & sallying feeders)
IL	Insectivores: insects on leaves (leaf gleaners)
IT	Insectivores: insects on trunks (trunk gleaners)
IE	Insectivores: insects in trees (excavators)
OM	Omnivores (eat both plant and animal tissue)
PI	Piscivores (fish eaters)

Nest Site

CT	Cavity, tree
CO	Cavity (other, cliff, building)
TR	Tree
GR	Ground
SH	Shrub
NN	No nest (Brown-headed cowbird)
OT	Other

Habitat Preference

AQ	Aquatic
ME	Mature, old growth with edge
MO	Mature, old growth, without edge
RE	Recently burned or clear-cut
YI	Young, immature
OT	Other

*Species foraging in aquatic habitats but requiring upland or bog habitat for nesting

Habitat Preference

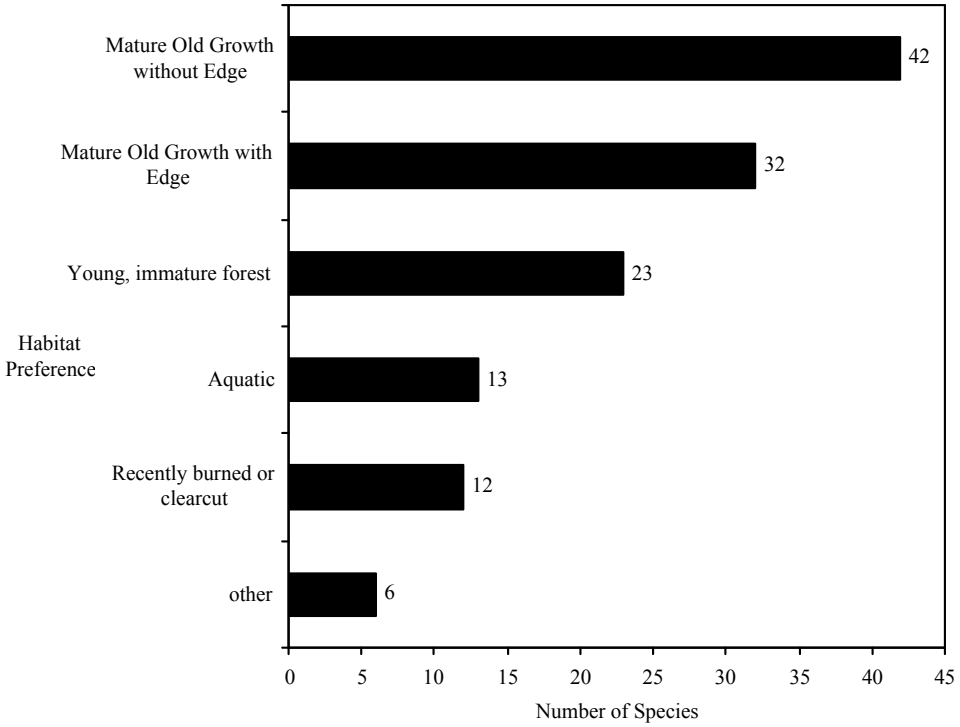

Figure 37. Habitat preferences of selected bird species of northwest Alberta. Data Source: Smith 1993.

Nesting Sites

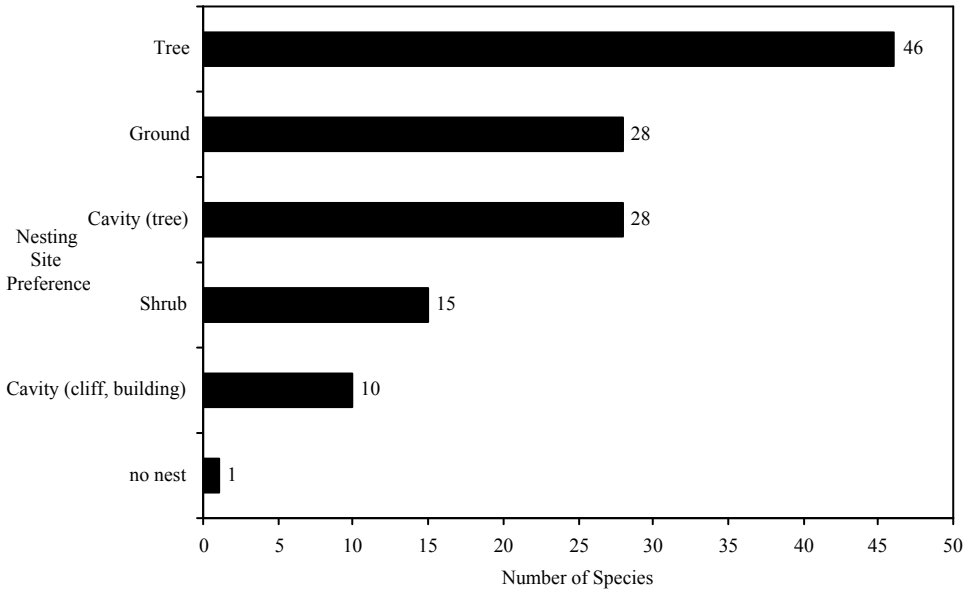

Figure 38. Nest site preferences of selected bird species of northwest Alberta. Data Source: Smith 1993.

Migratory Patterns

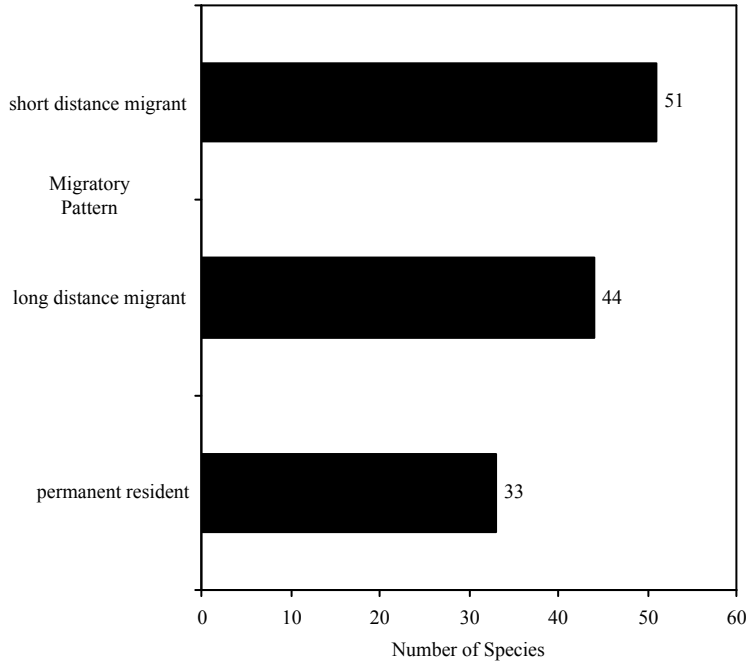

Figure 39. Migratory patterns of bird species of northwest Alberta. Data Source: Smith 1993.

Foraging Strategy

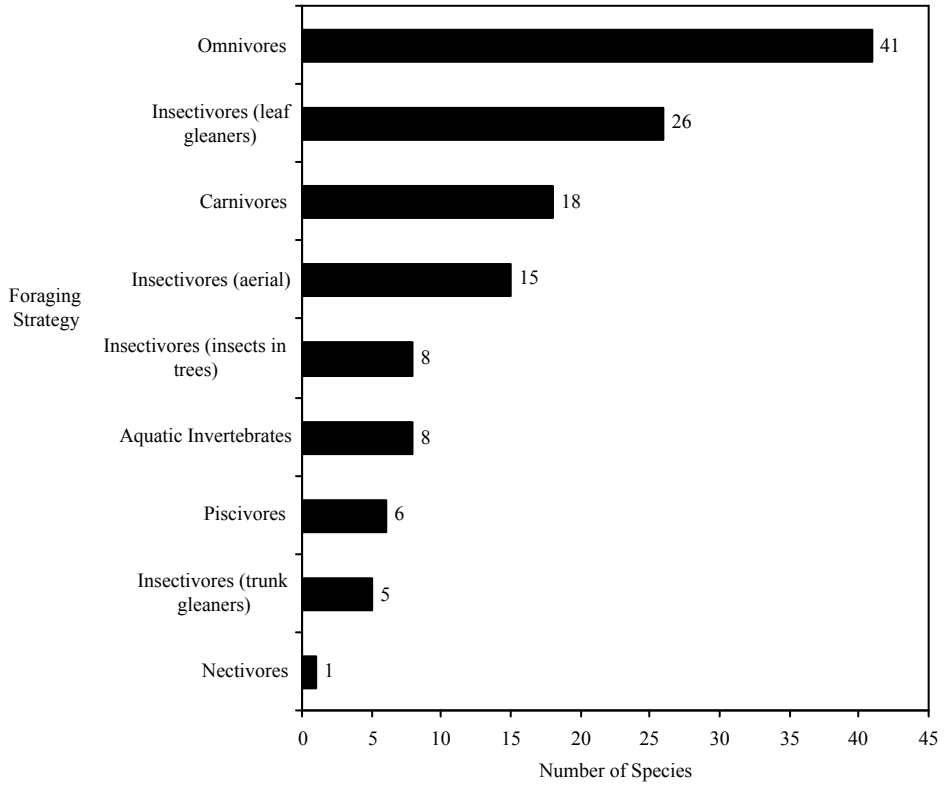

Figure 40. Foraging guilds of selected bird species of northwest Alberta. Data Source: Smith 1993.

Geographic Origin

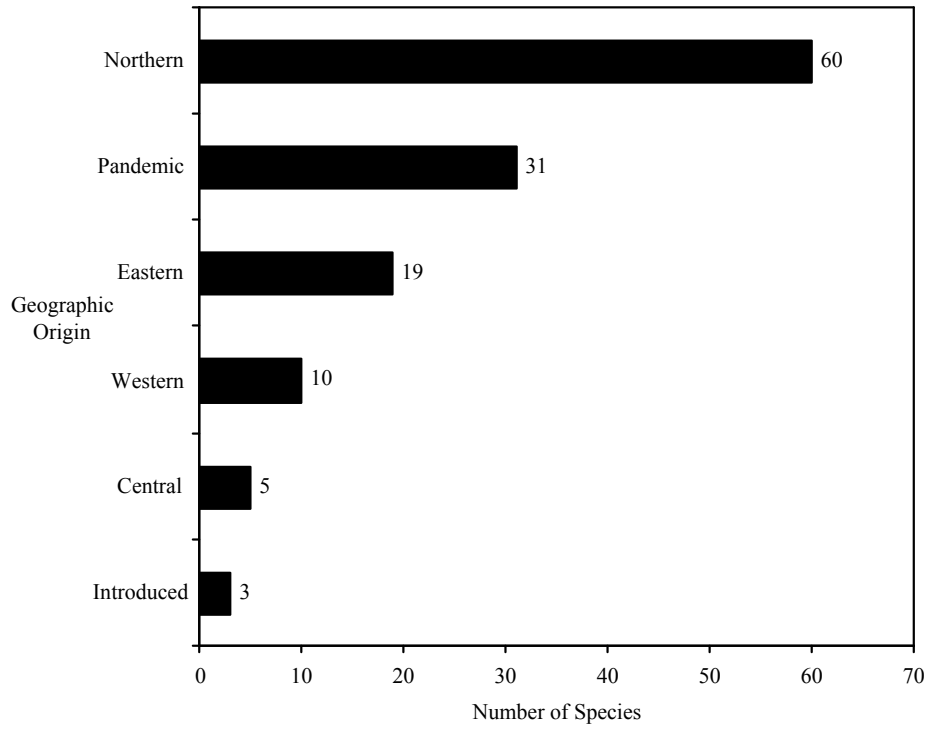

Figure 41. Geographic origin of selected bird species of northwest Alberta. Data Source: Smith 1993.

Special Concerns

The status of Alberta's birds has been recently assessed by the Natural Resources Service of the Department of Environmental Protection (The Status of Alberta Wildlife; Anonymous 1996). Of those species found in northwest Alberta and assessed on a provincial basis, 192 species were rated as Green (species not at risk), 26 species were rated as Yellow B (sensitive species not currently at risk buy require special management attention), 12 species were rated as Yellow A (sensitive species not currently at risk but have exhibited a longterm decline), 5 species were rated at Blue (species may be at risk), and 2 were rated as red (species is at risk). The status of each bird species found in northwest Alberta is presented in Table 26). Two bird species in northwest Alberta currently have unknown status applied to them.

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Mammals

Species Richness

Among vertebrates, mammals are second only to birds in species richness and number of families represented in northwest Alberta. Fifteen families and 46 species are found in this region of the boreal forest, the majority of which are smaller mammals such as weasels, mice, bats, shrews, and squirrels (Table 28, Table 29).

As with birds, mammal species richness is related to the diversity of habitat types in the mixedwood and coniferous forests of northwest Alberta, which is, in turn, related to the juxtaposition of several natural subregions of the Boreal Forest.

The diversity of habitat is often related to major geomorphic features, such as the Peace River valley and the Caribou Mountains. The natural zonation of the Peace River valley and its tributaries, for example, creates unique habitats through environmental gradients (in hydroperiod, microclimate, and elevation) and bottomland riparian forests (Johnston *et al.* 1996). Those bottomland forests are particularly important as winter range for moose and, in turn, for wolves. The north-facing banks of the rivers provide good denning habitat for black bears because they have stable, snow-covered slopes that are sheltered from the predominant northwest winds, and the south-facing slopes and uplands have abundant forage in berries patches. Similarly, the Caribou Mountains provide habitat for caribou in the black spruce bogs and pine ridges that predominate the Boreal Sub-Arctic Natural Subregion. During the winter, the abundant terrestrial lichens provide good forage habitat, and in the summer the open habitats wind may help provide protection to the caribou from flies.

Much of the region provides good habitat for moose, an important ungulate species of northwest Alberta. Severe winters and deep snow limit the habitat suitability for deer: it is secondary for mule deer, except prime along river valleys, and is secondary to poor for white-tailed deer, except around Peace River agricultural regions (Nietfeld *et al.* 1985). Habitat quality for elk is secondary, being prime in selected spots. Similarly, the highest densities of pine marten tend to occur in areas of mature conifer forest, and therefore tend to be dynamic on the landscape over time in response to forest fires and forest succession.

Northwest Alberta provides excellent habitat for aquatic mammals such as river otter and beaver (Nietfeld *et al.* 1985). The abundant small lakes and ponds offer abundant habitat for muskrats.

Special Concerns

Most of the mammal species are not of special conservation concern on a province-wide basis. Woodland caribou, wolverine, northern long-eared bat, and grizzly bear are listed as species which may be at risk in Alberta (Blue status; Table 29). The northern flying squirrel, fisher and lynx are listed as sensitive species that require special management concern (Yellow B status; Table 29). Locally or regionally, species may be of special concern, especially if unique habitats are threatened: such as areas that contain bat hibernacula (overwintering sites) or localized activities that affect caribou or grizzly bear ranges.

Although mammalian diversity is spread across 15 Families, most government, public and private sector interested has been focused on 5 families, that of Mustelidae (weasel), Cervidae (deer and moose), Ursidae (bears), Felidae (cats) and Canidae (dogs). This focus reflects the socioeconomic importance of these species based on hunting (moose, deer, elk, bear), trapping (marten, fisher, coyote, wolf) or conservation status (caribou, lynx). The less conspicuous rodent families are numerically dominant in individuals and biomass and likely play a critical role in boreal forest ecosystem function.

Table 28. Species richness in mammal families in northwest Alberta.

Common Family Name	Scientific Family Name	Total Species
Weasels	Mustelidae	8
New World Mice	Cricetidae	7
Bats	Vespertilionidae	5
Deer	Cervidae	5
Horned Ungulates	Bovidae	1
Shrews	Soricidae	5
Squirrels	Sciuridae	4
Dog	Canidae	3
Bear	Ursidae	2
Beaver	Castoridae	1
Cats	Felidae	1
Hares	Leporidae	1
Jumping Mice	Zapodidae	1
Old World Mice	Muridae	1
Porcupine	Erethizontidae	1
Total		46

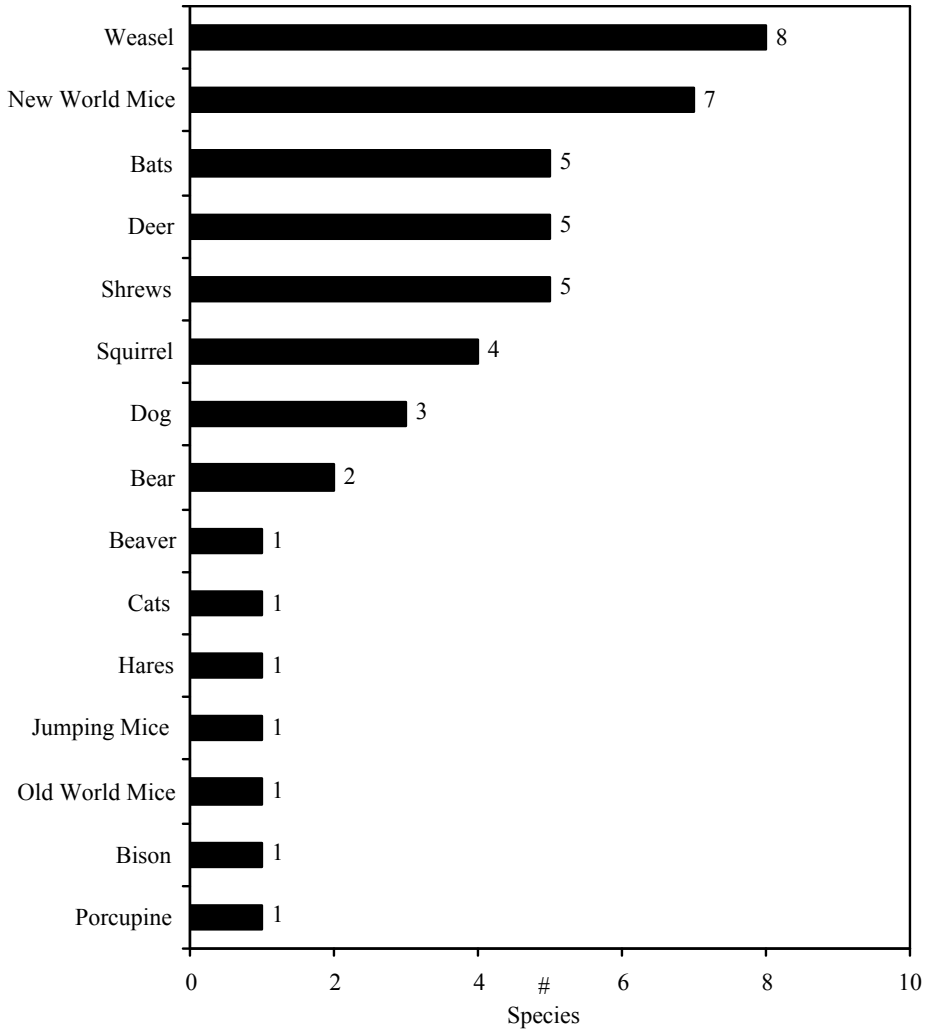

Figure 42. Species richness of mammal families in northwest Alberta.

Table 29. Mammal species found in northwest Alberta and their conservation status. Data Source: The Status of Alberta Wildlife (1996).

Order	Family	Common Name	Latin Name	Status
Insectivora	Soricidae	Masked Shrew	*Sorex cinereus*	Green
Insectivora	Soricidae	Dusky Shrew	*Sorex monticolus*	Green
Insectivora	Soricidae	Water Shrew	*Sorex palustris*	Green
Insectivora	Soricidae	Arctic Shrew	*Sorex arcticus*	Green
Insectivora	Soricidae	Pygmy Shrew	*Sorex hoyi*	Green
Chiroptera	Vespertilionidae	Little Brown Bat	*Myotis lucifugus*	Green
Chiroptera	Vespertilionidae	Northern Long-eared Bat	*Myotis septentrionalis*	Blue
Chiroptera	Vespertilionidae	Silver-haired Bat	*Lasionycteris noctivagans*	Green
Chiroptera	Vespertilionidae	Big Brown Bat	*Eptesicus fuscus*	Green
Chiroptera	Vespertilionidae	Hoary Bat	*Lasiuris cinereus*	Unknown
Lagomorpha	Leporidae	Snowshoe Hare	*Lepus americanus*	Green
Rodentia	Sciuridae	Least Chipmunk	*Tamias minimus*	Green
Rodentia	Sciuridae	Woodchuck	*Marmota monax*	Green
Rodentia	Sciuridae	Red Squirrel	*Tamiasciurus hudsonicus*	Green
Rodentia	Sciuridae	Northern Flying Squirrel	*Glaucomys sabrinus*	Yellow B
Rodentia	Castoridae	Beaver	*Castor canadensis*	Green
Rodentia	Cricetidae	Deer Mouse	*Peromyscus maniculatus*	Green
Rodentia	Cricetidae	Bushy-tailed Woodrat	*Neotoma cinerea*	Green
Rodentia	Cricetidae	Southern Red-backed Vole	*Clethrionomys gapperi*	Green
Rodentia	Cricetidae	Heather Vole	*Phenacomys intermedias*	Green
Rodentia	Cricetidae	Meadow Vole	*Microtus pennsylvanicus*	Green
Rodentia	Cricetidae	Muskrat	*Ondatra zibethicus*	Green
Rodentia	Cricetidae	Northern Bog Lemming	*Synaptomys borealis*	Green
Rodentia	Muridae	House Mouse	*Mus musculus*	Green
Rodentia	Zapodidae	Meadow Jumping Mouse	*Zapus hudsonius*	Green
Rodentia	Erethizontidae	Porcupine	*Erethizon dorsatum*	Green
Carnivora	Canidae	Coyote	*Canis latrans*	Green
Carnivora	Canidae	Gray Wolf	*Canis lupus*	Green
Carnivora	Canidae	Red Fox	*Vulpes vulpes*	Green
Carnivora	Ursidae	Black Bear	*Ursus americanus*	Green
Carnivora	Ursidae	Grizzly Bear	*Ursus arctos*	Blue
Carnivora	Mustelidae	Marten	*Martes american*	Green
Carnivora	Mustelidae	Fisher	*Martes pennanti*	Yellow B
Carnivora	Mustelidae	Ermine	*Mustela erminea*	Green
Carnivora	Mustelidae	Least Weasel	*Mustela nivalis*	Green
Carnivora	Mustelidae	Mink	*Mustela vison*	Green
Carnivora	Mustelidae	Wolverine	*Gulo gulo*	Blue
Carnivora	Mustelidae	Striped Skunk	*Mephitis mephitis*	Green
Carnivora	Mustelidae	River Otter	*Lutra canadensis*	Green
Carnivora	Felidae	Canada Lynx	*Lynx canadensis*	Yellow B
Artiodactyla	Cervidae	Wapiti	*Cervus elaphus*	Green
Artiodactyla	Cervidae	Mule Deer	*Odocoileus hemionus*	Green
Artiodactyla	Cervidae	White-tailed Deer	*Odocoileus virginianus*	Green
Artiodactyla	Cervidae	Moose	*Alces alces*	Green
Artiodactyla	Cervidae	Woodland Caribou	*Rangifer tarandus caribou*	Blue
Artiodactyla	Bovidae	Wood Bison	*Bison bison athabascae*	**Status?**

Biotic Inventories

Systematic longterm inventories of biota in northwest Alberta are scarce because of limited government funds, low numbers of government biologists, and incomplete systematics of non-vertebrate taxa. Selected wildlife species of social or economic importance, however, have been monitored by Natural Resources Service, and in some instances, by academia and industry. In most cases, obtaining data of sufficient accuracy and precision to evaluate numerical trends of biota has proven problematic. Table 30 identifies those species/taxa/structures that have received periodic or regular monitoring, the general monitoring strategy, the years for which abundance or distribution data are available, and the agency responsibility for the inventory.

Table 30. Partial listing of biota that have been monitored in portions of northwest Alberta.

Taxal / Functional Group	Inventory Type / Description	Years of Inventory	Agency
Forest Arthropods	–Forest Insect and Disease Survey (FIDS) monitored the following defoliating arthropods of importance to the forest sector: * spruce budworm (*Choristoneura fumiferana)* * forest tent caterpillar (*Malacosoma disstria*) * aspen tortrix (*Choristoneura conflictana)*	1936–1996	Canadian Forest Service
Forest Arthropods	–Provincial government (LFS) has monitored annually spruce budworm and spruce beetle –NRS has monitored Gypsy moth in association with Agriculture Canada using pheromone survey	1991– 1993–	Land and Forest Service
Amphibians	-Alberta Amphibian Monitoring Program	-1995–ongoing	Volunteer community coordinated by Natural Resources Service
Waterfowl	-annual aerial strip transects to quantify breeding waterfowl populations/status of wetland habitats	-late 1960's–ongoing	United States Fish and Wildlife Service
Trumpeter Swans	-irregular aerial surveys prior to 1990 -annual aerial surveys 1990–1995 potential continent wide survey every 5th yr	-annual 1990-95 -potential survey on 5 year intervals ongoing	Natural Resources Service
Sharp-tailed Grouse	-aerial survey one winter around High Level with poor result due to low densities	-mid 1980's	Natural Resources Service
Birds (general)	-The Atlas of Breeding Birds in Alberta	-published 1992	coordinated by Federation of Alberta Naturalists
Birds (general)	-Christmas Bird Count	-first measured in 1906 -continuous since mid-1950's	-Partial reporting by Federation of Alberta Naturalists; -Individual compilers submit results to National Audubon Society -Published by Alberta Naturalist
Furbearers	-Registered Trapping Area fur returns (limited value for population estimates dues to fur harvest affected by variable fur prices)	1977 – ongoing	Natural Resources Service
Elk	-aerial surveys in the Deadwood, Hotchkiss, North star and Notikewin areas	-1995 and 1996 - planned annual	Natural Resources Service
Moose	-DMI FMA aerial surveys -initially line and quadrat, results compared, survey completed using line transects -moose population surveys using Gasaway method -complete survey in 93/94, some WMUs resurveyed since -trying to establish rotational program	-coverage of FMA completed over 3 winters (88/89–90/91 -93/94 all WMUs -95/96 WMU 525 -96/97 WMUs 525, 536, 540, 544	Natural Resources Service
Caribou	–range surveys - sporadic, irregular -radio collaring program Dixonville herd Pedigree herd Caribou Mountain herd Red Earth herd	-1979 to present 1982 to 1983 1982-83 and 91-95 1994-ongoing 1995-ongoing	Natural Resources Service Natural Resources Service Natural Resources Service NWRSCC NWRSCC
Ungulates (general)	–aerial surveys in river valleys for moose, deer, and elk	irregular, pending budgets	Natural Resources Service

NWRSCC northwest regional steering committee on caribou

Conservation Status of Wildlife

Population sizes of plant and animal species are seldom static, for they respond to a host of external (environmental) and internal (demographic) factors. As such, it should not be alarming to observe variation (decreases and increases) in population densities of animal or plant species. What is of concern to conservation ecologists, and to the public in general, are directional declines of species caused by the cumulative impacts of regional human land-use practices. When dealing with populations, teasing apart cause from consequence can be highly problematic. Boreal landscapes do not represent simple experimental designs where only a single quantified landuse exists in isolation of others; rather our landscapes are simultaneously subjected to multitudes of landuses (forestry, petrochemical, mining, agriculture, recreational). To complicate matters further, populations seldom respond instantly to land-use practices; for example, changes observed in a moose population in the early 1990s may be the result of hunting regulations and forestry practices occurring in the 1980s.

What is clear, however, is the need for robust monitoring of biota in the boreal forest biome. The data generated by such monitoring programs will allow the public to evaluate cumulative effects of land-uses and provide industry with a means to test different resource use strategies.

The recently completed Status of Alberta Wildlife (1996) indicates that most vertebrates (excluding fish) are categorized as "green" and hence do not appear to be at risk based on the evaluation criteria used (Table 31, Figure 43). Across the spectrum of risk (low "green" to high "red") all categories are represented. Those species considered most at risk (blue or red) include Canadian toad, northern leopard frog, trumpeter swan, peregrine falcon, whooping crane, short-eared owl, Cape May warbler, bay-breasted warbler, northern long-eared bat, grizzly bear, wolverine, and woodland caribou. Comparisons of major vertebrate groups indicate that status of two amphibians species is alarmingly poor, reptile populations are generally in decline, and that bird and mammals provincial populations are generally healthy with some noticeable exceptions (see above). The relative proportion of the major groups (birds, mammals, amphibians, reptiles) to each of the status categories is presented in Table 32 and Figure 44. The poor status of amphibian and reptile species is clearly cause for concern.

Table 31. Number of vertebrate species (excluding fish) found in northwest Alberta for each biological status category. Data Source: The Status of Alberta Wildlife (1996).

Conservation Status	Description	Total
Green	Current knowledge suggest species not at risk	233
Yellow B	Current knowledge suggest these are sensitive species not currently at risk buy require special management attention; these species are often rare or of restricted distribution	30
Yellow A	Current knowledge suggest these are sensitive species not currently at risk but have exhibited a longterm decline	14
Blue	Current knowledge suggests species may be at risk	9
Red	Current knowledge suggests species is at risk	5
Status Unknown		3

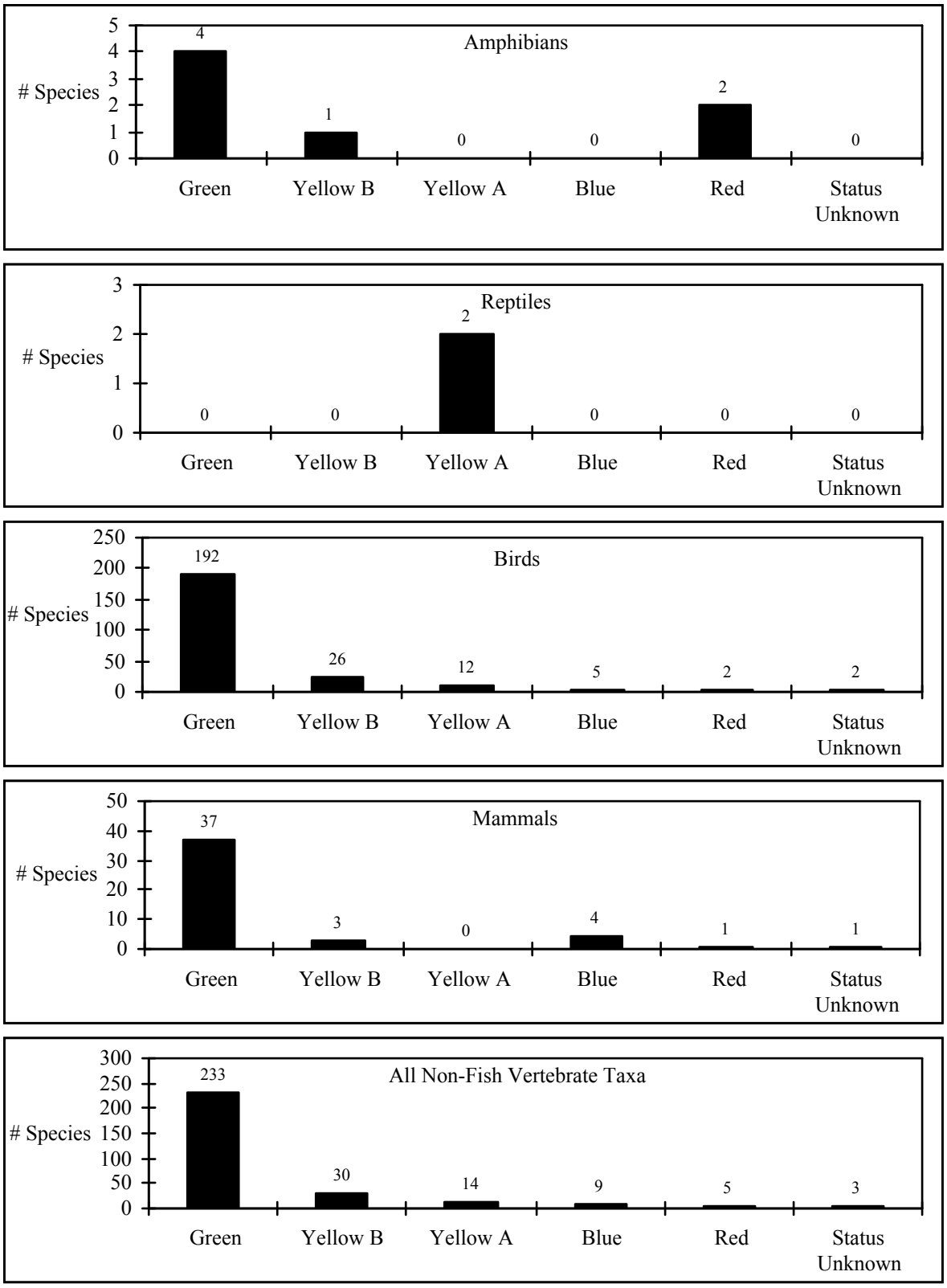

Figure 43. Number of vertebrate species (excluding fish) in each biological status categories in northwest Alberta. Data Source: The Status of Alberta Wildlife (1996).

Table 32. Status of non-fish vertebrate species in northwest Alberta. Data Source: The Status of Alberta Wildlife (1996).

Status Category	Green	Yellow B	Yellow A	Blue	Red	Status Unknown
Birds	192	26	12	5	2	2
Mammals	37	3	0	4	1	1
Amphibians	4	1	0	0	2	0
Reptiles	0	0	2	0	0	0
Total	233	30	14	9	5	3

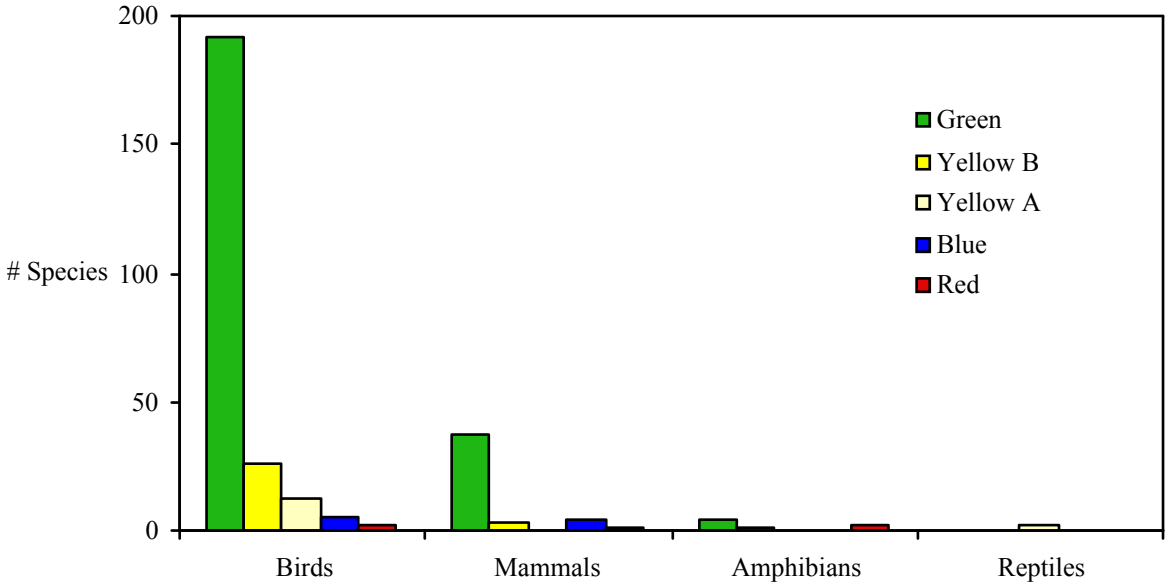

Figure 44. Distribution of status categories in non-fish vertebrate classes in northwest Alberta. Data Source: The Status of Alberta Wildlife (1996).

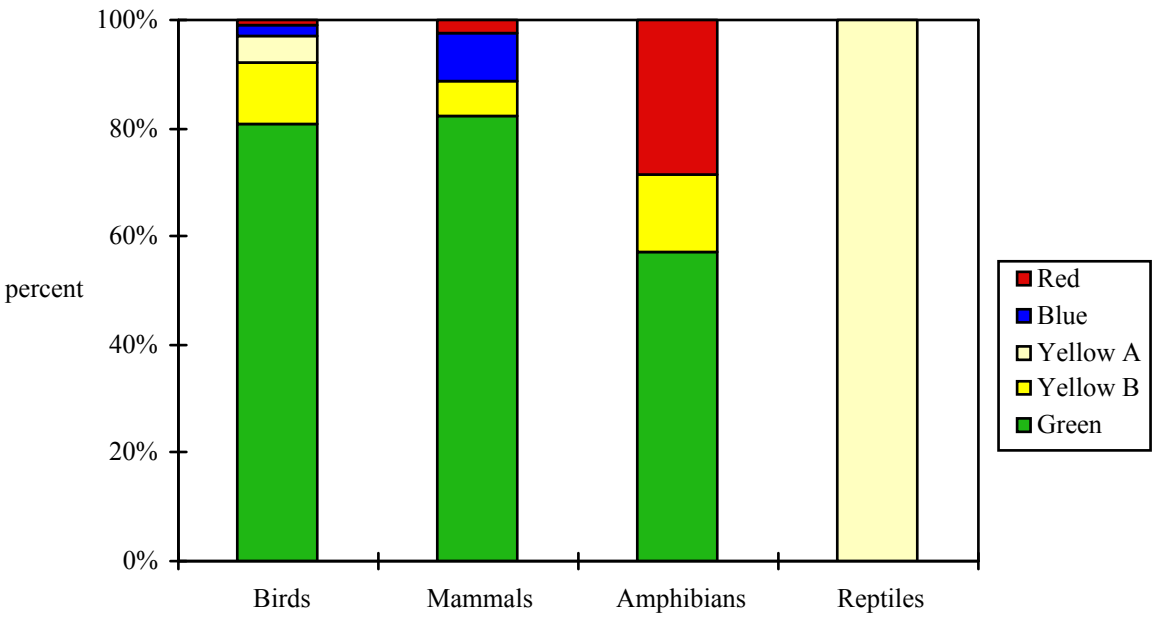

Figure 45. Distribution of status categories in non-fish vertebrate classes in northwest Alberta. Data Source: The Status of Alberta Wildlife (1996).

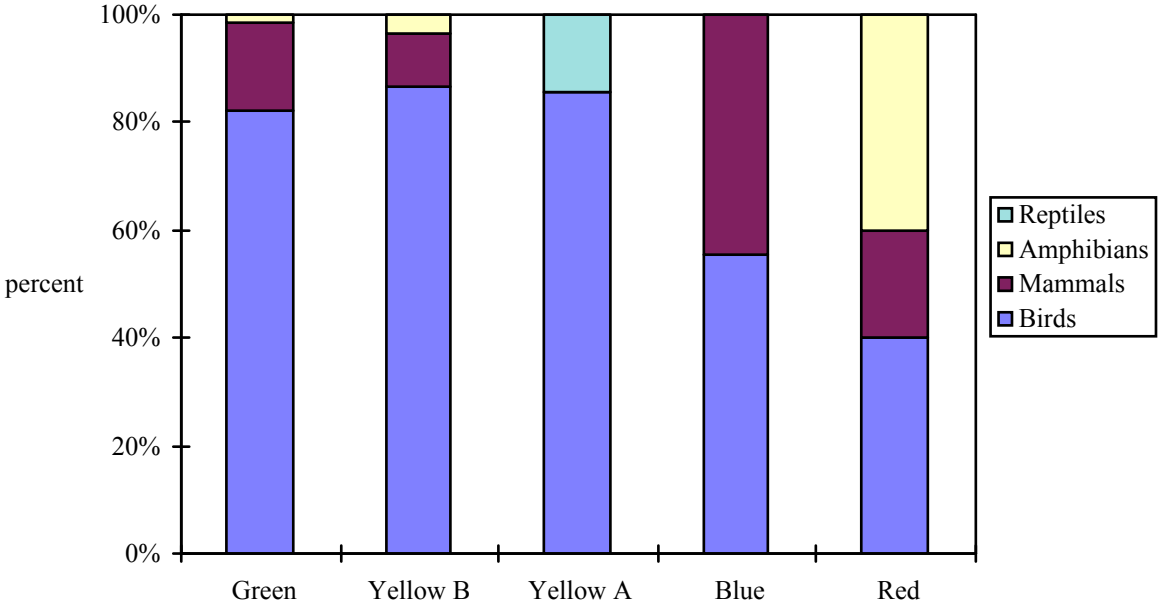

Figure 46. Distribution of non-fish vertebrate classes within each status categories in northwest Alberta. Data Source: The Status of Alberta Wildlife (1996).

Featured Species and Biotic Groups in northwest Alberta

Perspective

DMI's management strategy is intended to be inclusive and will accommodate the full suite of biota and ecological processes by recognizing that forestry practices should not advantage certain species of biota at the expense of others. Equally, DMI recognizes that certain species of wildlife enjoy elevated status by Albertans because of their importance to subsistence and recreational hunting (e.g., moose), trapping (e.g., marten, lynx) or because their populations have been threatened by human activities (e.g., trumpeter swans, arctic grayling, woodland caribou).

The following descriptions of life history and distribution are intended to provide the general public and public advisory groups with sufficient understanding of the species' biology such that the effects of different forestry strategies can be evaluated. Where possible, levels of spatial and temporal variation of populations are described. It will be against these benchmarks of variation that future population levels can be compared.

Trumpeter Swan

(Adapted From "Alberta's Threatened Wildlife – Trumpeter Swan" Feb 1992)

Status

Trumpeter swans are the world's largest and rarest swan. Historically, they bred in boreal, parkland, and prairie habitats throughout Canada and the United States from James Bay to the Rocky Mountains, south to Missouri and Wyoming. In Canada, trumpeter swans nested throughout the central regions of Alberta, Saskatchewan, and Manitoba, and along the James Bay coast of Ontario and Quebec. Although the total population size was unknown, the species was historically abundant.

By the early 1900s, trumpeter swans were nearly extinct. Large numbers of birds had been shot for their down, feathers, and meat, and increasing settlement had disturbed nesting areas, particularly in the southern part of their range. In 1930, the only known breeding population was in the newly created Yellowstone National Park in Wyoming, although other small remnant flocks probably existed in Alberta, Alaska, and Montana. To save the trumpeters from extinction, an international program began in the 1930s as the birds and their remaining habitat were granted additional protection. The public was made aware of their status and was encouraged to report sightings of trumpeters or their nests and to reduce human activity near nesting areas.

Trumpeters have responded well to the restoration program. Populations in Alaska and the tri-state region of Montana, Wyoming and Idaho, have increased steadily to where these birds have been removed from the endangered species list in the U.S. Under the Alberta Wildlife Act, trumpeters are still listed as endangered; however, they have been delisted nationally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1996).

In 1990, there were about 550 swans nesting in Canada. Locations of breeding flocks now include the Yukon, northern British Columbia, southwestern Northwest Territories, and the Grande Prairie/Peace River region of Alberta. In 1995, the provincial trumpeter swan was estimated at 779 birds of which 563 were adults and 216 were cygnets (NRS 1995). In the northwest Alberta study area, 121 adults and 67 cygnets were located at 63 lakes in 1995 (Figure 47, Figure 48, Figure 49).

Habitat

Trumpeter swans are not long-distance travelers; they fly only far enough to reach suitable habitats for nesting or wintering. They overwinter in the western United States and are found in Alberta only during the spring, summer and fall seasons.

Trumpeter swans require shallow lakes with an abundant supply of aquatic plants, insects, and snails (for nest sites and food). They also need protection from predators and human disturbance. Water levels must remain relatively constant during the summer and have minimal wave action or currents.

Swans have very strong ties to their nesting and wintering areas. They return to the same lakes and often the same nest each year. Family groups remain together during migration, and the adults guide their offspring to the wintering areas. Trumpeter swans usually mate for life, and most birds three years or older are paired. Paired adults stay together throughout the year and may defend a nesting territory even though they often do not breed until they are four or five years old. Their maximum lifespan is about 12 years.

Reproduction

Nests of trumpeter swans are large and bulky mounds of reeds, rushes, roots, and grasses lined with down. They are often built on beaver lodges, muskrat houses, small islands, or mats of floating plants. Trumpeters prefer the nest to be surrounded by open water to provide good visibility and protection from land predators.

Swans are highly territorial and will drive all other swans from the nesting lake. Thus, the usual density of breeding swans is one pair per lake, which helps ensure sufficient food for the adults and 5–6 cygnets throughout the summer.

Food

Swans use a variety of aquatic foods not used by other waterfowl. Their long neck and powerful bill allow them to extract deep roots and stems that other birds cannot reach. Adults eat up to 9 kg daily from a variety of aquatic plants, such as arrowhead, pondweeds, sedges, cattail, duckweed, and water moss. Swans often supplement their plant diet with a few large aquatic insects and snails. Very young cygnets feed on the surface, eating large aquatic invertebrates and often depending on the adults to stir up the water around them. Within two or three weeks, the cygnets start to eat aquatic plants.

Limiting Factors

A major limiting factor affecting Alberta trumpeter swans is the size of their wintering habitat, which is concentrated in a small portion of the Snake River in Idaho. In addition, they share this small area with migratory trumpeters from the Yukon, Northwest Territories, and British Columbia. Competition for food is so high throughout the winter that some birds are in relatively poor condition by spring. Exhausted energy stores in overwintering swans can lead to reduced migratory movement, egg laying, incubation success and survivorship. Overcrowding and concentration in one area also increases the potential for major losses from disease, parasites, or severe weather.

Unfortunately many trumpeter swans are still accidentally or intentionally shot. They are often mistaken for snow geese or, in some parts of the United States, for tundra swans where there is a hunting season on this species. (All swans in Canada are completely protected and killing them is illegal.)

Human activity and disturbance in breeding areas may cause death of adult birds and/or decreased survival of eggs or cygnets. Trumpeter swans are sensitive to repeated disturbance and may refuse to nest or may abandon an existing nest when disturbed. Adults are most sensitive to disturbance from mid April to mid June, unfortunately when the eggs and cygnets are also at greatest risk. Swans will not nest on lakes intensively developed for recreation. They can nest on lakes near areas being developed for resources but only if increased access does not result in greater recreational use or other disturbance.

Management

Management of trumpeter swans in northwest Alberta has focused on protecting nesting lakes and minimizing disturbance during the nesting season. Current DMI Timber Harvest Planning and Operating ground rules require a 200-metre permanent reserve around trumpeter swan nesting lakes. Additionally, harvesting in the area between 200 and 500 metres must be planned in a way that provides additional buffering, and no industrial activities will occur within 500 metres of the lake between April 15 and July 5. These measures are designed to minimize access development near the lake, provide an effective tree screen around the lake, and minimize disturbance of the swans from human activity during the sensitive nesting period.

Wildlife managers are working to spread the breeding and wintering birds onto new range to continue the recovery of the species.

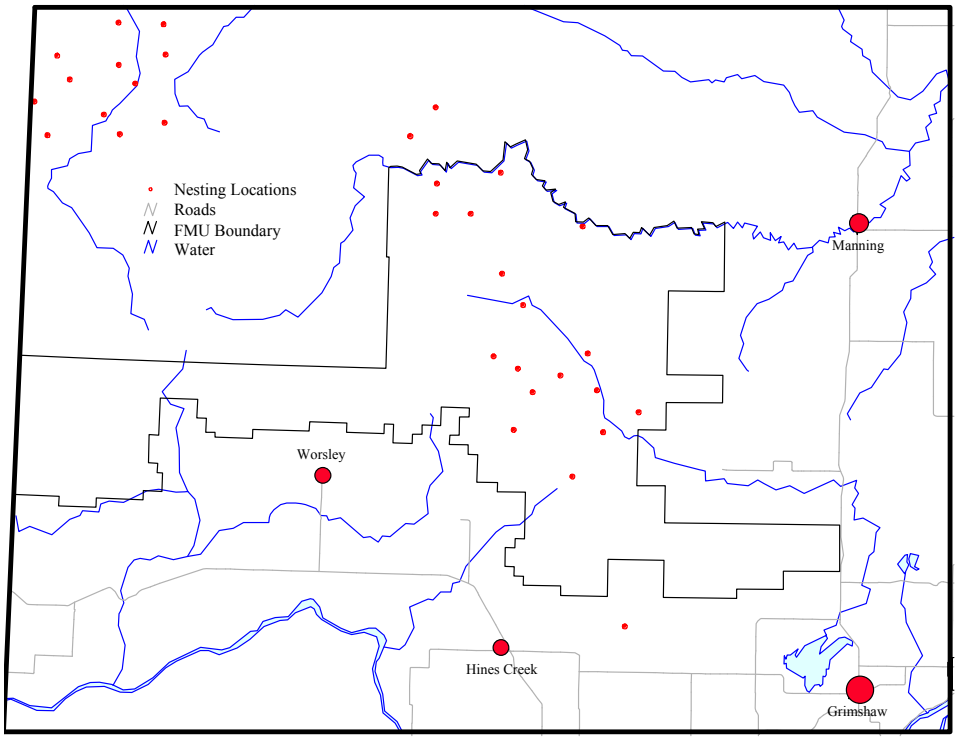

Figure 47. Distribution of trumpeter swan nesting sites in P1 and P2 FMUs. Data Source: Natural Resources Service, Peace River office.

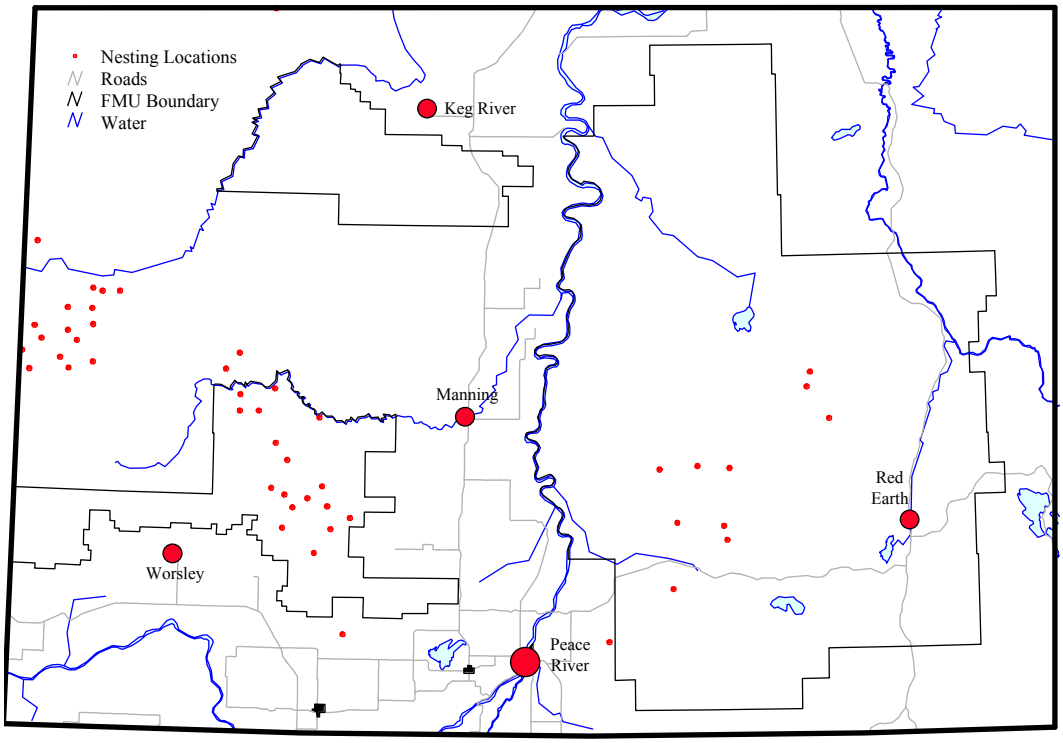

Figure 48. Distribution of trumpeter swan nesting sites in the PRPD FMA. Data Source: Natural Resources Service, Peace River office.

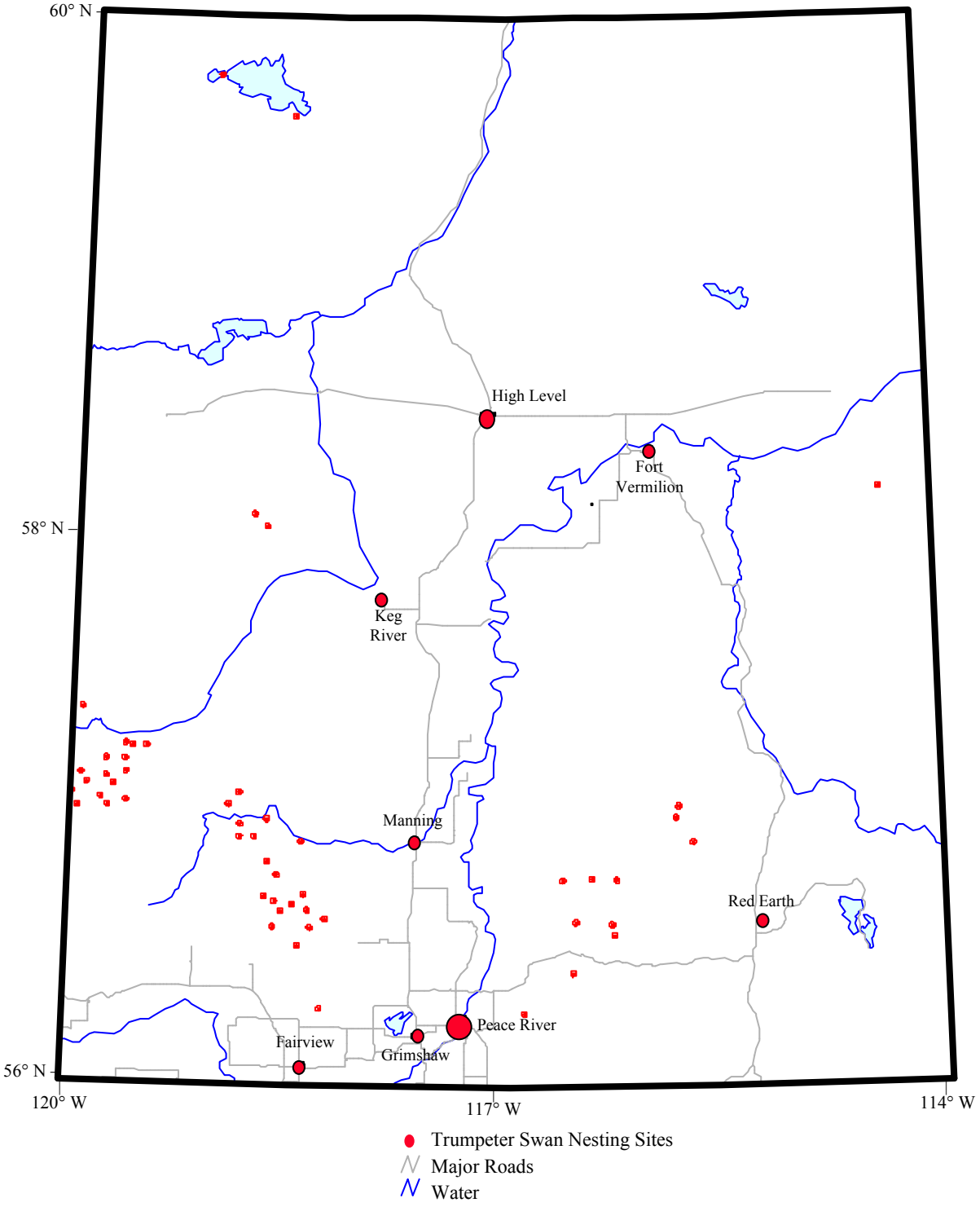

Figure 49. Distribution of trumpeter swan nesting sites in northwest Alberta. Data Source: Natural Resources Service, Peace River office.

Migratory Waterfowl

prepared by Doug Collister of Ursus Ecosystem Management Ltd.

Introduction

Thirty-one species of waterfowl have potential to occur in northwestern Alberta (Table 33). Of these, 8 occur only as migrants during spring and/or fall. One swan (trumpeter), 1 goose (Canada goose), 7 surface-feeding ducks (mallard, northern pintail, blue-winged teal, cinnamon teal, northern shoveler, gadwall, american wigeon), 9 diving ducks (canvasback, redhead, ring-necked duck, lesser scaup, surf scoter, white-winged scoter, common goldeneye, barrow's goldeneye, bufflehead), 1 stiff-tailed duck (ruddy duck), and 3 mergansers (common, red-breasted and hooded) comprise the remaining 23 summer residents and breeders.

All 8 migrant species can most predictably be found on waterbodies and agricultural fields while passing through northwest Alberta. Forested habitats are not important to these species.

The trumpeter swan is a blue-listed species in Alberta primarily due to its sensitivity to disturbance during breeding and a low population level (see earlier section on trumpeter swans). This species breeds on shallow waterbodies with significant emergent vegetation (Collister 1997). Nests are placed on substrate within or along the edge of the waterbody.

The Canada Goose occurs in a wide variety of habitats including beaver ponds and other wetlands within forested landscapes. Nests are usually placed on substrate isolated by water for protecting against predators but this species also nests on cliffs and in tree nests constructed by other species. Canada geese feed on grasses, seeds, grain, and aquatic plants.

Nests of surface-feeding ducks are typically a down-lined hollow in reeds, grass or under a shrub. Nest sites, although typically near water, may be a considerable distance (>1 km) from the edge of a waterbody particularly in open areas. Surface-feeding ducks feed on aquatic plants, seeds, grain, grass, small aquatic animals and insects.

Of the diving ducks, redhead, canvasback, ring-necked duck, lesser scaup, white-winged scoter and surf scoter all nest in down-lined cups on or near a waterbody. Common goldeneye, Barrow's goldeneye and bufflehead nest in tree cavities near water. Diving ducks feed on small aquatic animals and plants.

Ruddy Ducks construct nests in reeds above water. Food consists of small aquatic life, insects and water plants.

Common and red-breasted merganser nests are often a down-lined hollow on the ground under a bush, spruce or roots near water. Hooded mergansers nest in a cavity in a tree or stump near water. Common mergansers also occasionally nest in tree cavities. Mergansers feed almost exclusively on fish.

Habitat

Little information is available on habitat supply for waterfowl in northwest Alberta. An annual cooperative survey by United States Fish and Wildlife Service (USFWS), Canadian Wildlife Service (CWS), Alberta Environmental Protection/Wildlife Management Division (AEP), and Ducks Unlimited Canada (DUC) does include an estimate of the number of May ponds. The pond estimate for Strata 76 which is the data which may best represent northwest Alberta varied slightly around 250,000 from 1989 to 1994 and has increased since then to an estimated 405,400 ponds in 1997 (Figure 50). The area within Strata 76 includes Grande Prairie, Fort St. John and Peace River. Ducks Unlimited Canada manages 53 projects in northwest Alberta (Table 34, Figure 55, Figure 56) encompassing 1,911 ha of upland and 61,098 ha of wetland habitat. Currently, 176,811 ha associated with several of these projects is protected.

Populations

Little information is available on waterfowl populations in northwest Alberta. An annual cooperative survey by United States Fish and Wildlife Service (USFWS), Canadian Wildlife Service (CWS), Alberta Environmental Protection/Wildlife Management Division (AEP), and Ducks Unlimited Canada (DUC) does include an estimate of the breeding population by species (Table 35). Methods used by this consortium were significantly modified in 1989 precluding meaningful comparison with older data sets.

Data specific to Strata 76 is broken out back to 1992 while data including Strata 75 and 76 is available back to 1989. Several species show high variability in estimated populations (e.g. Canada goose, redhead, ruddy duck etc.). The total estimated duck breeding population in Strata 76 (Table 35, Figure 51) was 891,700 in 1997 up from a low of 640,300 in 1994 (Figure 52). The total estimated duck breeding population in Strata 75 and 76 combined varied

around 1200,000 from 1989 to 1994 and has increased since then to an estimated 1,656,500 in 1997 (Table 35, Figure 52). The area within Strata 76 includes Grande Prairie, Fort St. John and Peace River while Strata 75 includes Slave Lake, Lac La Biche and Cold Lake.

Hunting Permit Sales

Migratory game bird hunting permit sales data compiled by CWS are available back to 1966 (Table 36). The number of permits sold in northern Alberta has decreased from 29,700 in 1966 to 15,800 in 1996. Throughout that time period the number of permits sold in northern Alberta has been higher than in southern Alberta ranging from 53.0% to 61.7% of the total. the number of permits sold to non-resident aliens (i.e. non-Canadians) has varied from 1.3% to 3.3% of the total.

A detailed breakdown of the Canadian portion of permit sales between Albertans and other Canadians is only available since 1992. From 1992 to 1996 between 47.2% and 48.2% of total permit sales were to Albertans.

Harvest

Migratory game bird harvest data compiled by CWS is available back to 1968 (Table 37, Figure 53). Consistent with declining permit sales the harvest of ducks in Alberta has declined from 275,000 in 1968 to 183,100 in 1996. However the goose harvest has increased from 50,100 in 1969 to 161,200 in 1996. Specific harvest information for northwest Alberta has been compiled by AEP since 1986 (Table 37, Figure 54). Again, consistent with declining permit sales the harvest of ducks in northwest Alberta has declined from 16,000 in 1986 to 4,900 in 1996. The goose harvest in northwest Alberta has declined from 16,400 in 1986 to 10,300 in 1996. Wiebe and Hines (1997) did not find any evidence that boreal populations of mallards and northern pintails are suffering from heavier harvest rates than southern populations or that other survival-related conservation problems are occurring in the north.

Acknowledgements

Ken Lungle of AEP provided waterfowl harvest data. Reg Arbuckle of DUC provided a list of projects in northwest Alberta. Brett Calverly of Ducks Unlimited Canada provided population and habitat information. Paul Pryor of CWS provided population and permit sales information.

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Smith, A. 1993. Ecological profiles of birds in the boreal forest of western Canada. Canadian Wildlife Service. Proceedings of a workshop held March 10-12 in Prince Albert, SK.

Wiebe, M.O. and J.E. Hines. 1997. Survival and recovery rates of Mallards and Northern Pintails from the Northwest Territories, 1966-95. Canadian Wildlife Service Progress Note No. 212. 21 pp.

Table 33. Waterfowl known or with potential to occur in northwest Alberta.

Common Name	Scientific Name	Status	Abundance	Special Status	
				AEP	COSEWIC
Tundra Swan	*Cygnus columbianus*	M	U		
Trumpeter Swan	*Cygnus buccinator*	S	S	Blue	
Greater White-fronted Goose	*Anser albifrons*	M	U		
Snow Goose	*Anser caerulescens*	M	C		
Ross' Goose	*Anser rossii*	M	S		
Canada Goose	*Branta canadensis*	S	C		
Green-winged Teal	*Anas crecca*	S	U		
Mallard	*Anas platyrhynchos*	S	C		
Northern Pintail	*Anas acuta*	S	C		
Blue-winged Teal	*Anas discors*	S	U		
Cinnamon Teal	*Anas cynaoptera*	S	S		
Northern Shoveler	*Anas clypeata*	S	C		
Gadwall	*Anas strepera*	S	U		
Eurasian Wigeon	*Anas penelope*	M	R		
American Wigeon	*Anas americana*	S	C		
Canvasback	*Aythya valisineria*	S	U		
Redhead	*Aythya american*	S	U		
Ring-necked Duck	*Aythya collaris*	S	U		
Greater Scaup	*Aythya marila*	M	S		
Lesser Scaup	*Aythya affinis*	S	C		
Harlequin Duck	*Histrionicus histrionicus*	M	R	Yellow A	
Oldsquaw	*Clangula hyemalis*	M	S		
Surf Scoter	*Melanitta perspicillata*	S	R		
White-winged Scoter	*Melanitta fusca*	S	S		
Common Goldeneye	*Bucephala clangula*	S	C		
Barrow's Goldeneye	*Bucephala islandica*	S	R		
Bufflehead	*Bucephala albeola*	S	C		
Hooded Merganser	*Lophodytes cucullatus*	S	S		
Common Merganser	*Mergus merganser*	S	U		
Red-breasted Merganser	*Mergus serrator*	S	R		
Ruddy Duck	*Oxyura jamaicensis*	S	C		

Status Codes
S - summer resident
W - winter resident
R - permanent resident
M - migrates through area spring and/or fall

Abundance Codes
C - common (encountered frequently)
U - uncommon (encountered infrequently)
S - scarce (encountered occasionally)
R - rare (unexpected)

Red - species whose populations have declined, or are believed to have declined, to nonviable levels, or show a rate of decrease indicating that they are at immediate risk of declining to nonviable levels
Blue - species particularly vulnerable because of non- cyclical declines in population or habitat, or reductions in provincial distribution
Yellow A - species for which concern has been expressed over long-term declines in their numbers
Yellow B - species that are naturally rare but not in decline, naturally rare and have clumped breeding distributions, or associated with habitats or habitat elements that are, or may be, deteriorating
COSEWIC
Endangered - species threatened with imminent extirpation or extinction
Threatened - a species likely to become endangered if the factors affecting its vulnerability are not reversed
Vulnerable - species particularly at risk due to low or declining numbers, occurrence at the fringe of its range or in restricted areas, or some other reason but is not currently threatened

Table 34. Ducks Unlimited Projects (north of 56°N, West of 5th Meridian). Data Source: Ducks Unlimited Canada, Grande Prairie.

Project Name	Project	Hectares			Coordinates	
	Code #	Upland	Wetland	Protected*	Latitude	Longitude
Hanna Marsh Management	377	7	19	38	56.76	117.69
Craven Lake	379	1	42	0	56.42	117.60
Davis	398	0	31	0	56.15	118.06
North Gull Lake	445	21	197	13	58.43	116.10
Hale	464	20	31	0	56.31	118.91
Sled Island Complex	483	0	0	1,496	58.36	115.88
South Gull Lake	550	0	29	19	58.43	116.12
Thomas	580	94	80	0	56.42	117.64
Erickson	581	0	12	0	56.23	118.62
Cardinal Lake Peninsula	694	170	11	0	56.27	117.69
Last Lake	751	134	23	0	56.23	118.02
Helen Lake	849	57	6	0	56.53	117.82
Sydorko	856	57	6	0	56.24	118.04
Allen	894	64	0	0	56.13	118.10
Little Burnt River Uplands	910	104	22	0	56.13	118.12
Little Stoney Lake	941	31	0	0	56.13	117.96
Nowatzek	942	7	0	0	56.13	117.96
George Lake East Uplands	943	237	0	0	56.21	118.62
D. Peters	956	32	16	0	58.15	116.33
Pashko Wetland Project	968	21	11	0	56.06	116.97
Teichroeb	992	19	0	0	58.15	116.33
Caron Uplands	1,041	168	24	0	56.13	118.11
Erickson Uplands	1,042	51	0	0	56.23	118.62
G. Turner	1,050	28	0	0	56.23	118.09
Syrnyk	1,145	49	16	0	56.16	118.80
G. Turner-2	1,158	19	0	0	56.23	118.09
West George Lake Uplands	1,170	148	0	0	56.21	118.61
Close	1,172	19	0	0	56.50	117.83
D. Evans	1,197	50	8	0	56.56	117.89
D. Evans-2	1,203	53	36	0	56.55	117.78
Petrowich	1,218	50	15	0	56.17	118.82
Fairview Wetlands	1,224	0	24	0	56.08	118.38
Dixonville Parkland	1,266	48	16	0	56.56	117.81
Lundgard	1,341	28	14	0	56.20	118.84
Sora	1,381	0	13	0	56.55	117.79
Godberson	1,546	0	8	0	56.27	118.51
Klein	1,567	0	8	0	56.54	118.02
Ostaszewski	1,584	11	0	0	56.22	118.43
Drury	1,585	40	21	0	56.21	118.45
Failee	3,170	25	96	0	56.13	118.26
Cadotte Lake North	3,171	18	1,536	0	56.49	116.45
Hay Zama Lakes	3,257	0	57,293	175,246	58.83	118.84
George Lake	3,263	0	540	0	56.21	118.62
Sunrise	3,374	6	117	0	56.16	118.53
Roreigh Project	3,549	0	110	0	56.18	118.45
Lyman	3,555	22	75	0	56.16	118.73
Chalmers Lake	3,560	0	65	0	56.28	118.21
Wren	3,561	0	50	0	56.23	118.43
Flood Lake	3,713	0	174	0	56.50	117.80
Pluvius Lake	3,714	0	152	0	56.57	117.61
Deadwood Lake	3,715	0	93	0	56.71	117.58
Sheehan	3,783	0	59	0	56.56	117.78
Total		1,911	61,098	176,811		

* Means that a License of Occupation and/or a Protective Notation is registered on this property.

Table 35. Waterfowl population data for central Alberta. Data Source: Canadian Wildlife Service.

	Estimated Breeding Population in Thousands								
Species/Grouping	1989	1990	1991	1992	1993	1994	1995	1996	1997
Ducks Unlimited data (Strata 76)									
Canada Goose	·	·	·	5.8	4.8	4.6	9.6	27.3	15.0
Green-winged Teal	·	·	·	42.2	63.5	94.2	81.9	65.4	103.3
Mallard	·	·	·	204.6	232.5	175.6	218.9	230.5	261.3
Northern Pintail	·	·	·	3.9	1.3	7.3	7.3	9.6	40.8
Blue-winged Teal	·	·	·	80.1	16.0	41.2	39.7	89.6	61.7
Northern Shoveler	·	·	·	81.8	31.8	32.6	36.1	31.8	55.4
Gadwall	·	·	·	26.0	20.1	17.2	13.7	28.5	40.9
American Wigeon	·	·	·	30.7	50.4	63.1	82.0	78.5	71.0
Canvasback	·	·	·	3.0	48.6	4.2	7.3	48.0	7.2
Redhead	·	·	·	48.6	22.6	10.3	4.0	6.1	11.0
Ring-necked Duck	·	·	·	11.3	11.2	49.6	33.1	22.6	9.6
Lesser Scaup	·	·	·	77.6	69.1	75.6	66.4	70.0	56.2
Common Goldeneye	·	·	·	7.5	9.8	2.9	29.3	7.6	31.7
Bufflehead	·	·	·	119.7	80.7	56.1	74.2	105.9	128.5
Ruddy Duck	·	·	·	17.1	57.2	1.7	23.5	33.1	3.8
White-winged Scoter	·	·	·	7.2	2.3	7.3	3.4	0.0	9.3
Merganser spp.	·	·	·	3.4	6.0	1.4	5.8	0.0	0.0
Total Ducks	·	·	·	764.7	723.1	640.3	726.6	827.1	891.7
American Coot	·	·	·	9.2	54.3	15.1	8.4	13.7	62.0
Ducks Unlimited data (Strata 75 and 76)									
Canada Goose	12.5	19.0	15.4	19.8	18.9	20.7	43.3	48.2	29.1
Total Ducks	1,235.1	1,412.8	1,135.1	1,425.1	1,145.7	1,268.1	1,390.2	1,609.4	1,656.5

The area within Strata 76 includes Grande Prairie, Fort St. John and Peace River while Strata 75 includes Slave Lake, Lac La Biche and Cold Lake.

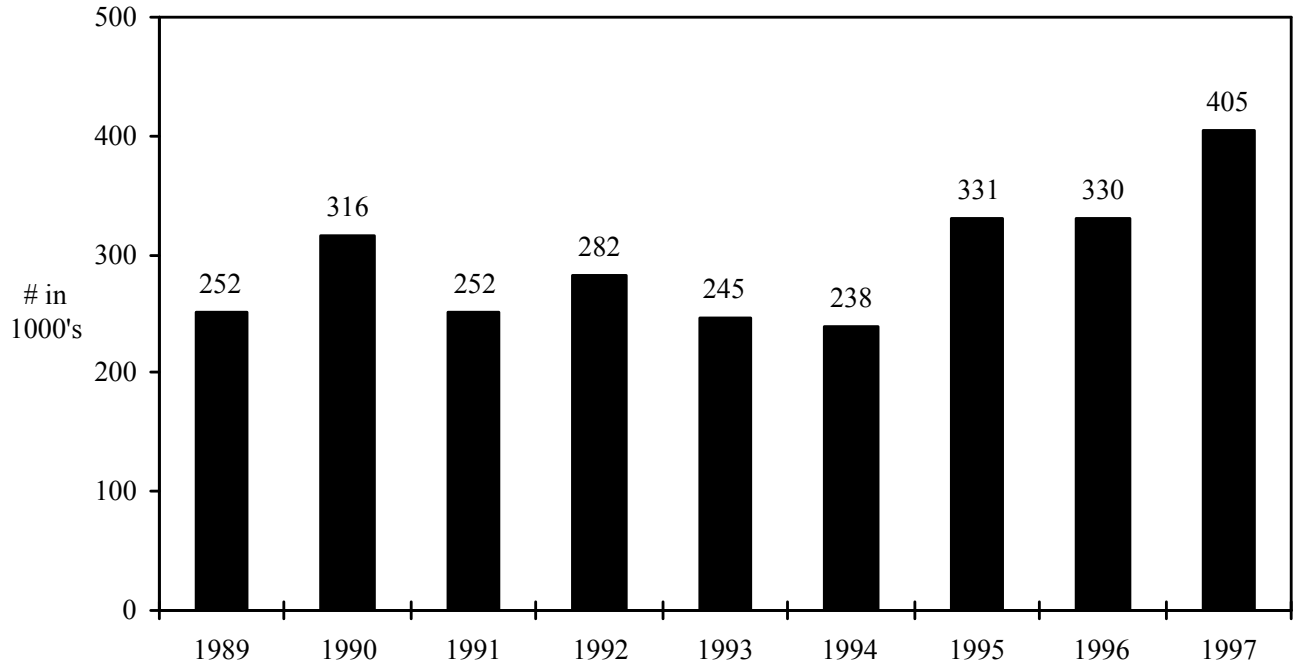

Figure 50. Annual variation in pond frequency in northwest Alberta; Strata 76. Data Source: Canadian Wildlife Service.

Table 36. Migratory game bird hunting permit sales (for residents and non-residents) in southern and northern Alberta. The right portion of the table summarizes the geographic origin of hunters (e.g., from Alberta, Canadian outside Alberta, or non-resident aliens (non-Canadians). Prior to 1992 it was not possible to partition the hunter data between Albertans and non-Albertan Canadians. Data Source: Canadian Wildlife Service.

	Southern Alberta		Northern Alberta		Total	Residents				Non-Residents	
	('000s)	%	('000s)	%	('000s)	Alberta	%	Canada	%	Alien	%
1966					52.9			52.2	98.7%	0.7	1.3%
1967	26.3	47.0%	29.7	53.0%	56.0			55.2	98.4%	0.9	1.6%
1968	25.0	46.6%	28.6	53.4%	53.6			52.7	98.3%	0.9	1.7%
1969	22.5	41.9%	31.2	58.1%	53.7			52.7	98.3%	0.9	1.7%
1970	25.5	42.4%	34.6	57.6%	60.1			59.1	98.5%	0.9	1.5%
1971	26.2	41.7%	36.7	58.3%	62.9			62.1	98.7%	0.8	1.3%
1972	26.3	41.5%	37.0	58.5%	63.3			62.7	99.1%	0.6	0.9%
1973	26.7	39.9%	40.3	60.1%	67.0			66.2	98.8%	0.8	1.2%
1974	25.5	38.6%	40.6	61.4%	66.1			65.3	98.8%	0.8	1.2%
1975	28.3	40.9%	40.9	59.1%	69.2			68.2	98.6%	1.0	1.4%
1976	30.9	40.8%	44.8	59.2%	75.7			74.6	98.5%	1.1	1.5%
1977	31.6	38.5%	50.5	61.5%	82.1			81.1	98.7%	1.1	1.3%
1978	30.2	39.1%	47.0	60.9%	77.2			76.1	98.7%	1.0	1.3%
1979	29.5	38.3%	47.5	61.7%	77.0			75.9	98.6%	1.1	1.4%
1980	30.4	38.3%	49.0	61.7%	79.4			78.3	98.6%	1.1	1.4%
1981	27.6	41.8%	38.5	58.2%	66.1			65.2	98.6%	0.9	1.4%
1982	27.8	42.8%	37.2	57.2%	65.0			64.3	98.9%	0.7	1.1%
1983	25.9	42.0%	35.8	58.0%	61.7			60.9	98.5%	0.9	1.5%
1984	19.4	37.5%	32.3	62.5%	51.7			50.9	98.5%	0.8	1.5%
1985	18.5	41.1%	26.4	58.9%	44.9			43.9	97.9%	0.9	2.1%
1986	18.2	40.5%	26.8	59.5%	45.0			44.1	97.8%	1.0	2.2%
1987	16.5	41.1%	23.6	58.9%	40.1			39.1	97.5%	1.0	2.5%
1988	13.8	40.1%	20.7	59.9%	34.5			33.5	97.2%	1.0	2.8%
1989	14.1	40.8%	20.4	59.2%	34.6			33.6	97.1%	1.0	2.9%
1990	13.2	41.0%	19.0	59.0%	32.2			31.1	96.7%	1.1	3.3%
1991	12.0	40.9%	17.4	59.1%	29.4			28.4	96.6%	1.0	3.4%
1992	12.7	45.3%	15.3	54.7%	28.1	26.1	48.2%	26.9	49.7%	1.1	2.1%
1993	12.1	45.1%	14.7	54.9%	26.8	24.8	48.0%	25.6	49.7%	1.2	2.2%
1994	10.0	44.7%	12.4	55.3%	22.4	20.2	47.4%	21.0	49.4%	1.4	3.3%
1995	11.5	44.5%	14.3	55.5%	25.7	23.2	47.5%	24.2	49.4%	1.5	3.2%
1996	11.5	42.1%	15.8	57.9%	27.3	24.4	47.2%	25.4	49.1%	1.9	3.7%

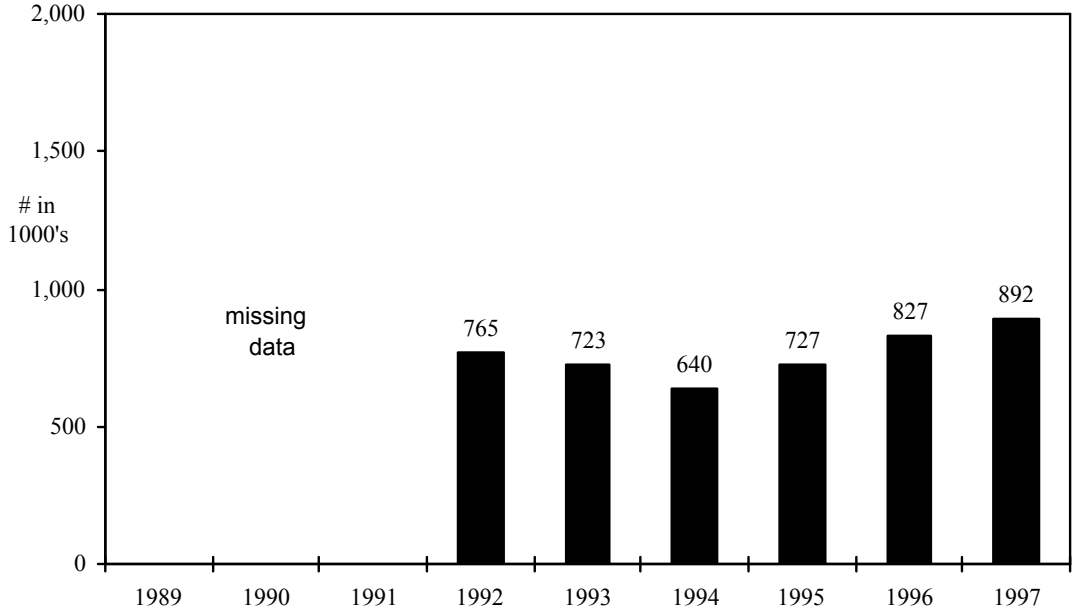

Figure 51. Estimated breeding duck populations in northwest Alberta (Strata 76). Data Source: Canadian Wildlife Service.

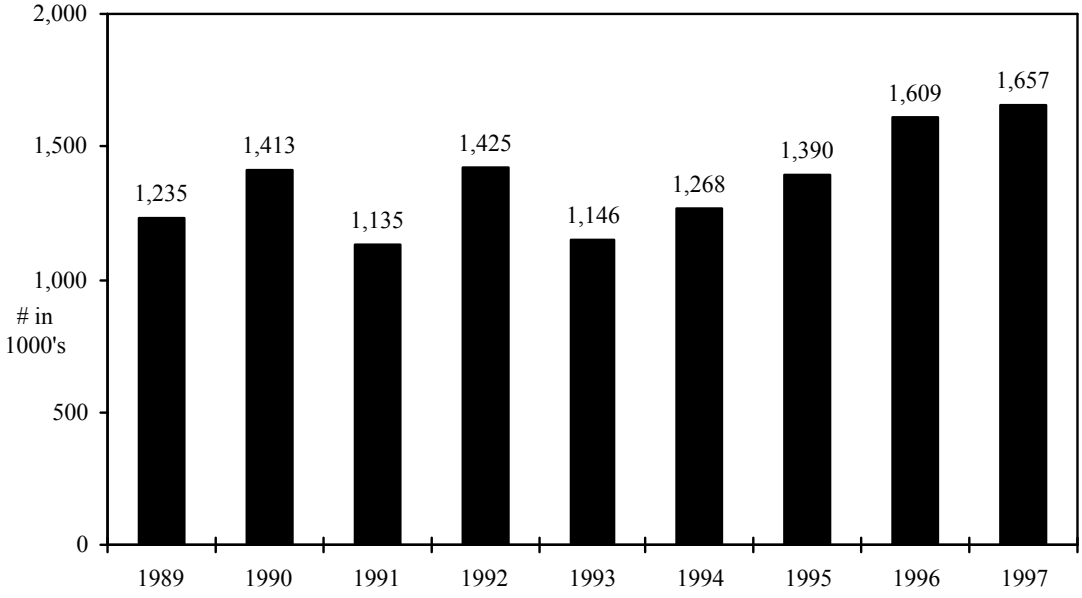

Figure 52. Estimated breeding duck populations in central Alberta (Strata 75 and 76).). Data Source: Canadian Wildlife Service.

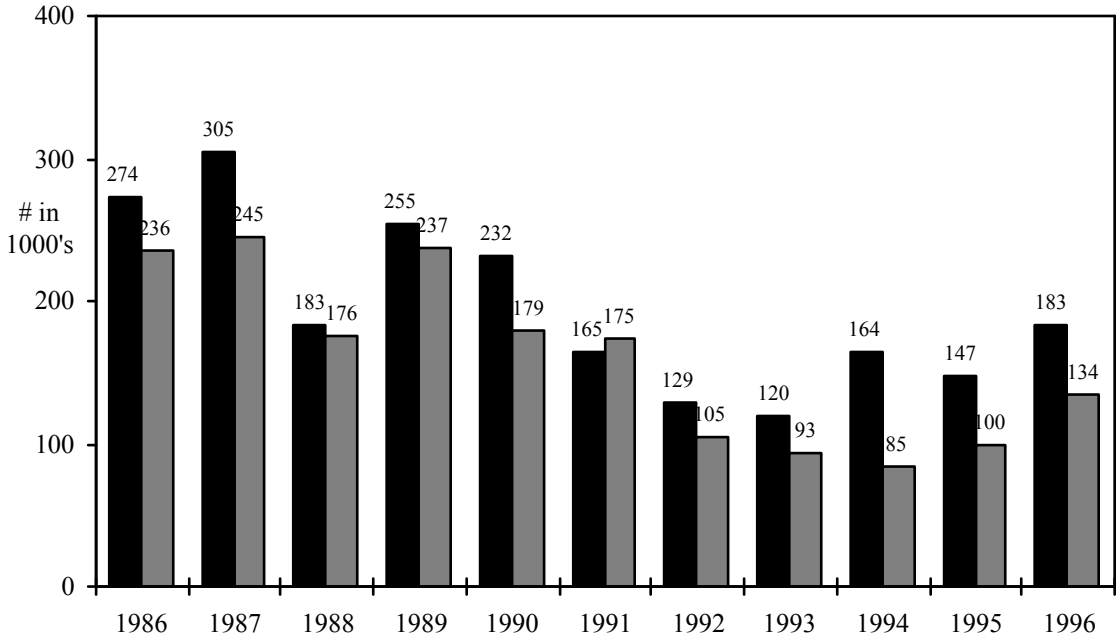

Figure 53. Annual variation (1986–1996) in waterfowl harvest. Data Source: Canadian Wildlife Service (black) and Alberta Environmental Protection (gray).

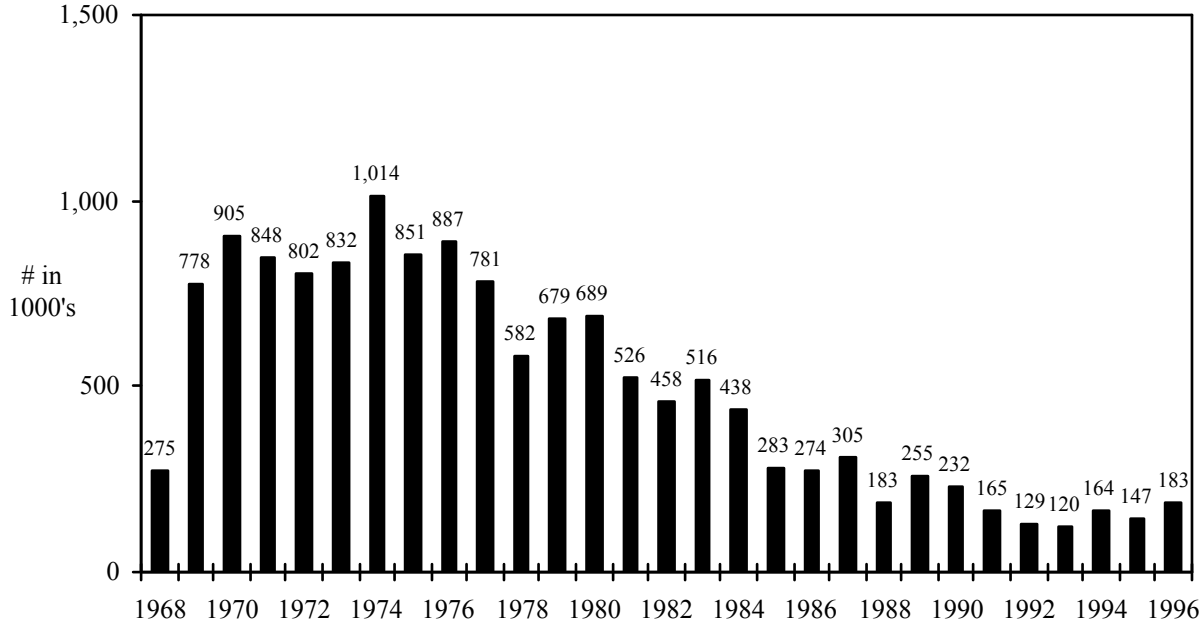

Figure 54. Annual (1968–1996) variation in waterfowl harvest. Data Source: Canadian Wildlife Service.

Table 37. Waterfowl harvest data from Alberta and northwest Alberta. Data Source: Canadian Wildlife Service.

Species/Grouping	´Estimated Harvest in Thousands 1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Canadian Wildlife Service Data													
G W-fronted Goose	0.0	0.0	16.2	11.3	17.6	18.2	16.2	15.6	9.4	16.1	11.5	11.4	18.8
Snow Goose	0.0	0.0	21.8	12.3	17.2	15.2	12.7	16.8	27.4	26.7	15.4	9.5	9.8
Ross' Goose	0.0	0.0	0.2	1.0	0.6	0.8	1.0	1.8	1.5	2.9	0.5	1.0	0.9
Canada Goose	0.0	50.1	61.6	53.3	57.2	67.8	63.4	86.0	74.3	67.7	80.6	82.8	103.7
Green-winged Teal	0.0	14.0	13.6	16.6	13.6	15.2	13.7	28.7	28.0	26.5	19.5	17.3	13.5
Mallard	275.0	541.8	634.3	568.0	557.6	546.9	714.1	531.5	612.3	515.6	379.6	486.5	482.4
Northern Pintail	0.0	48.8	78.1	71.6	68.8	94.1	98.9	82.5	60.8	71.3	38.1	48.3	43.9
Blue-winged Teal	0.0	11.0	21.6	28.0	13.4	24.5	23.5	22.0	30.5	24.5	20.2	20.1	25.3
Northern Shoveler	0.0	26.8	37.8	32.2	21.7	27.1	28.4	33.8	19.6	17.6	19.8	17.8	25.7
Gadwall	0.0	52.5	50.2	54.3	48.2	47.9	58.9	61.0	63.4	39.6	37.1	32.4	41.8
American Wigeon	0.0	57.1	35.5	36.8	39.7	32.9	35.3	50.6	38.8	55.8	34.1	25.8	23.7
Canvasback	0.0	5.1	6.9	5.6	3.5	5.7	4.8	4.2	3.4	1.7	2.6	2.4	5.6
Redhead	0.0	7.4	9.6	15.7	9.3	8.6	10.8	8.1	6.5	13.9	7.8	10.6	7.9
Ring-necked Duck	0.0	0.6	1.1	1.0	0.7	2.0	2.1	2.4	0.3	1.6	0.7	0.5	0.6
Lesser Scaup	0.0	9.5	11.7	13.4	15.0	18.9	14.1	19.0	14.8	8.7	15.5	10.0	13.2
Common Goldeneye	0.0	1.3	2.0	1.4	4.0	2.5	2.8	4.4	5.0	0.5	2.4	1.4	2.1
Bufflehead	0.0	1.9	2.0	2.7	1.4	2.8	2.1	0.7	2.5	3.3	4.0	4.1	2.9
Ruddy Duck	0.0	0.3	0.2	0.4	1.3	0.4	0.5	0.1	0.0	0.4	0.0	1.1	0.3
Total Ducks (Alta)	275	778	905	848	802	832	1014	851	887	781	582	679	689
Total Geese (Alta)	0.0	50.1	99.8	77.9	92.5	102.0	93.2	120.2	112.7	113.4	108.0	104.7	133.2
Alberta Environmental Protection Data													
Total Ducks (Alberta)		-	-	-	-	-	-	-	-	-	-	-	-
Total Ducks (NW Alberta)		-	-	-	-	-	-	-	-	-	-	-	-
% of Alberta		-	-	-	-	-	-	-	-	-	-	-	-
Total Geese (Alberta)		-	-	-	-	-	-	-	-	-	-	-	-
Total Geese (NW Alberta)		-	-	-	-	-	-	-	-	-	-	-	-
% of Alberta		-	-	-	-	-	-	-	-	-	-	-	-

Table 37 (continued). Waterfowl harvest data from Alberta and northwest Alberta. Data Source: Canadian Wildlife Service.

	Estimated Harvest in Thousands															
Species/Grouping	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Canadian Wildlife Service Data																
G W-fronted Goose	14.4	11.5	6.1	14.5	12.0	20.4	13.4	17.9	19.1	17.1	11.7	9.2	7.0	8.7	13.9	17.9
Snow Goose	13.9	6.6	6.2	8.2	12.8	11.0	5.0	9.5	11.3	10.7	5.4	8.8	5.2	6.7	8.3	4.2
Ross' Goose	0.4	0.4	0.0	1.1	1.2	2.3	0.4	2.0	1.8	3.2	1.4	1.6	0.9	2.0	3.3	1.6
Canada Goose	96.8	101.4	110.5	98.8	103.1	88.0	126.2	99.7	121.6	125.4	109.9	91.0	90.2	103.3	108.7	137.4
Green-winged Teal	8.4	32.0	12.6	9.1	11.4	7.2	10.3	2.8	8.6	4.9	3.7	4.7	5.2	4.0	3.2	5.3
Mallard	388.2	295.0	363.7	304.8	180.9	182.0	215.3	138.0	186.6	175.9	121.0	95.2	80.3	109.0	106.6	115.7
Northern Pintail	41.0	28.7	27.8	32.5	23.7	9.0	21.2	15.3	12.0	13.5	5.7	6.9	3.9	7.3	7.2	9.6
Blue-winged Teal	12.6	11.2	16.9	12.5	10.0	8.5	5.9	1.9	8.5	3.7	2.6	1.7	2.8	2.5	2.5	6.4
Northern Shoveler	12.4	12.4	18.5	14.2	10.6	17.4	7.0	2.7	8.0	4.0	4.5	2.4	3.9	5.5	1.6	7.5
Gadwall	17.3	36.1	27.2	22.8	17.4	18.4	19.6	8.1	15.4	12.6	10.4	6.6	8.9	15.1	10.4	16.0
American Wigeon	18.7	22.7	20.0	16.5	13.2	13.2	12.0	7.9	9.9	5.6	3.9	5.6	7.0	6.4	5.2	10.2
Canvasback	5.5	0.4	4.0	3.8	1.4	4.0	0.8	0.4	0.9	0.7	1.9	0.2	0.5	1.8	1.5	1.4
Redhead	5.1	1.7	8.6	3.6	5.2	5.0	3.8	0.7	1.2	4.0	1.3	0.6	1.8	3.6	2.0	3.3
Ring-necked Duck	0.4	0.0	0.9	0.3	0.6	1.0	0.9	0.4	0.2	1.2	1.0	0.1	0.7	2.0	0.2	0.9
Lesser Scaup	8.5	13.4	6.8	5.7	6.2	5.8	5.5	3.3	3.1	3.9	2.4	2.3	1.6	3.1	2.8	2.8
Common Goldeneye	4.6	1.4	5.0	4.8	0.9	0.6	2.2	0.1	0.1	0.5	1.9	1.4	1.7	2.2	2.8	1.4
Bufflehead	1.8	1.5	3.3	5.5	0.5	0.1	0.4	0.7	0.0	0.5	1.9	0.5	1.1	1.3	0.8	1.6
Ruddy Duck	0.5	0.2	0.3	0.3	0.3	0.7	0.2	0.0	0.0	0.1	0.4	0.2	0.1	0.0	0.0	0.2
Total Ducks (Alta)	526	458	516	438	283	274	305	183	255	232	165	129	120	164	147	183
Total Geese (Alta)	125.5	119.8	122.8	122.5	129.0	121.7	145.0	129.1	153.8	156.5	128.3	110.6	103.3	120.7	134.2	161.2
Alberta Environmental Protection Data																
Total Ducks (Alberta)	-	-	-	-	236.4	245.2	175.6	237.3	178.9	174.5	105.0	92.7	84.8	100.0	134.4	
Total Ducks (NW Alberta)	-	-	-	-	16.0	12.9	9.4	10.0	12.5	12.6	6.4	5.5	4.1	4.4	4.9	
% of Alberta	-	-	-	-	6.8	5.2	5.3	4.2	7.0	7.2	6.1	5.9	4.8	4.4	3.7	
Total Geese (Alberta)	-	-	-	-	102.3	91.8	104.6	128.5	98.7	131.2	86.1	75.5	60.0	79.4	101.2	
Total Geese (NW Alberta)	-	-	-	-	16.4	15.0	12.4	16.5	14.3	18.5	13.8	9.7	6.1	8.1	10.3	
% of Alberta	-	-	-	-	16.0	16.3	11.8	12.8	14.5	14.1	16.1	12.8	10.2	10.2	10.2	

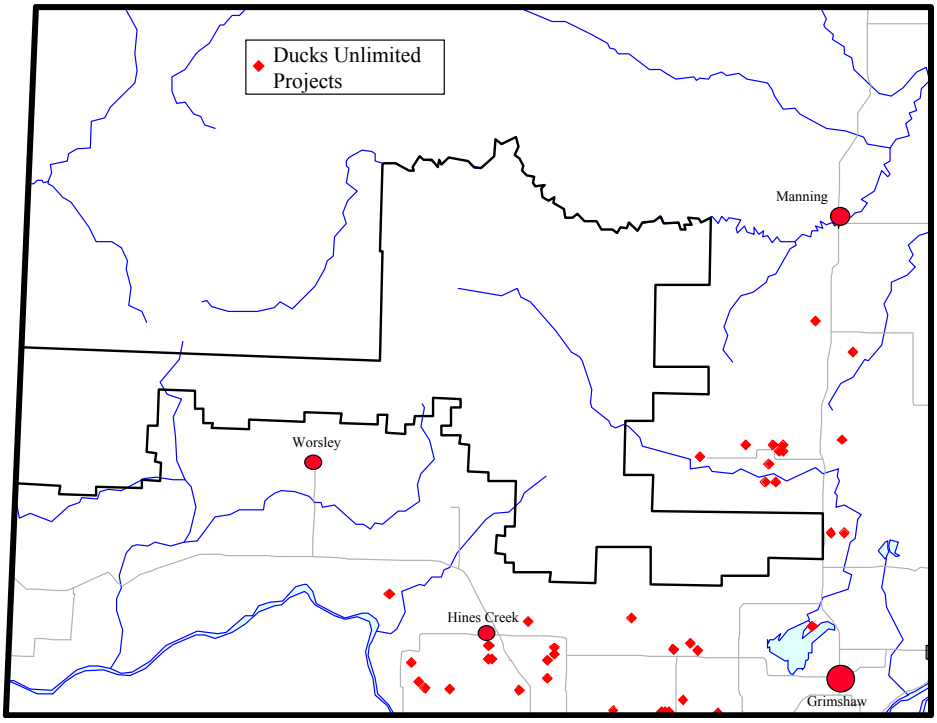

Figure 55. Location of Ducks Unlimited projects in the P1 and P2 FMUs of northwest Alberta. Data Source: Ducks Unlimited Canada, Grande Prairie.

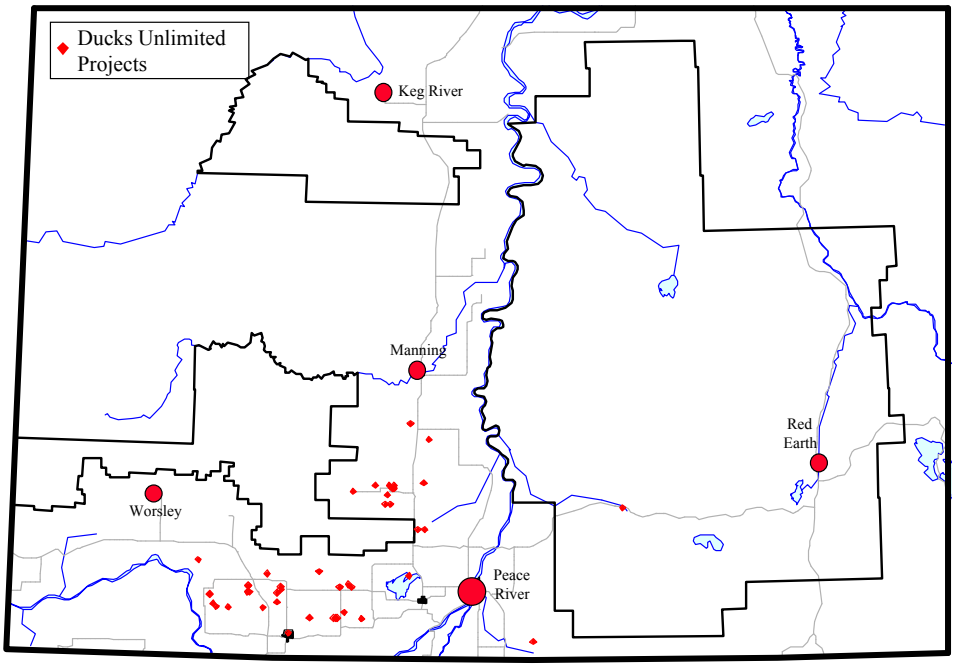

Figure 56. Location of Ducks Unlimited projects in the PRPD FMA of northwest Alberta. Data Source: Ducks Unlimited Canada, Grande Prairie.

Woodland Caribou

Status

Woodland caribou in Alberta are subdivided into the mountain and boreal eco-types, although both belong to the same subspecies (*Rangifer tarandus caribou*). Mountain caribou winter in the forested foothills of west-central Alberta (the eastern slopes of the Rockies) and migrate into the mountain forests and alpine tundra of northern Jasper National Park, Willmore Wilderness Area, and adjacent portions of British Columbia during summer months. Boreal caribou in northern and west-central Alberta are generally non-migratory, although highly mobile within their ranges. Both mountain and boreal types occur in northwest Alberta.

Historically, the woodland caribou occupied all provinces of Canada and extended into the northeastern United States. But since the 1800s, its range has decreased, particularly in the southeast, due to loss of mature conifer forests, overhunting, and possibly the role of the white-tailed deer in spreading a parasitic worm in eastern areas.

The Alberta Wildlife Act lists woodland caribou as an endangered species within the province. This designation was established in the mid-1980s in response to the general erosion of caribou range throughout North America, to declining numbers at the southern boreal fringe, and to a documented decline of caribou in west-central Alberta (Alberta Woodland Caribou Conservation Strategy 1996).

The decline of caribou populations along the eastern slopes appears to be the result of 1) excessive wolf predation; 2) excessive licensed and unlicensed hunting; 3) habitat degradation from industrial activity; and 4) accidental death, primarily from vehicle collisions in the Grande Cache area (Edmonds 1986).

Current Populations

Accurate population estimates are difficult to obtain because woodland caribou occur at low densities across large ranges, and their cryptic coloration and preference for coniferous habitat makes them difficult to detect during aerial surveys. The Alberta Woodland Caribou Conservation Strategy (1996) estimates the current provincial population of caribou to be 3,600 to 6,700. Slightly over half of this population is thought to be in northwest Alberta, the rest being in northeastern Alberta and along the eastern slopes of the Rockies.

Ecotype	Region	Range (km^2)	Population
Mountain	Eastern Slopes*	13,000	600-750
Boreal	Eastern Slopes	3,000	100-150
	North East	33,200	1,000-2,000
	Peace River	63,700	1,900-3,800
Total		102,900	3,600-6,700

* note that the Mountain caribou range and population estimates include the mountain parks

Habitat

Woodland caribou are generally associated with old conifer forests. In northwest Alberta, they occupy habitats across a wide variety of natural subregions, with the exceptions of the relatively small areas of the Peace River Parkland and Peace River Lowlands. Their range is associated with open and treed bog and fen complexes dominated by black spruce and larch. Many of those peatlands are interspersed with upland vegetative types. Important caribou ranges in northwest Alberta are illustrated in Figure 57–Figure 59.

Preference for specific plant community types reflects the observation that caribou feed primarily on terrestrial lichens, mainly *Cladina* sp., during the winter. These lichens are abundant in bog and fen habitats, and in upland pine stands.

Reproduction And Survival

Based on spring telemetry flights, between 79–95% of radio-collared cows have been observed to have calves. However, calf survival surveys have shown that recruitment (the percentage of calves in the total population surviving to one year of age) in the Red Earth range has been only 6, 14 and 8% for the years 1994/95, 1995/96 and 1996/97, respectively. For the same years, the percentages in the Caribou Mountains range are 6, 10 and 16%

respectively. Although no specific research has been conducted to identify the cause of calf mortality, adverse weather conditions and predation by wolves or bears are likely factors.

Limited information is available on adult mortality. From January 1995, when the Caribou Mountains and Red Earth research programs commenced, 76 caribou were collared from which 43 were still active in mi-1999. Of those collars not currently active, 20 were suspected wolf kills, 1 was killed legally by humans, 1 died of non-wolf natural causes, 11 died of unknown causes, and 1 slipped its collar (Elston Dzus, personal communication).

Research And Management

Detailed research on caribou population and habitat use focused on the eastern slopes region in west central Alberta from the late 1970s to the 1990s. Research in northwest Alberta in the 1990s has been coordinated by the research subcommittee of the NorthWest Region Standing Committee for Caribou (NWRSCC), which is a co-operative between the forest industry, energy sector, provincial government, and First Nations. Recently the research subcommittees from NWRSCC and the NorthEast Region Standing Committee for Caribou (NERSCC) have amalgamated to form the Boreal Caribou Research Committee, which coordinates research across northern Alberta.

Current research in northwest Alberta is focused primarily on caribou distribution, movements, calf recruitment, adult mortality factors, and habitat use. Additional information is being collected on calving dates, fidelity to calving sites, feeding sites, bedding sites, and daily rates of movement.

An extensive winter backtracking effort has been undertaken in the Red Earth and Caribou Mountains ranges since 1995 to 1997. This has provided insight into specific activities in selected habitats and has provided the opportunity for collection of fecal pellets to study food habitats.

Information about calf production and calf survival is obtained through aerial surveys twice per year. In the first survey, conducted in conjunction with the radio telemetry flights from April to June, the ratio of calves to radio-collared cows is recorded. Aerial surveys conducted the following March are based on a substantially larger sample of the population, using the radio-collared animals to locate groups of caribou.

Classification of the peatland component of the landscape is being incorporated into the new Alberta Vegetation Inventory (AVI) being collected by Daishowa-Marubeni International Ltd. in the High Level area. When matched to the radio telemetry observations, this inventory will provide an important opportunity to evaluate caribou habitat selection.

Ground rules for timber harvest planning in Alberta have been developed to enhance moose habitat, using relatively small cutblock sizes and limited line of sight. However, such harvesting regimens could result in fragmentation of important caribou habitat. Increased numbers of moose may lead to increased wolf numbers on caribou range, thereby increasing the potential for predation. Minimizing damage to caribou habitat from forestry may require alternative harvesting plans. An appropriate way to manage forest harvesting in caribou range might be to duplicate the fire-generated forest pattern (size of forest patches, stand age distribution and stand composition) in which caribou have evolved.

Industrial development in caribou range can significantly increase density of roads and corridors that lead to increased human access which, in turn, can lead to increased caribou mortality from vehicle collisions and hunting. (Although sport hunting was discontinued in 1981, First Nations people are allowed to hunt caribou in Alberta.) Corridors created by industry can also increase predator hunting efficiency. To address these concerns, NWRSCC has developed guidelines for industrial development that strive to limit the amount of high-grade access development.

Moose

Prepared by Bob Wynes (DMI) and Dave Moyles (NRS); Adapted from Alberta Moose Management Plan, Natural Resources Service.

Introduction

Moose are distributed throughout the forested regions of Alberta and are a common ungulate of northwestern Alberta. The moose has received a great deal of consideration by Natural Resources Service due to its socio-economic importance to Albertans. In the early 1990s, approximately 61,000 licensed hunters harvested 12,000 to 15,000 moose each year. Additional moose are harvested by Treaty Indians as they exercise their aboriginal hunting rights, by residents of Metis settlements, and by holders of subsistence hunting permits.

Due to the social and economic importance of moose, habitat management favoring this species has been a major consideration in the development of timber harvest planning and operating ground rules in northern Alberta.

Habitat And Forage

Distribution of moose in North America appears limited in northern latitudes by the absence of woody food plants on the tundra; in the west by mountain ranges with excessive snow depth and absence of woody plants; and in the prairies and arid valleys of the south and west by absence of cover, water and suitable food. Local distribution and abundance are related to successional stages of vegetation, created by natural disturbances such as lightning-induced wildfires, flooding and glacial movement, as well as from man's activities such as forestry practices, land clearing, homesteading, farming, construction and anthropogenic fires. These successional forces and associated changes in natality and mortality of moose populations account for the dynamic nature of moose populations (Franzmann 1978).

Food and climate are the most important aspects of habitat for moose. Forage preferences include willow, red-osier dogwood, white birch, aspen, balsam poplar and saskatoon (Allison 1972; Nowlin 1976) which are prevalent in early successional stages of forests.

Logging is generally believed to be beneficial to moose because mature forests are converted to early successional stages with abundant forage. However, this relationship is affected by the juxtaposition of habitat types that meet the requirements of moose for both food and cover. Forest harvest planning and operating ground rules in Alberta have been significantly influenced by moose habitat management considerations. Two or three pass logging to maintain intermixed cover and relatively small block sizes to maintain close proximity of forage and cover are designed to increase habitat carrying capacity. Moose populations in Alberta have not increased dramatically in the vicinity of clearcuts, but this may be a function of disturbance and overhunting resulting from improved access (Brusnyk and Westworth 1988).

Moose activity in winter appears largely regulated by snow conditions. Snow influences the timing and distance of movements by moose. In addition, snow may alter the energy balance of moose by increasing metabolic demands for locomotion and decreasing energy reserves through limiting access to forage.

Historical Populations and Management in Alberta

Information on trends and abundance of moose in Alberta is sketchy, but has been used to reconstruct historical population dynamics (Stelfox 1993). Available information suggests that moose numbers were relatively high before 1940, but declined to low levels by 1950. This decline was attributed to predation by wolves, harvest by natives and non-native hunters, and heavy losses caused by winter ticks. Moose populations increased to high levels by the late 1960's in response to reductions in wolf populations and restrictions of recreational harvests of moose. Since then, the moose population has been portrayed as declining gradually to medium or low levels. This most recent decline has been attributed to overhunting and predation and, in central Alberta, to a major infestation of moose with winter ticks in the early 1980's.

Professional wildlife biologists were first employed in Alberta in the early to mid-1950's and undertook broad-scale inventory programs at that time. Before 1968, separate moose licenses were not required for residents. Rather, hunters purchased a Resident Big Game license, which allowed them to harvest one of several antlered big game species. Similar license arrangements were available for hunters who were non-residents and non-resident aliens. License sales are summarized in section dealing with hunting in Chapter 4.

The management regime for moose became both more specific and more refined in the late 1960's. In 1968 the General Moose License was introduced for residents; it has been retained ever since. A variety of special moose

licenses have also been available to residents since 1968. Specific management measures for non-resident hunters also were initiated in the late 1960's.

Sales of moose hunting licenses have fluctuated as a result of hunting regulations and other factors.

There is little information on subsistence harvests of moose, particularly that taken by Treaty Indians. Some of the earliest North American estimates of numbers of moose harvested by natives were for Alberta (Wolfe 1987). Neave (1972) reported for Alberta that 19,000 moose were killed by 53,000 sport hunters versus some 8,000 by 29,000 Treaty Indians. However, in the foothills, Neave considered that a kill of 10,000 animals, of which 40 percent was attributable to Indians, exceeded annual recruitment to the population and thus was contributing to a regional population decline. These appear to be the most recent published estimates for the province.

Mortality Factors

Predation by wolves is a mortality factor that may affect moose over large parts of North America. Increased snow density and crusting allows wolves to maneuver better and can increase their predation rates on moose. In addition, deep snow packs often result in concentrations of moose, making individuals more accessible to wolves. Low nutritional status, associated with snow conditions, can also increase vulnerability of moose (Peterson and Allen 1974). In situations where severe winters result in moose population declines, wolf populations may contribute further to this decrease and continued predation undoubtedly slows the recovery of the populations (Rausch et al. 1974).

Black and grizzly bears can also contribute significantly to moose predation, particularly on calves. Hauge and Keith (1981) portrayed low calf survival in northeastern Alberta as limiting to moose population growth, and suspected that black bears contributed substantially to the high early mortality of calves (39 percent within the first month).

Collisions with vehicles can also be a significant cause of mortality.

A radio collaring program to study moose is underway in 3 WMUs outside of northwestern Alberta. These include WMU 346, 350 and 358. A total of 26 mortalities have been recorded and the causes of mortality of cow moose are listed as follows: predation 19.2%, while giving birth 3.8%, confirmed poached 23.1%, aboriginal harvest 15.4%, and undetermined human caused 38.5%. The total related to humans is 77% of the cow mortalities. Access creation related to resource development increases the opportunity for human harvest of moose.

Status

In 1991 the provincial population of moose was estimated at just over 100,000 animals. Important winter range of moose in northwest Alberta is summarized in Figure 57–Figure 59.

The Peace River Region includes an area greater than the area described as northwestern Alberta in the Detailed Forest Management Plan (north of 56 degrees and west of 114 degrees).

NRS responded to public concerns over a perceived decreasing moose population by conducting extensive surveys of moose across northern Alberta in 1993/94. In some management units the surveys have been repeated since and it is hoped the surveys will be repeated on a rotational basis. The table below indicates the estimated number of moose and corresponding density in those WMUs surveyed and reported in the Northern Moose Management Program February 1997 Progress Report for the WMUs which have significant portions within northwestern Alberta.

Table 38. 1991 estimate of moose populations in NRS administrative regions in Alberta. Data Source: Natural Resources Service, AEP.

Natural Resources Service Administrative Region	Estimated Moose Population
Southern	1,485
Central	2,435
East Slopes	26,275
Peace River	43,455
Northeast	27,030
Total Province	100,680

Table 39. Density (#/km^2) and numbers of moose in selected wildlife management units in northwest Alberta. Data Source: Natural Resources Service, AEP.

WMU	93/94		94/95		95/96		96/97	
	#/km^2	Pop'n	#/km^2	Pop'n	#/km^2	Pop'n	#/km^2	Pop'n
522	.67	2,178	.58	1,894				
525	.28	1,598			.62	3,578		
526	.39	2,677					.36	2,562
536 S	.15	2,065					.23	3,226
540	.10	1,040					.18	1,895
544	.34	2,091					.28	2,170

Table 40. Harvest of moose in selected wildlife management units in northwest Alberta. Data Source: Natural Resources Services, AEP.

WMU	93/94	94/95	95/96	96/97
522	196	43	207	137
525	146	139	140	148
526	259	147	217	121
536 S	42	76	56	55
540	34	23	18	12
544	94	113	56	122

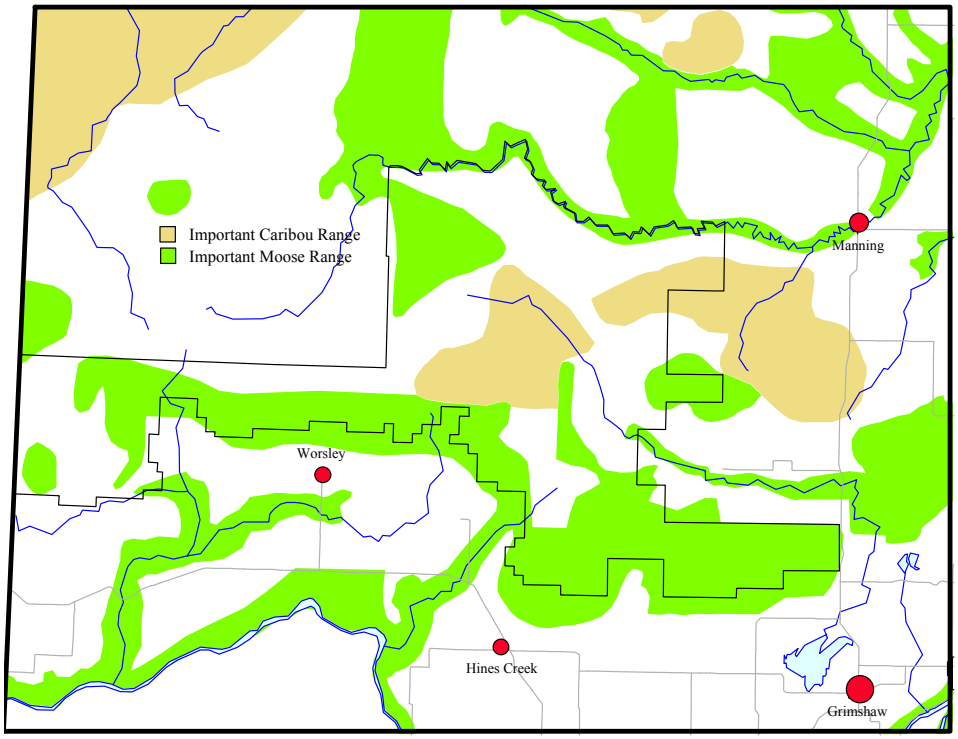

Figure 57. Distribution of important caribou and moose areas in P1 and P2 FMUs. Data Source: Natural Resources Service, Peace River office.

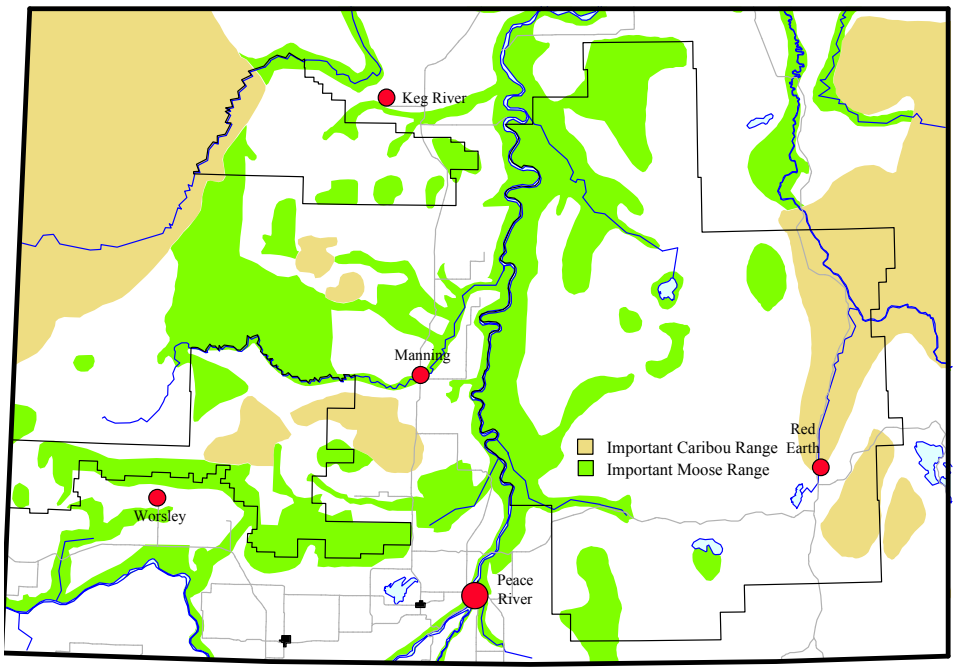

Figure 58. Distribution of important caribou and moose areas in the PRPD FMA. Data Source: Natural Resources Service, Peace River office.

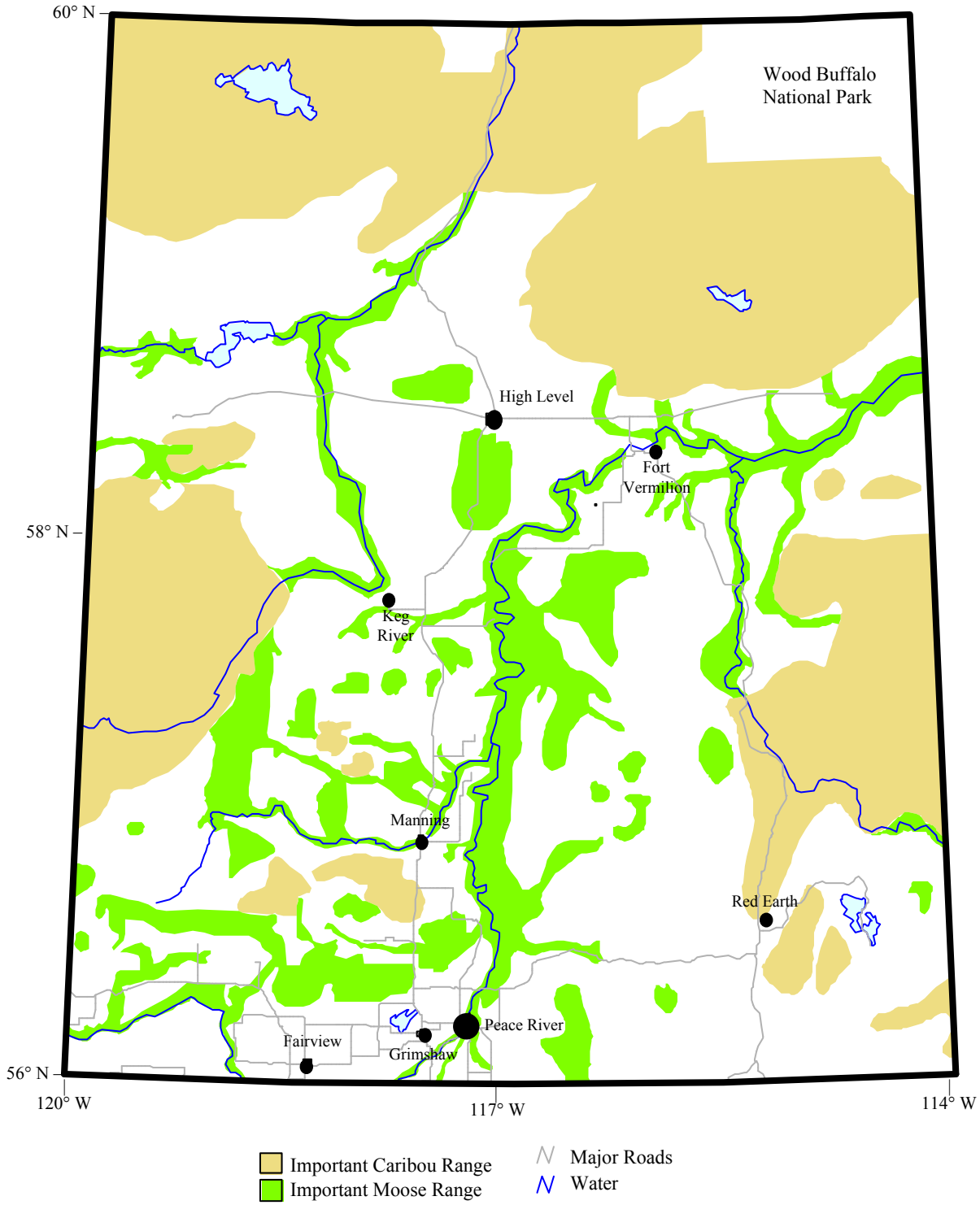

Figure 59. Distribution of important caribou and moose areas in northwest Alberta. Data Source: Natural Resources Service, Peace River office.

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Wood Bison

Prepared by Richard Schneider

Introduction

The bison is the largest native terrestrial land mammal in North America (Reynolds et al., 1982). Males can exceed 800 kg in weight and females typically weigh up to 500 kg (Reynolds et al., 1982; WBNP, 1995). The size and characteristic appearance of the bison render it unmistakable to observers.

Two subspecies of bison have been defined on the basis of taxonomic differences: the plains bison (*Bison bison bison*) and the wood bison (*Bison bison athabascae*) (Geist, 1991). Wood bison are slightly larger, have a taller and squarer hump, the beard is smaller and more pointed, the cape is less distinct from the rest of the body, and they are darker in color (Carbyn et al., 1993). Historically, the plains bison inhabited the vast interior plains of North America and the wood bison primarily occupied the boreal forest of northern Alberta and British Columbia and the Mackenzie valley region of the Northwest Territories (Figure 60; Gates *et al.* 1992). This report will focus on the wood bison since it is the subspecies that historically inhabited northwestern Alberta.

History

Prior to the era of European influence wood bison probably numbered between 100-200 thousand animals, compared with many millions of plains bison (FEARO, 1990). In northwestern Alberta herds were prevalent along the Peace and Hay Rivers and in the area north of Grande Prairie (FEARO, 1990; Gates et al., 1992; Carbyn et al., 1993). As with the plains bison, wood bison suffered a severe decline in the 19th century. The hunting of wood bison associated with the fur trade was an important cause of the decline (Gates et al., 1992); however, other factors may have also been involved (FEARO, 1990). By the late 1890s fewer than 500 animals remained, primarily in the region that is now Wood Buffalo National Park (FEARO, 1990).

In response to the dramatic decline of bison in Canada the federal government passed legislation in 1893 to save the remaining herds, and in 1897 the North West Mounted Police were given the mandate of enforcing these laws (Gates et al., 1992). These measures were too late to prevent the extirpation of wild herds of plains bison from Canada, but the remaining population of wood bison stabilized and began to slowly increase (Gates et al., 1992). To ensure the survival of the wood bison the federal government established Wood Buffalo National Park (WBNP) in 1922, by which time the population had reached approximately 1,500 animals (FEARO, 1990).

Between 1925 and 1928, in what has been termed the "one of the worst blunders in conservation history" (Van Camp and Calef, 1980), 6,673 captive-raised plains bison were released into WBNP (Carbyn et al., 1993). The transfer of the plains bison was initiated to relieve overcrowding within an enclosed federal facility near Wainright, Alberta, when public criticism prevented a slaughter program from proceeding. Government officials had been warned that the transfer would jeopardize the viability of the wood bison because hybridization between the two subspecies would eventually occur and because the plains bison were known carry tuberculosis and brucellosis (FEARO, 1990). But the transfer proceeded, leading to hybridization and infection as predicted, and millions of dollars and countless hours of effort later, we are today still battling the legacy of this astoundingly short-sighted decision.

In 1957 a group of approximately 200 bison were found in the extreme northwest corner of WBNP. Because these animals had the morphological appearance of wood bison and were found at the point farthest from the release of the plains bison they were considered to be representatives of "pure" wood bison herds, though we now believe that some limited exposure to plains bison had occurred (Gates et al., 1992; Carbyn et al., 1993). In the mid-1960s selected disease-free animals from this group became the foundation stock for new wood bison herds in the Mackenzie Bison Sanctuary (MBS) and Elk Island National Park. Both herds demonstrated exponential growth, and since the 1970s bison from the Elk Island National Park have been used to establish new herds as part of a reintroduction program (Blythe, 1995).

As a consequence of the reintroduction program there are currently five free-ranging disease-free herds of wood bison within their former range (Figure 59; WBRT 1999). Of these, only the MBS herd exceeds the estimated minimal viable population size of 400 animals (WBRT 1999). There are two additional free-ranging disease-free herds of wood bison in the Yukon (n=350) and in Manitoba (n=56), approximately 3,100 diseased wood bison and wood bison hybrids in and around WBNP, 750 disease-free wood bison in four captive breeding herds under public ownership, and 500-700 disease-free wood bison on 45-60 private ranches in Canada (WBRT 1999). The success of

the reintroduction program prompted the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to downlist the status of wood bison from "Endangered" to "Threatened" in 1988 (Burnett et al., 1989).

In northwestern Alberta there is currently one free-ranging disease-free herd of wood bison, located in the vicinity of Hay-Zama lakes. This herd was initially captive when started in 1984, but became free-ranging in 1993 when part of the fence collapsed (WBRT, 1999). The herd has remained in the vicinity of Hay-Zama lakes and currently numbers approximately 100 animals (D. Moyles, pers. comm.). There are also a number of privately-owned herds of captive wood bison and plains bison in northwestern Alberta, primarily on agricultural land in the White Zone. The distribution of wood bison in northern Alberta and surrounding regions is illustrated in Figure 60.

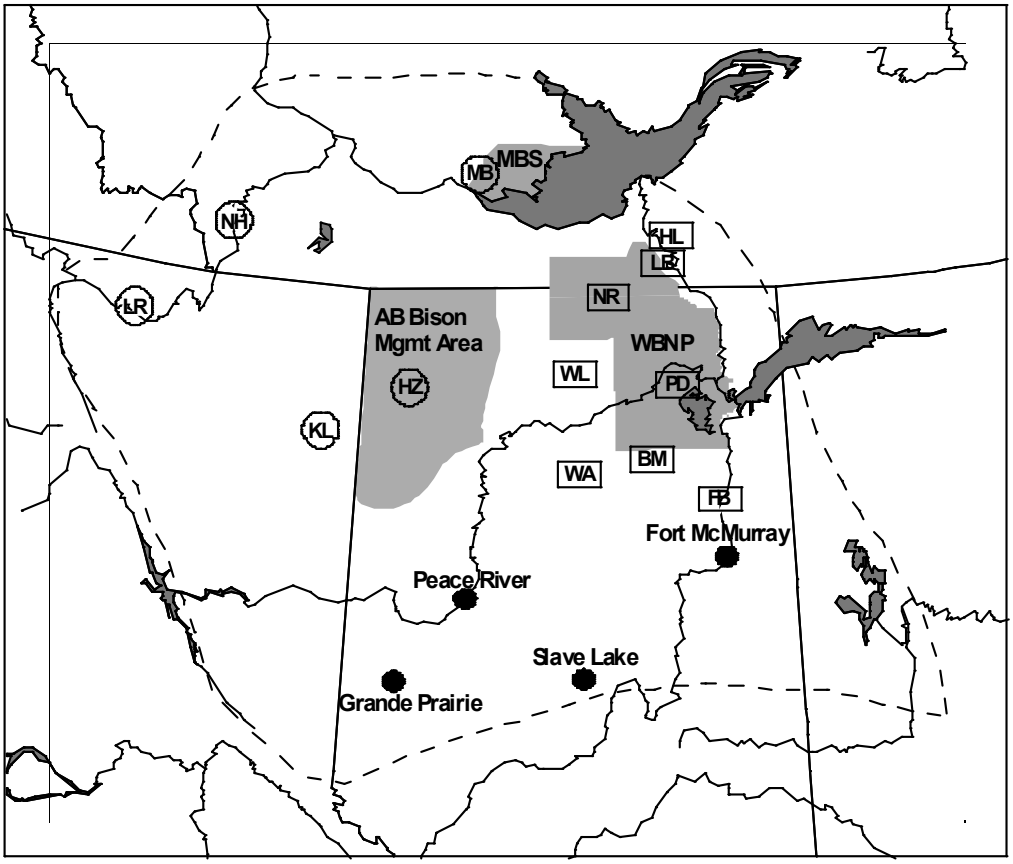

Figure 60. Historical range of wood bison (dashed line) and current distribution of free-ranging herds within this range. Diseased herds are designated by squares and disease-free herds are designated by circles. Herd names: BM=Birch Mountains; FB=Firebag; HL=Hook Lake; HZ=Hay-Zama; KL=Kantah Lake; LB=Little Buffalo; LR=Liard River; MB=Mackenzie; NH=Nahanni; NR=Nyarling River; PD=Peace Delta; WA=Wabasca; WL=Wenzel Lake.

Habitat requirements

Wood bison are primarily grazers. Sedges (especially slough sedge, *Carex atherodes*) and grasses constitute the bulk of their diet, though forbs and browse are used to a limited extent in the summer and fall (Reynolds, 1976). Because of these forage preferences the key habitat types for bison are grass and wet sedge meadows, commonly found scattered throughout the forest matrix. In some areas, such as around shallow lake basins (e.g., the MBS) and flood-prone rivers and deltas (e.g., the Peace-Athabasca Delta), periodic flooding maintains large sedge meadows that are capable of supporting very large bison populations (Carbyn et al., 1993).

Behavior

Bison are gregarious animals. Throughout the year adult females, young males, and juveniles travel together in loosely-structured groups. In forested areas group size is typically between 10 and 20 animals; however, in large meadow complexes group size can exceed 200 animals (Fuller, 1960). Male bison tend to leave the mixed-sex groups after reaching adulthood and thereafter forage by themselves or in small groups with other bulls (Komers et

al., 1992). During the rut (late July and August) the bull groups and lone bulls seek out and associate with the mixed-sex groups (Komers et al., 1992).

Because suitable habitat patches are generally widely dispersed, wood bison tend to move greater distances than other forest herbivores. Also, distinct summer and winter ranges, separated by up to 50 km, have been observed in WBNP (WBNP, 1995). However, the long-range migrations historically reported in plains bison are not characteristic of wood bison. Mean annual home range size has been estimated at 3,609 km^2 in WBNP (WBNP 1995) and 897 km^2 in the MBS (Larter and Gates, 1990).

Population dynamics

Bison are capable of phenomenal population growth when not limited by predation or competition for forage. For example, during the initial 11 years after release the MBS population increased at a mean rate of 0.26 per year (Larter et al., 1993). Since twin calves are rare, the rate of pregnancy must have been 90% during this period (Calef, 1984). While the rate of growth subsequently slowed, it took only 26 years for the initial herd of 18 animals to reach its peak of 2,431 animals in 1989 (Larter et al., 1993).

The major cause of mortality for free-ranging bison is predation by wolves. Calves, yearlings, and aged animals are killed most often, relative to their availability; however, wolf packs can and regularly do kill adult cows and bulls (Van Camp, 1987; Carbyn et al., 1993). The overall rate of mortality due to predation is influenced by the number of wolf packs within the bison range, size and density of the bison population, configuration of the habitat, and season (Schneider, 1997). Consequently, observed rates of mortality vary widely over time and among study areas. For example, the rate of survival of calves (primarily influenced by wolf predation) has been estimated to be as high as 87% in the Mink Lake region of the MBS (Larter et al., 1993) and less than 25% in the Slave River Lowlands in northeastern Alberta (Van Camp and Calef, 1987). Annual adult survival in predated populations is generally estimated to be between 90 and 95% (Carbyn et al., 1993; Gates, 1993).

Another important cause of mortality in bison is disease. Anthrax, tuberculosis, and brucellosis are responsible for the greatest losses, and all three have been reported in bison in northeastern Alberta (Tessaro et al., 1990). The Hay-Zama herd in northwestern Alberta is considered to be free of disease at this time (D. Moyles, pers. comm.). Anthrax causes sudden death in sporadic outbreaks, occasionally involving large numbers of animals (Choquette et al., 1972). The causative factors underlying these outbreaks are still unknown (Gates et al., 1995); therefore, it is not possible to predict when and where they will occur. Tuberculosis and brucellosis are both endemic diseases, meaning that infected individuals are always present in the population once the diseases are established. Tuberculosis is initially restricted to the lymph nodes and causes no symptoms, but the infection often becomes generalized in older animals leading to chronic wasting and premature death (usually via predation) (Tessaro et al., 1990). Brucellosis is also symptomless in most animals; however, a small proportion of cases develops chronic arthritis, predisposing them to starvation and predation (Tessaro et al., 1990). Brucellosis also causes abortions, primarily in an animal's first pregnancy (Peterson et al., 1991).

Bison are highly adapted to cold climates, therefore environmental factors are generally not an important cause of mortality. A significant exception is drowning caused by thin ice conditions on flooded meadows. Occasionally this can cause massive mortality, as in 1969 when up to 3,000 bison in WBNP drowned in this manner (Carbyn et al., 1993).

Over the long-term, the key factors determining the size of bison populations are the availability of habitat, configuration of habitat (i.e., patch distribution), wolf predation, and disease (Schneider, 1997). While sporadic causes of mortality such as anthrax or drowning may cause temporary fluctuations in population size, they generally do not contribute to long-term regulation. In areas such as the MBS and northwestern Alberta habitat patches (i.e., meadows) make up only a small proportion of the landscape, and are generally widely scattered. Under these conditions wolves must expend considerable effort to locate the small and widely dispersed herds, limiting the overall rate of predation. Consequently, in these areas the availability of habitat (i.e., competition for forage) is expected to be the key regulating factor on bison density and overall population size (Schneider, 1997). In contrast, habitat patches in the Peace-Athabasca Delta and Slave River Lowlands are large and relatively concentrated. The number of bison that can be supported in these areas before forage becomes limiting is very large. However, because search effort by wolves is minimal, predation can reduce the population far below the carrying capacity of the habitat, and cyclical population dynamics may occur (Schneider, 1997). On the basis of computer simulations the predicted effect of infection with tuberculosis and brucellosis is a reduction in the mean population size (relative to the disease-free state) by 7.3% in the MBS and 21.4% in the Peace-Athabasca Delta (Schneider, 1997). Most of the effect of the diseases is through their impact on reproduction.

Management

While wood bison are no longer at risk of imminent extinction, additional efforts are required to ensure their long-term survival. These efforts are being coordinated through the development of a national recovery plan, which is now nearing completion (WBRT, 1999). The key objective of the recovery plan is to establish four or more free-ranging herds of wood bison in suitable habitat within their original range. Each herd should meet or exceed the minimum viable population size of 400 animals and should be stable or increasing.

The greatest obstacle to implementation of the recovery plan is the presence of tuberculosis and brucellosis in the bison in and around WBNP. The main cause for concern is that the diseases may be transmitted to domestic livestock and humans (FEARO, 1990). As previously noted, there may be a direct detrimental effect on bison as well. Agriculture Canada is mandated to maintain domestic animals free of these diseases, and the bison in and around WBNP represent the last reservoir of these diseases in Canada (FEARO, 1990). An expert panel in 1990 concluded that the best solution was to slaughter all bison in and around WBNP and then repopulate the park with healthy animals (FEARO, 1990). However, their recommendation was politically untenable and the issue currently remains at an impasse. Until a decision is ultimately made management efforts are being directed to towards maintaining an exclusionary buffer between diseased and healthy herds, effectively placing recovery efforts across much of the historical range on hold (Gates et al., 1992).

Another issue of concern for the recovery of the wood bison is that of hybridization (FEARO, 1990). While the morphological basis for the subspecies classification of wood bison has been challenged (Geist, 1991), DNA studies have shown that genetically-based differences between plains bison and wood bison do exist and therefore, that separate management is warranted (Bork et al., 1991; Van Zyll de Jong et al., 1995). What remains to be resolved is the best course of action regarding the hybridized bison in WBNP. One perspective is that these animals should be excluded from recovery efforts because they no longer represent pure wood bison. However, all the existing so-called “pure” wood bison herds have arisen from only 40 founding animals (Gates et al., 1992). Therefore, a significant component of the original wood bison gene pool may be lost if the hybridized animals (and their wood bison genes) are excluded from the recovery program. Because the hybridized bison are also diseased, the resolution of the genetic issue will likely follow the outcome of the disease issue.

Hunting is not yet a significant management issue as the existing disease-free herds are too small to support a sustained harvest (with the exception of the MBS herd). It is anticipated that hunting opportunities will become available in the future, once the reintroduced herds become fully established (WBRT, 1999).

In northwestern Alberta the government has established a 36,680 km^2 management area, within which bison are protected (Figure 60). The long-term goal is to allow the Hay-Zama herd to expand within this area and thereby contribute to the national recovery program and to provide hunting opportunities for local native bands and sport hunters (D. Moyles, pers. comm.). However, until the disease issue is resolved the Hay-Zama herd will be limited to 250-400 animals, in an effort to prevent contact with the diseased bison in the northeast (WBRT, 1999).

The potential for wood bison to fully reoccupy their historic range in northwestern Alberta will be limited by the human settlement that has occurred in this region. For example, much of the core habitat along the Peace River is no longer available to the bison because of agricultural development. Furthermore, the steady proliferation of game ranches is expected to lead to conflicts as it is difficult to maintain fences where wild and captive herds occur in the same area (WBRT, 1999). A related concern is the potential for additional hybridization resulting from the escape of plains bison from captive herds (Gates et al., 1992). Forest harvesting and petroleum activities are expected to have beneficial effect on bison, in that they produce early successional habitats. However, because bison require meadow, not browse, the beneficial effects of industrial activities may be limited.

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Arctic Grayling

Prepared in consultation with Dave Walty, Head, Fisheries Management, Peace River. Adapted from draft Alberta's Arctic Grayling Management and Recovery Plan.

Status And Distribution

As their name implies, Arctic grayling are a northern species. They are typically found in northern drainages entering the Arctic Ocean, the Bering Sea, and the northern portion of the Pacific Ocean, in both Eurasia and North America. In Canada, populations of Arctic grayling also occur in a few drainages entering on the northwest shores of Hudson Bay. Scattered, fragmented populations of hatchery-planted grayling can be found in Montana in the headwaters of the Missouri River where they were once native, but, in Michigan, grayling populations were extirpated by the 1930s through habitat alteration, pollution, and overfishing.

Arctic grayling are native to the Athabasca, Peace, and Hay River drainages in northern Alberta. Although the Pembina River is the southern limit of that distribution, Arctic grayling have occasionally been taken from the Belly River in southern Alberta. This river may have a remnant population that originated from upstream in Montana.

Few detailed studies have been conducted on Arctic grayling populations in Alberta; however, considerable survey information has been collected about populations throughout the province. At present, the natural range in Alberta remains much the same as it was in the past, but, within this range, the numbers and sizes of fish have declined. These declines have resulted in a general reduction in the health of populations. Although Arctic grayling, as a species, is not in danger of extinction, individual populations continue to decline; therefore, the Fisheries Management Division has classified Arctic grayling in a "vulnerable status".

The current status of each distinct Arctic grayling population has not been fully documented. However, the potential for the loss of grayling populations is evident in the severe decline of populations in the upper Athabasca River drainage. For example, the Pembina, McLeod, and Wildhay watersheds had strong grayling populations prior to the 1950s, but only severely limited populations exist there today. Some stream populations in the Swan and Smoky watersheds have also declined. Although overharvest has contributed to most of the declines, habitat alteration has caused the fragmentation or loss of populations in some areas.

Life History

Although primarily stream dwellers, grayling are occasionally found in lakes, especially in shallow areas along shore. Stream types for grayling range from the rocky streams of the foothills to those throughout the boreal forests, which are low-gradient, brown-water streams from muskeg drainages. Preferred streams are generally the headwaters and upper halves of large tributaries to the Athabasca, Peace, and Hay Rivers.

Grayling tend to avoid the turbid waters of large rivers by selecting locations where tributaries enter and by moving upstream into cleaner, cooler-water tributaries in the spring to spawn. After spending the summer upstream, most adults return to overwinter in large pools in mainstem rivers, while many of the young remain in their natal (birth) tributaries for their first year and a half.

There are also examples of grayling spending their entire lives in the same stream, including some of the Caribou Mountains in northwest Alberta. Beaver dams may play an important role in providing overwintering areas for stream-resident grayling, although spring runoff is necessary to breach these dams to permit fish movement for spawning. A few small lakes in the Caribou Mountains are also home for lake-dwelling populations of grayling.

Spawning

Although up to 50% of grayling adults mature to spawn at the age of three, full maturity (100% of the adults) is not reached until the age of four. At that age, they exceed a total length of more that 33 cm.

Arctic grayling spawn primarily in riffle areas in small streams, although they sometimes use riffle areas of larger streams. The selection of spawning sites may depend on suitable stream flows; they spawn in headwater areas during years of high discharge and in lower stream areas during years of low discharge. During high flows, riffles in lower stream areas are susceptible to floods and the subsequent loss of spawning success. Eggs are usually laid over gravel or rocky bottoms; however, sand and organic material substrates are sometimes used. Evidence of lake spawning is not common.

Spawning movements start immediately as the ice leaves the spawning streams at water temperatures of 0–6 °C. In most areas of Alberta, that occurs during the first two weeks of May, although in foothills streams such as the Kakwa and Cutbank rivers, spawning occurs in the latter part of May. No egg nest (redd) is built, but the fertilized

eggs are forced under and become buried in the gravel loosened by the caudal fins during spawning. The eggs hatch in 11 to 22 days. Newly hatched larvae are about 8 mm in length and spend 3 to 4 days in the gravel substrate absorbing their yolk before emerging as swimming fry.

Feeding

The first food taken by grayling fry consists mainly of small zooplankton (microscopic animals). Juveniles and adults are opportunistic feeders and eat a broad variety of food items from the stream bottom, mid-water, and the surface. Aquatic insects (caddis flies, stoneflies, dragonflies, and midges) and terrestrial insects (bees, wasps, ants, grasshoppers, and beetles) are very important to the diet of grayling. At times, snails, small fish, and even small mammals like mice, shrews, and voles are eaten by grayling. Schools of grayling have been observed in feeding frenzies, repeatedly breaking the water's surface to grab floating insects.

Major Limitations To Production

A number of factors affect the rate at which Arctic grayling can grow both individually and as population. Major limitations to production include the following:

Productive Capacity of the Habitat – In many cases, the smaller tributary streams into which Arctic grayling enter for the summer are naturally limited in their amount of gravel riffles for spawning. These nursery streams may also have a scarcity of pools and cover for both adults and young. Similarly, the limited number and size of pool sites in larger streams may limit the overwinter survival of adult grayling, thereby affecting the production of young in subsequent years.

During low water years, small streams may dry up, or flows may decline to leave streams with only isolated small, pools. Low stream flows during the spring can result in the blockage of spawning migration; for example, in small streams, good flows are needed to open up beaver dams to allow grayling to reach spawning areas. Low stream flows during the winter months can seriously impact survival of young grayling in nursery streams, and of adults when the number and size of pool areas are decreased in larger streams.

Habitat Alteration – Arctic grayling are very susceptible to various forms of habitat disturbances and are good indicators of the quality of the aquatic environment. Siltation, erosion, and the removal of stream cover result in reduced productivity in streams because shelter, food production, and good spawning and nursery areas are lost. Changes in watersheds that cause flash floods in the spring can render riffle areas unusable as spawning sites, can destroy eggs, and can wash fry out of important nursery areas. Improperly installed culverts are also a major cause of spawning migration blockages. Grayling are also particularly susceptible to water pollution, which can impair their ability to recognize mates and spawn successfully.

Biological Constraints – The aggressive nature and territorial habits of dominant male grayling can limit production because of the need for numerous, visually isolated breeding territories to reduce conflict among males defending territories. Although grayling of all sizes frequently reside together in the same pool, dominant males tend to take up the best feeding locations at the expense of subdominant males and females.

Survival rates for Arctic grayling decline with age, an indication that grayling are short lived and few mature age classes exist. A study of grayling populations in northern Saskatchewan suggests that adult grayling may suffer from particularly high natural mortality rates. Their aggressive feeding habits also make adults extremely easy for anglers to catch.

Overharvest – The productive capacity of the habitat, the biological characteristics of the species, and the species composition of the water body primarily control fish production. However, fish harvest has historically been a major factor limiting the size and growth of otherwise productive fish populations. Overharvest reduces population density, and the adults can be removed so quickly that too few mature fish remain to provide sufficient spawning and subsequent recruitment to maintain the population.

Throughout Alberta, a dominance of smaller-sized individuals has become a consistent pattern in Arctic grayling populations; fish over 40 cm in length (age 7+) have disappeared from all but a few remote areas. Current levels of harvest exceed the levels of fish that can be produced for this species in most areas of northern Alberta. In more accessible areas, overharvest has already contributed to population declines and the loss of grayling in some places. It is clear that the development of a remote road network has contributed to an unsustainable level of harvest of grayling in many northern drainages.

Natural Subregions

Introduction

In 1994, The Land Information Services Division of the Provincial government completed a Natural Regions classifications map of Alberta. This classification stratified Alberta based on regions of similar landform, climate, and plant community structure. The natural subregions of P1/P2, the PRPD FMA, and northwest Alberta are illustrated in Figure 61, Figure 62, Figure 63, Figure 64, and Figure 65. The biogeoclimatic descriptions of each natural subregion have been extracted, with minor revisions, from the Department of Environmental Protection, Alberta Provincial Government, web page.

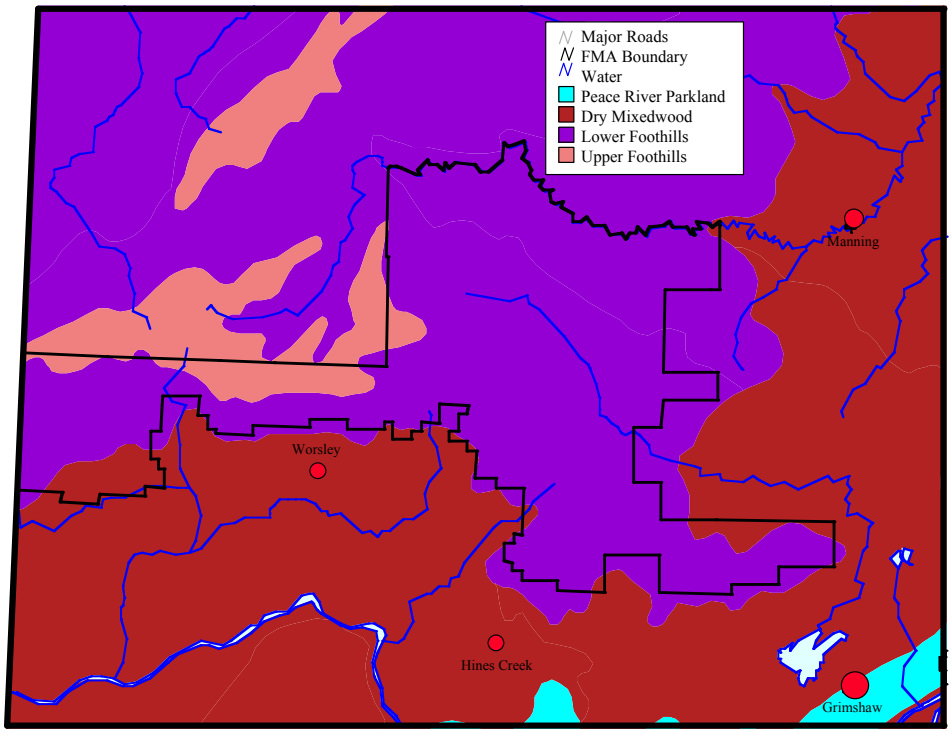

Figure 61. Natural regions and subregions of the P1 and P2 FMUs of northwest Alberta. Data Source: Natural Regions and Subregions Map of Alberta. Produced by Land Information Services Division 1994.

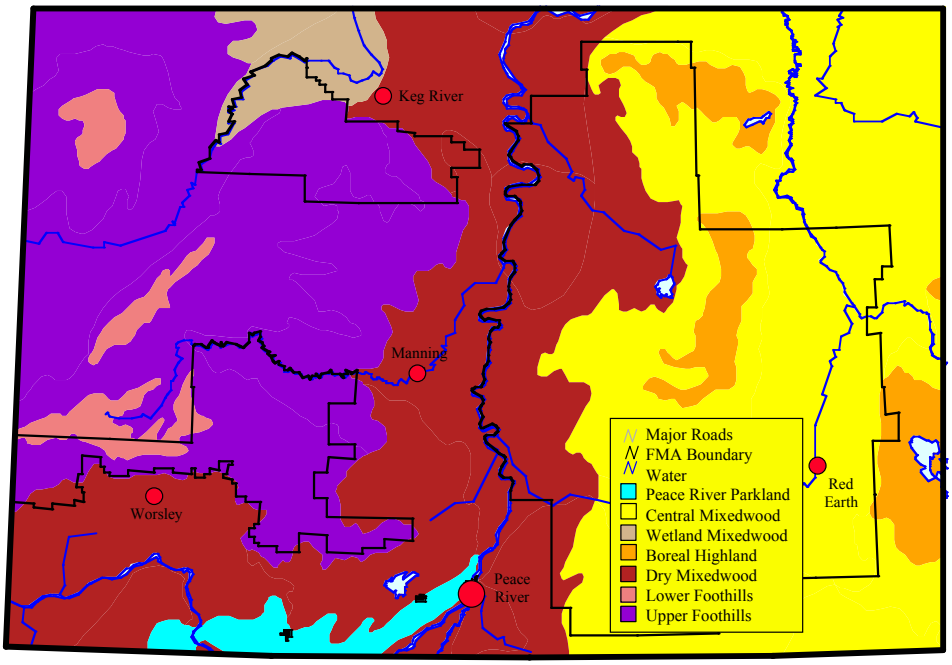

Figure 62. Natural regions and subregions of the PRPD FMA. Data Source: Natural Regions and Subregions Map of Alberta. Produced by Land Information Services Division 1994.

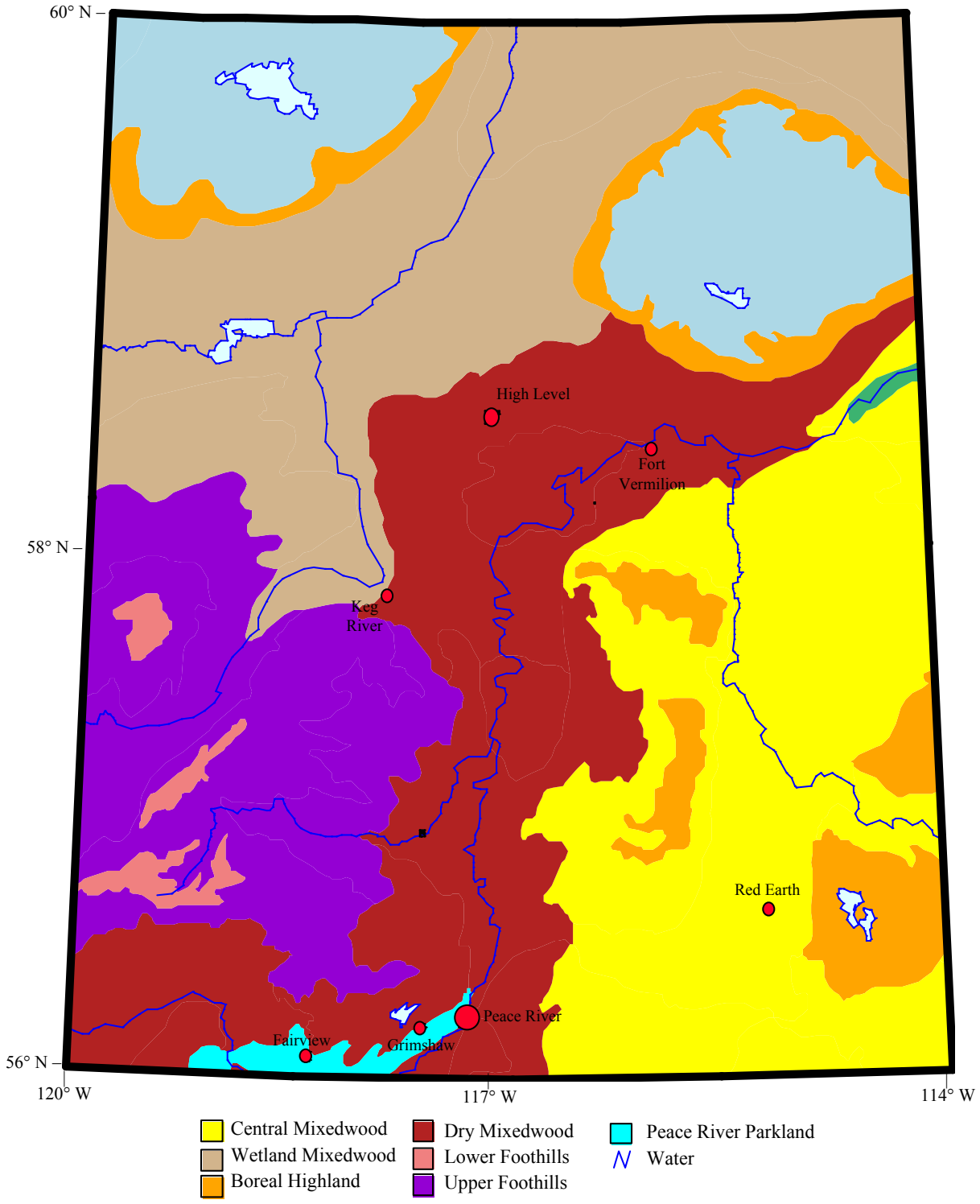

Figure 63. Natural regions and subregions of northwest Alberta. Data Source: Natural Regions and Subregions Map of Alberta. Produced by Land Information Services Division 1994.

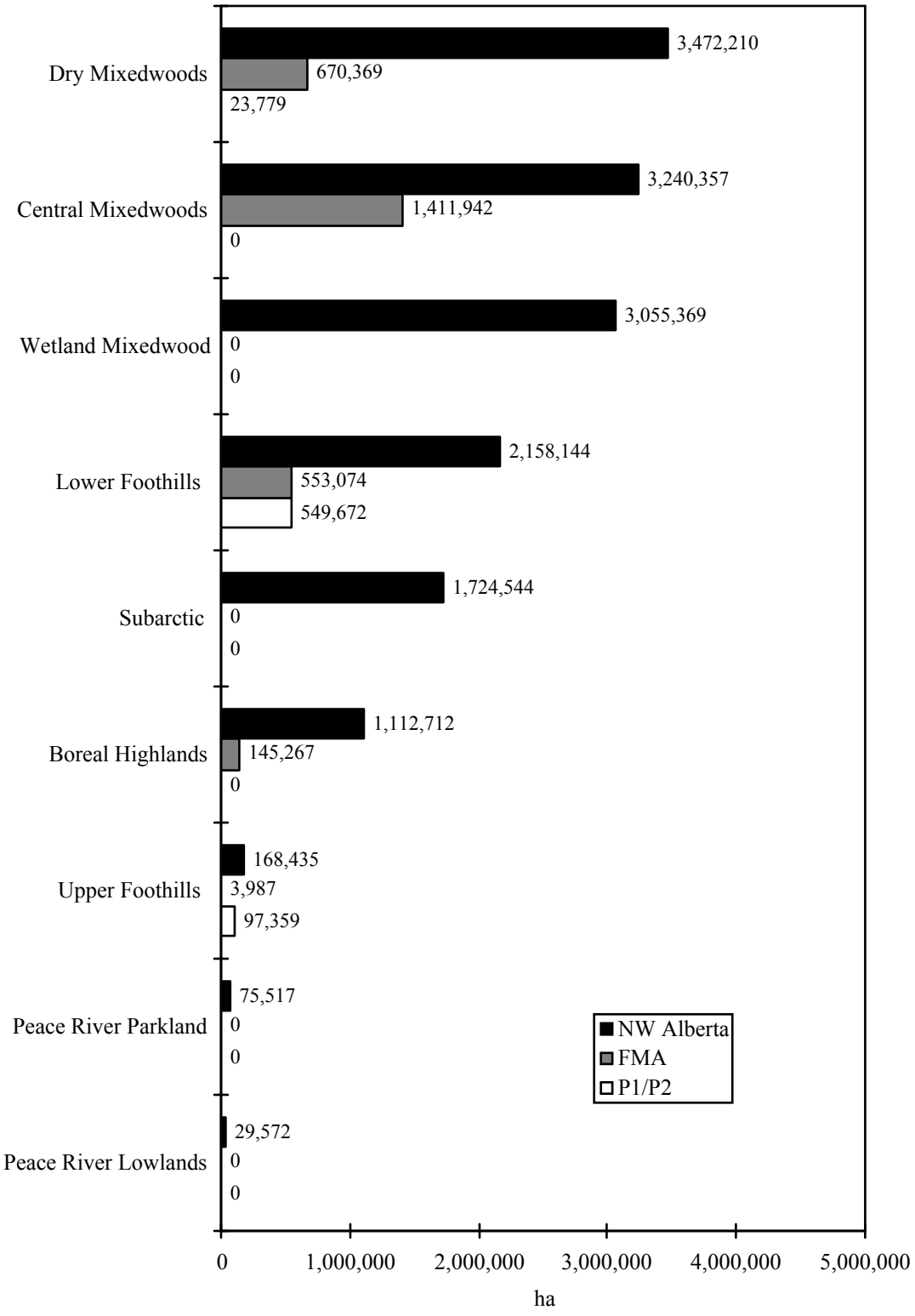

Figure 64. Area (ha) of natural subregions within P1 and P2 FMUs, the PRPD FMA, and northwest Alberta (56–60°N, 114–120°W). Values for P1/P2 include the entire P1 FMU and not just P1 south. Data Source: DMI GIS Library.

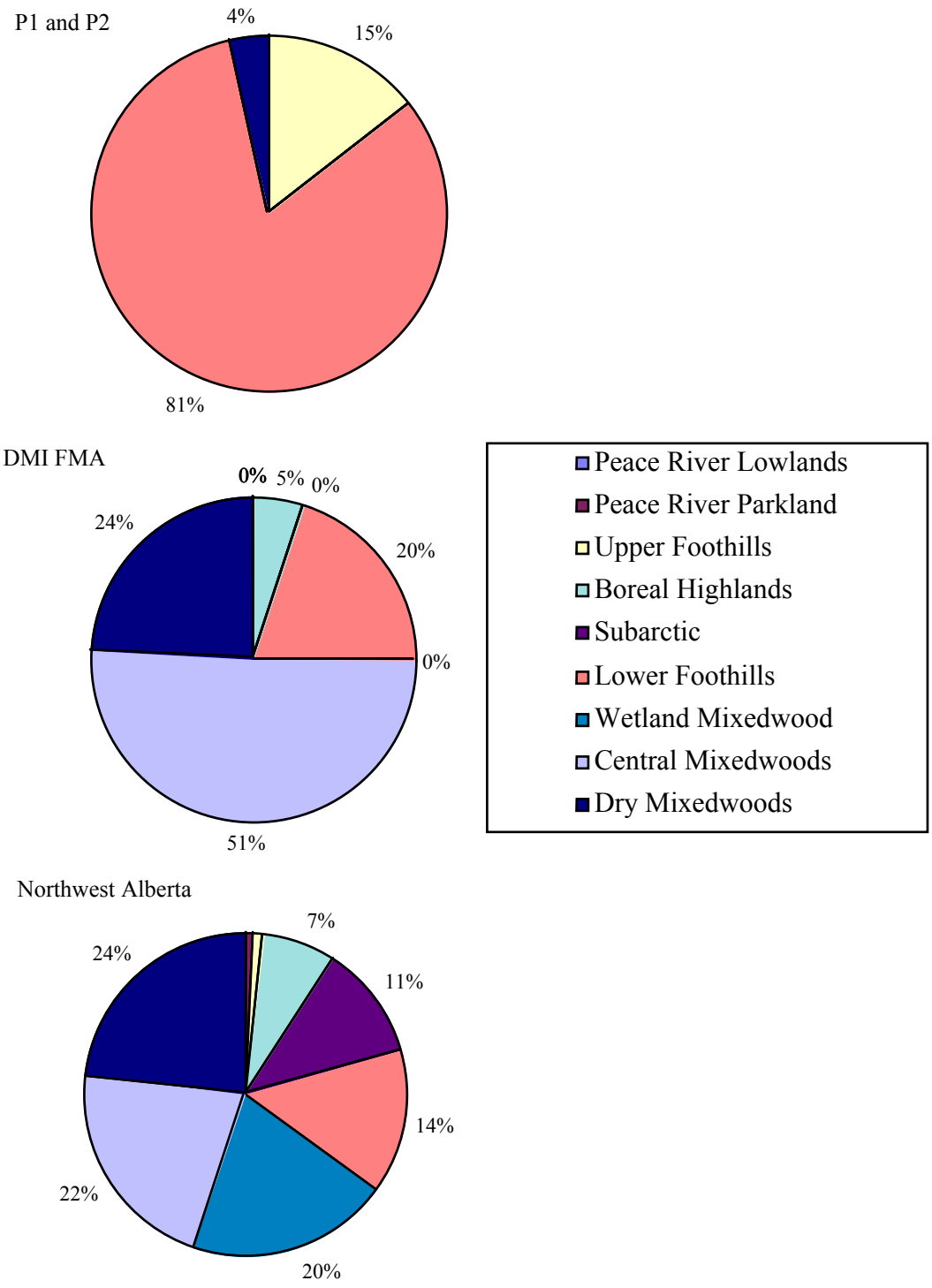

Figure 65. Percent composition of natural subregions in northwest Alberta (top), the PRPD FMA (middle) and the P1 and P2 FMUs (bottom). Values for P1/P2 include the entire P1 FMU and not just P1 south. Data Source: DMI GIS Library.

Dry Mixedwood Subregion

Figure 66. Example of dry mixedwood natural subregion in northwest Alberta. Photo Source: Bob Wynes.

Geology and Landforms

The Dry Mixedwood Subregion is characterized by low relief and level to undulating terrain. Surficial materials are mostly till as ground moraine and hummocky moraine landforms with some areas of aeolian dunes and sandy outwash plain. The Subregion includes two main areas: the southern edge of the Boreal Forest Natural Region from Cold Lake west to about Barrhead and south along the western edge of the Central Parkland Subregion to about Gull Lake and a broad region from Lesser Slave Lake to Grande Prairie then north along the Peace River to Fort Vermilion. The Cooking Lake moraine east of Edmonton is a disjunct portion of this Subregion.

Drainage is to both the Saskatchewan and Mackenzie river systems via numerous rivers and small streams.

Climate

The climate of this Subregion is subhumid, continental with short, cool summers and long, cold winters. The mean May -September temperature is about 13C and the growing period is about 90 days. Annual precipitation averages about 350 mm with June and July the wettest months. Winters are relatively dry with about 60 mm of precipitation. Overall, the climate is some what drier and warmer than the Central Mixedwood Subregion with somewhat higher moisture deficits.

Soils

Soils are typically Gray Luvisols in well-drained, upland till sites and Eutric Brunisols in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

Vegetation

The vegetation of the Dry Mixedwood Subregion is transitional between the Central Parkland and Central Mixedwood Subregions and there are community types common to all three. The differences are largely in the proportion of various vegetation types and other landscape features. Aspen is an important species in all three Subregions, occurring

in both pure and mixed stands. Balsam poplar frequently occurs with aspen especially on moister sites in depressions and along streams.

Successionally, white spruce and, eventually in some areas, balsam fir can be expected to increase or replace aspen and balsam poplar as stand dominants. However, frequent fire seldom permits this to occur and pure deciduous stands are common in the southern part of the Dry Mixedwood Subregion. Coniferous species are more common further north in the Dry Mixedwood Subregion with mixed stands of aspen and white spruce being widespread. Older stands in protected sites, such as islands, may have significant amounts of balsam fir.

Upland aspen forests contain a diverse understory that may include low-bush cranberry, beaked hazel, prickly rose, *a* red-osier dogwood, marsh reed grass, sarsaparilla, dewberry, creamy peavine, pink wintergreen and twinflower. Both balsam poplar and paper birch may occur in these forests as well.

Coniferous, spruce or spruce-fir forests are not common but generally have a less diverse understory with greater moss cover especially of the feather mosses (*Hylocomium splendens*, *Pleurozium schreberi*, *Ptilium crista-castrensis*).

Mixedwood forests generally contain a mosaic of deciduous and coniferous patches with species typical of each occurring through the stand.

Dry, sandy upland sites are usually occupied by jack pine forests. These may be quite open and have a prominent ground cover of lichens. Other understory species may include bearberry, blueberry, bog cranberry and prickly rose.

Peatlands are common throughout the Subregion and are extensive in some areas, e.g. south of Athabasca, but are not as prevalent as in other Boreal Forest Subregions. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by black spruce, labrador tea, and *Sphagnum* spp. (peat mosses) and more nutrient-rich fens, containing tamarack, dwarf birches, sedges, and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur in several areas.

Wildlife

Characteristic species of deciduous forests in the Dry Mixedwood Subregion include least flycatcher, house wren, ovenbird, red-eyed and warbling vireos, Baltimore oriole and rose-breasted grosbeak. Species of mixedwood forests include yellow-bellied sapsucker, Swainson's thrush, solitary vireo, magnolia warbler, white-throated sparrow, pileated woodpecker and northern goshawk.

A few species are restricted to the Cold Lake area and represent an eastern faunal element. These include yellow rail, sedge wren, great-crested flycatcher, chestnut-sided warbler and blackburnian warbler.

Typical mammals include beaver, moose, snowshoe hare, black bear, wolf, lynx and ermine.

Central Mixedwood Subregion

Figure 67. Example of central mixedwood natural subregion in northwest Alberta.

Geology and Landforms

Surficial materials in the Central Mixedwood Subregion are predominantly till as ground moraine and hummocky moraine landforms with some areas of aeolian dunes, sandy outwash plain, and glaciolacustrine plain. The terrain has low relief and a level to undulating surface. The Subregion includes the much of the central and southeastern part of the Boreal Forest Natural Region and is the largest Subregion in Alberta. Highland plateaus and hill masses within the Central Mixedwood Subregion are mostly placed in other Subregions such as the Boreal Highlands although similarities are apparent.

Climate

The climate of the Central Mixedwood Subregion is subhumid, continental with short, cool summers and long, cold winters. The mean May - September temperature is about 12C and the frost-free period is about 85 days. Annual precipitation averages about 380 mm with June and July the wettest months. Winters are relatively dry. Overall, the climate is somewhat moister and cooler than the Dry Mixedwood Subregion with somewhat lower moisture deficits.

Soils

Soils are similar to those of the Dry Mixedwood Subregion with Gray Luvisols in well-drained, upland till sites and Eutric Brunisolsin coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

Vegetation

The vegetation of the Central Mixedwood Subregion is similar to that of the Dry Mixedwood Subregion with many community types in common. The differences are largely in the proportion of various vegetation types and other landscape features. Aspen is the characteristic forest species occurring in both pure and mixed stands. Balsam poplar frequently occurs with aspen especially on moister sites in depressions and along streams.

Paper birch also occurs commonly with aspen. It forms nearly pure stands infrequently, e.g. in the Christina Highland north of Lac La Biche; the reason for this is not clear although it may be related to sandy soils.

Successionally, white spruce and, eventually, balsam fir can be expected to increase or replace aspen and balsam poplar as stand dominants. However, frequent fire seldom permits this to occur and pure deciduous stands are

common in the southern part of the Subregion. Further north, coniferous species are more common with mixed stands of aspen and white spruce being widespread. Older stands in protected sites, such as islands, may have significant amounts of balsam fir.

Upland aspen forests contain a diverse understory that may include low-bush cranberry, beaked hazelnut, prickly rose, red-osier dogwood, marsh reed grass, wild sarsaparilla, dewberry, creamy-coloured peavine, common pink wintergreen and twinflower. Both balsam poplar and paper birch may occur in these forests as well.

Coniferous-dominated, spruce or spruce-fir forests are not common but generally have a less diverse understory with greater moss cover especially of the feather mosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Mixedwood forests, containing a mosaic of deciduous and coniferous patches with species typical of each are widespread throughout the Subregion and characteristic of upland sites.

Dry, sandy upland sites are typically occupied by jack pine forests. These may be quite open and have a prominent ground cover of lichens. Other understory species may include common bearberry, blueberry, bog cranberry and prickly rose.

Fluvial deposits along major stream valleys have white spruce or white spruce-balsam poplar forests that often contain large trees that have benefited from the favorable nutrient and moisture regimes of these sites. Gleyed Luvisols and Gleysolics are typical of these sites.

Peatlands are common and extensive throughout the Central Mixedwood Subregion. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by black spruce, common Labrador tea, and *Sphagnum* spp. (peat mosses) and more nutrient-rich fens containing tamarack, dwarf birches, sedges, and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur commonly in several areas.

Wildlife

The wildlife of the Central Mixedwood Subregion is the most diverse and varied of the Boreal Forest Natural Region. The species of coniferous forests are wide-ranging and include western wood pewee, gray jay, red-breasted nuthatch, golden and ruby-crowned kinglets, yellow-rumped warbler, pine siskin, red and white-winged crossbills, dark-eyed junco, boreal chickadee, and red squirrel. Three warblers, bay-breasted, Cape May and black-throated green, are confined largely to mature conifer dominated mixedwood stands in the central and eastern portions of the Subregion. Balsam fir stands have a particularly diverse assemblage of coniferous forest birds.

Characteristic species of deciduous forests are similar to those in the Dry Mixedwood Subregion and include least flycatcher, house wren, ovenbird, red-eyed and warbling vireos, northern oriole and rose-breasted grosbeak. Species of mixedwood forests include yellow-bellied sapsucker, Swainson's thrush, solitary vireo, magnolia warbler, white-throated sparrow, pileated woodpecker and northern goshawk.

The most species-rich habitats are mixedwoods and shrublands associated with swamps, ponds, streams and lakes. Some species, such as yellow and black-and-white warblers, American redstart, song sparrow, northern waterthrush, fox sparrow and Philadelphia vireo are mostly restricted to these sites. Barred owl occasionally occurs in mature mixedwoods along lakeshores and river valleys.

Typical, widespread mammals include beaver, moose, snowshoe hare, black bear, wolf, lynx, Southern red-backed vole, masked shrew, deer mouse, least chipmunk, moose and ermine. Others, such as fisher, wolverine, river otter, and woodland caribou, are less common and locally distributed.

Wetland Mixedwood Subregion

Figure 68. Example of wetland mixedwood natural subregion in northwest Alberta.

Geology and Landforms

The topography of the Wetland Mixedwood Subregion is generally subdued and nearly level to gently rolling. Elevations range from about 280 to 450 m. Surficial materials are predominantly glaciolacustrine overlain by extensive organic and till deposits. Limited areas of glaciofluvial and aeolian sandy deposits also occur.

Climate

The climate of this Subregion is characterized by cool, moist summers and long, cold winters. It is generally colder than the Central Mixedwood Subregion but probably more moderate than the Subarctic or Boreal Highlands subregions. The mean May - September temperature is about 11°C and the frost-free period is about 85 days. Average annual precipitation is 400-450 mm with 250-300 mm in the summer. Snow cover lasts an average of 185 days per year, one of the longest in Alberta.

Soils

Organic and Gleysolic soils are widespread in the wet depressional sites that are prevalent in this Subregion. Permafrost occurs in many peatlands in a discontinuous fashion. Upland sites typically have Gray Luvisols on fine or medium-textured materials or Eutric Brunisols on coarse-textured materials.

Vegetation

The vegetation of the Wetlands Mixedwood Subregion appears quite similar to that of the Central Mixedwood Subregion, although little is known about much of it. Generally, the landscape in this Subregion contains a greater proportion of wetlands, both peatlands and willow-sedge complexes on mineral soil, and more upland black spruce forest than the Central Mixedwood. This perhaps reflects the more rigorous, cooler climate with a lower moisture deficit. The differences are subtle and need further examination.

Drier tills and glaciofluvial deposits typically have Brunisolic soils with pine forests, lodgepole pine in the west and jack pine in the east. Mesic till sites are limited in area but contain typical aspen-white spruce mixedwood forest with Gray Luvisols similar to those of the Central Mixedwood Subregion but apparently with fewer understory species.

Moist upland sites on tills and glaciolacustrine deposits generally have black spruce or mixed black and white spruce closed forests with a well-developed moss layer dominated by feather mosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Mature white spruce-balsam poplar forests, similar to those along the lower Peace and Athabasca rivers, occur along the lower Hay River on fluvial terraces.

Peatlands are common and extensive throughout the Wetland Mixedwood Subregion. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by black spruce, common Labrador tea, and *Sphagnum* spp. (peat mosses) and more nutrient-rich fens containing tamarack, dwarf birches, sedges, and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur in several areas. Permafrost frequently occurs in these peatlands as well.

Wildlife

The wildlife of the Wetland Mixedwood Subregion is relatively depauperate both in species and numbers compared with the Central Mixedwood Subregion. The scarcity of deciduous and mixedwood communities is largely responsible for this. The extensive wetlands that characterize this Subregion provide important habitat for nesting and migrating waterfowl including sandhill crane and the rare whooping crane.

Boreal Highlands Subregion

Figure 69. Example of boreal highlands natural subregion in northwest Alberta. Photo Source: Bob Wynes.

Geology and Landforms

The Boreal Highlands Subregion occurs on the sides and tops of plateaus and hill masses within the Central Mixedwood and Wetland Mixedwood subregions. It includes portions of the Cameron Hills, Caribou Mountains, Buffalohead Hills, Birch Mountains, Thickwood Hills, and the highlands around Graham and Peerless lakes, and south of Ft. McMurray. The topography varies from rolling uplands to steep slopes on the flanks of hill masses and plateaus.

Most of the subregion is covered by glacial till in the form of both ground moraine and hummocky moraine. Aeolian dune fields occupy limited areas.

Climate

Climatic data are scarce for this Subregion but conditions appear somewhat cooler and moister than the Central Mixedwood Subregion. May - September temperatures average 12°C but the winter temperatures are likely colder than the Central Mixedwood. May - September precipitation is about 265 m which is slightly greater than the Central Mixedwood and is due mostly to more rain in July and August.

Soils

Soils are similar to those of the Central Mixedwood Subregion with Gray Luvisols in well-drained, upland till sites and Brunisolics in coarse-textured sandy uplands. Organics and Gleysolics occur on wet depressional sites.

Vegetation

The vegetation of the Boreal Highlands Subregion is similar to that of the Central Mixedwood Subregion. Mixedwood forests of aspen and white spruce are characteristic but with the somewhat moister conditions, greater amounts of

balsam poplar and white spruce are expected. Black spruce may also occur more frequently in upland sites and coniferous forests occupy a larger proportion of the landscape.

Upland white spruce-aspen mixedwood and aspen forests contain a diverse understory that may include low-bush cranberry, prickly rose, red-osier dogwood, marsh reed grass, wild sarsaparilla, dewberry, creamy-coloured peavine, common pink wintergreen and twinflower. Both balsam poplar and paper birch may occur in these forests as well.

Coniferous-dominated, spruce or spruce-fir forests generally have a less diverse understory with greater moss cover especially of the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Dry, sandy upland sites are typically occupied by jack pine forests. Typical understory species include common bearberry, blueberry, bog cranberry, prickly rose and reindeer lichens (*Cladina* spp. and *Cetraria nivalis*).

Peatlands are common and extensive throughout the Subregion. Peatland complexes typically contain both nutrient-poor, acidic bog portions, dominated by black spruce, common Labrador tea, and *Sphagnum* spp. (peatmosses) and more nutrient-rich fens containing tamarack, dwarf birches, sedges, and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp.). Patterned peatlands occur in some areas and permafrost is frequent.

Wildlife

The animals of the Boreal Highlands Subregion are similar to those of the Central Mixedwood Subregion, although the species diversity is somewhat reduced although not as much as in the Subarctic Subregion. The occurrence of woodland caribou in the Birch and Caribou mountains is noteworthy although this species also uses adjacent Subregions as well.

Peace River Lowlands Subregion

Figure 70. Example of Peace River lowland natural subregion in northwest Alberta. Photo Source: Wood Buffalo National Park.

Geology and Landforms

The Peace River Lowlands Subregion consists primarily of fluvial landforms along the lower Peace, Birch and Athabasca rivers including the Peace-Athabasca Delta, one of the largest freshwater deltas in the world. Although the bedrock is seldom exposed, it influences the character of till deposits and groundwater discharge. The bedrock includes Cretaceous marine shales and silty shales, Devonian marine limestones and dolomites, evaporite gypsum and anhydrite, and marine shales and siltstones. Some lacustrine deposits also occur in the Subregion.

Climate

The climate of the Peace River Lowlands Subregion is characterized by a cool summers and long, cold winters. The mean annual temperature is -3.5°C. The mean May - September temperature is about 11C (range 10–13°C) increasing slightly to the northeast. Total annual precipitation is divided about equally between snow and rain. Total May - September precipitation averages 250 mm (range 150-300 mm), increasing to the southeast.

Soils

Soils on well drained upland sites are mostly Eutric Brunisols and Gray Luvisols. However, the majority of the Subregion is occupied by Cumulic Regosols and Gleysolics on active fluvial landforms or by Organics in wet depressional areas.

Vegetation

White spruce forests containing large trees (16-23 m tall) occur on imperfectly to well drained fluvial terraces along major rivers. These forests have been heavily logged and little remains of this very productive forest currently.

On drier upland sites, forests of jack pine, green alder, bog cranberry, *Cladina* spp. (reindeer lichen) and feathermosses occur with Brunisolic soils. Mixedwood forests of aspen, balsam poplar, and white spruce occur on mesic sites with Luvisolic soils.

Non-forested, wet fluvial communities form a very complex mosaic of aquatic, shoreline, meadow, shrub and marsh vegetation. Much of this complexity is driven by periodic flooding and deposition of fresh fluvial sediments, especially in the Peace-Athabasca Delta area.

Wildlife

The overall diversity of wildlife is lower here than in the Central Mixedwood Subregion although many of the same species occur in both Subregions. However, the Peace-Athabasca Delta supports a rich wildlife population and is a major nesting and moulting ground for ducks, and a key staging and migration area for waterfowl such as tundra swan. Bison also use the large wet sedge meadows. Muskrats are also important in this area.

White pelicans nest along the Slave River and the most northerly populations and hibernacula of common (red-sided) garter snakes also occur in this Subregion.

A very diverse fish assemblage occurs in this Subregion. Lake whitefish, northern pike, goldeye, emerald shiner, longnose sucker, trout-perch, walleye, Ninespine stickleback, flathead chub, burbot, spottail shiner, spoonhead sculpin and longnose dace are common in the river and streams of this Subregion.

Boreal Subartic Subregion

Figure 71. Example of boreal subarctic natural subregion in northwest Alberta.

Geology and Landforms

The Subarctic Subregion occurs on the tops of the Birch Mountains, the Caribou Mountains, and the Cameron Hills. These hill systems are erosional remnants that rise above the surrounding plain as flat-topped hills with escarpments that are dissected by numerous small streams.

Surficial deposits are primarily either till or organic peat. The latter predominates in the Subregion and contains discontinuous permafrost. Palsas and peat plateaus occur in these peatland areas and are landforms characteristic of subarctic conditions. Morainal land organic deposits occur on the plateaus, and morainal blankets occur over rolling residuum on the flanks of the hills.

Climate

The climate of the Subarctic Subregion is continental, cold-temperate with moist, short, cool summers and long, cold winters. The mean May–September temperature is about 10–12°C. While summer temperatures are cooler here than in adjacent low elevation areas, winter temperatures are likely more moderate, especially when cold Arctic air masses affect lower areas and temperatures increase with altitude. Total annual precipitation is likely 400-450 mm with most falling in the summer. The frost-free period is less than 45 days.

Soils

Soils are predominantly Organics and Cryosolics on poorly drained sites. Luvisolics occur on well drained sites while Gleysolics are typical of poorly drained mineral soils.

Vegetation

The most widespread vegetation is an open forest of black spruce/Labrador tea/lichen on Organic Cryosols and Organics. Typical understory species include northern Labrador tea, cloudberry, bog cranberry, *Sphagnum* spp. (peat mosses), and *Cladina* spp. (reindeer lichens). Widespread fires in this type have resulted in large areas of heath shrub/lichen vegetation with scattered, young black spruce.

Black spruce forests on moderately well to imperfectly drained mineral soils include a black spruce/feathermoss type which typically includes common Labrador tea, bog cranberry, crowberry, woodland horsetail, bunchberry, and the feathermosses, *Hylocomium splendens* and *Pleurozium schreberi*. A similar forest on well drained sites has less cover of feathermosses and greater amounts of lichens, especially *Cladina mitis* and *Cetraria nivalis*.

Less common on warm, well drained till sites are mixed forests of white spruce-aspen or white spruce-paper birch. Black spruce-lodgepole pine (jack pine in the Birch Mountains) also occur in limited areas of warmer, drier sites.

Fens, both patterned and unpatterned, occur in this Subregion often as part of peatland complexes that contain a variety of peatlands and community types. Organic landforms include palsas and peat plateaus that are related to the occurrence of discontinuous permafrost.

Several subarctic plant species also occur in this Subregion including hairy butterwort, ground-cone, northern Labrador tea, bog bilberry, polar grass, and purple rattle.

Wildlife

The Subarctic Subregion is lower in wildlife diversity than other Boreal Forest Subregions because of the harsh environment and limited vegetational diversity, especially the scarcity of deciduous communities. Some Boreal Forest species are either local or absent, while other species more typical of Subarctic habitats further north are present. These latter include red-throated loon, surf scoter, American tree sparrow and northern phalarope.

Common species of black spruce forests include gray jay, common raven, yellow-rumped warbler, blackpoll warbler, dark-eyed junco, chipping sparrow, red squirrel, snowshoe hare and black bear. Woodland caribou occur in the Birch and Caribou mountains.

Wetland species include lesser yellowlegs, palm warbler, rusty blackbird, Lincoln's sparrow, and moose. On lakes and ponds, common loon, bald eagle, osprey, spotted sandpiper, swamp sparrow and beaver are common. The largest concentration of nesting bald eagles is around Bistcho Lake in the Cameron Hills and there are nesting colonies of American white pelicans in the Birch Mountains.

Lower Foothills Subregion

Figure 72. Example of lower foothills natural subregion in northwest Alberta.

Geology and Landforms

The Lower Foothills Subregion generally occurs on rolling topography created by the deformed bedrock along edge of the Rocky Mountains. Lower elevations range from about 1250 m in the south, to about 700 m near Lesser Slave Lake, 500 m west of Manning, and to about 350 m at the northern end near Rainbow Lake. Upper elevational limits range from about 1450 m in the south to 1000 m in the north. The subregion also includes several flat-topped erosional remnants with flat-lying bedrock that are partially capped with Tertiary gravels, such as Swan Hills, Pelican Mountain, and Clear Hills.

Surficial materials are commonly a morainal veneer or blanket over bedrock. Extensive organic deposits occur in valleys and wet depressions, especially in eastern portions. Along the mountains, bedrock outcrops of marine shales and non-marine sandstones occur often in valleys. Fluvial and glaciofluvial deposits occur along major stream valleys.

Climate

The climatic regime is continental. Mean annual precipitation ranges from 285 mm to 756 mm with an average of about 465 mm, about two-thirds of which falls in May - September. From east to west and from south to north, there are increases in precipitation. The mean May - September temperature is 11-13°C. With cool summer temperatures and much of the precipitation coming during the growing season, evapotranspiration deficits are generally near zero during the growing season. Although this subregion is somewhat cooler in summer than the adjacent, lower elevation Boreal Forest subregions, it is warmer in winter because it is often not influenced by cold Arctic air masses.

Soils

Soils of upland forests are predominantly Luvisolics and Brunisolics with Gleyed Luvisols and Gleysolics in more poorly drained sites. Organic soils are common in depressional sites, and Regosolics occur along stream valleys and on steeper slopes.

Vegetation

The forests reflect the transitional nature of this subregion in which mixed forests of white spruce, black spruce, lodgepole pine, balsam fir, aspen, paper birch, and balsam poplar occur. Lodgepole pine communities are perhaps the best indication of the lower boundary of this subregion with the adjacent Boreal Forest mixedwood forests. The upper

boundary to the Upper Foothills Subregion is marked by the absence of mixed deciduous-coniferous forests (absence of aspen, balsam poplar and birch and the occurrence of a nearly pure coniferous forest cover.

At lower elevations and along the eastern edge of the subregion, introgressive hybridization between lodgepole pine, a cordilleran species, and jack pine, a boreal species, occurs.

Lodgepole pine forests occupy extensive portions of the upland in this subregion, especially following fire. Understory species on drier sites include Canadian buffalo-berry, white meadowsweet, junipers, bearberry, and blueberry. On more mesic sites, white spruce and aspen are more frequent in the tree layer and the understory contains a large number of species including prickly rose, common Labrador tea, bunchberry, twin flower, fireweed, bog cranberry, and the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptiliumcrista-castrensis*). Successionally, white spruce and, in the north, black spruce, likely will eventually replace lodgepole pine and aspen in these communities in the absence of fire.

Black spruce forests occur on moist upland sites in the north but the species essentially does not occur south of the Red Deer River, although one small, disjunct stand is known near Bragg Creek. Black spruce also occurs on wet organic soils (muskegs). Typical understory species include Common Labrador tea, dwarf birch, bracted honeysuckle, horsetails, bishop's cap, twinflower, *Sphagnum* spp. (peatmosses), and the brown mosses (*Aulacomnium palustre, Tomenthypnum nitens*).

Fens, both patterned and unpatterned, are common in much of this subregion. These communities typically contain scattered trees of black spruce and tamarack with an understory of dwarf birch, Common Labrador tea, willow, sedges, buck bean, tufted hair grass, and both peat and brown mosses (*Sphagnum* spp., *Tomenthypnum nitens*, *Aulacomnium palustre*).

Wildlife

Many of the animal species of the Lower Foothills Subregion that inhabit coniferous forests are wide-ranging species that are common to spruce and pine forests of the Boreal Forest, Foothills, and Rocky Mountain Natural Regions. However, for those species that have Rocky Mountain and Boreal Forest subspecies, the Boreal Forest subspecies is characteristic of the Lower Foothills. Species of coniferous forests include boreal chickadee, spruce grouse, ruby-crowned kinglet, white-winged crossbill, and red squirrel.

Areas with deciduous forests have diverse animal communities including ruffed grouse, warbling vireo, black-capped chickadee and Tennessee warbler. Along the boundary with the Central Mixedwood Subregion, species more typical of the boreal forest occur including moose, yellow-bellied sapsucker (northern race), rose-breasted grosbeak and purple finch.

Upper Foothills Subregion

Figure 73. Example of upper foothills natural subregion in northwest Alberta.

Geology and Landforms

The Upper Foothills Subregion occurs on strongly rolling topography along the eastern edge of the Rocky Mountains from about the Bow River north to the Grande Cache area, with disjunct occurrences in the Swan Hills and Clear Hills. The subregion is generally between the Lower Foothills and Subalpine subregions with an upper elevational limit of about 1500 m in the south to 1000 m in the north. Bedrock outcrops of marine shales and non-marine sandstones are frequent. Morainal deposits are common over bedrock throughout much of the area, although colluvium and residuum occur on steeper terrain.

Climate

This subregion has the highest summer precipitation in Alberta at about 340 mm and has a mean annual precipitation of about 540 mm. July is the wettest month and a moisture surplus probably occurs during much of the growing season. The mean May -September temperature is about 10–12°C. The winters are colder than the Lower Foothills Subregion but the Upper Foothills Subregion generally is similarly little affected by cold Arctic air masses.

Soils

Soils of upland sites are typically Luvisolics and Brunisolics with Gleysolics and Organics in wet sites.

Vegetation

Upland forests of the Upper Foothills Subregion are nearly all coniferous and dominated by white spruce, black spruce, lodgepole pine, and, occasionally, subalpine fir. Some introgressive hybridization between white spruce and Engelmann spruce and between subalpine fir and balsam fir occurs in portions of the subregion.

Lodgepole pine forests occupy extensive portions of the subregion on upland sites. Understory species typically include false azalea, Canadian buffalo-berry, prickly rose, common Labrador tea, bunchberry, twin flower, fireweed, bog cranberry, and the feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*). Successionally, white spruce and black spruce likely will eventually replace lodgepole pine in these communities in the absence of fire.

The understory of upland spruce forests in this subregion is very similar to that of the lodgepole pine forests with older stands on mesic sites often having a well developed moss layer dominated by feathermosses (*Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*).

Black spruce dominates on wet sites with Organic and Gleysolic soils. Typical understory species include common Labrador tea, dwarf birch, bracted honeysuckle, horsetails, bishop's cap, twinflower, *Sphagnum* spp. (peat mosses), and brown mosses (*Aulacomnium palustre, Tomenthypnum nitens*).

Wildlife

Animals of the Upper Foothills Subregion are similar to those of coniferous forests of the Lower Foothills and Subalpine Subregions. These include pine siskin, yellow-rumped warbler, ruby-crowned kinglet, white-crowned sparrow and varied thrush. Wapiti and both black and grizzly bear are also characteristic. Species diversity is lower here, generally, than in the Lower Foothills Subregion because of a lower vegetational diversity, including few deciduous forest stands.

Peace River Parkland Subregion

Figure 74. Example of Peace River parkland natural subregion in northwest Alberta.

Geology and Landforms

The Peace River Parkland is characterized by broad, gently rolling plains with scattered upland and deeply-incised, steep-sided river valleys. Mass wasting is common along stream valleys and widens many valleys considerably.

The main part of the Peace River Parkland is in the Grande Prairie and Peace River areas. Most of the extensive grasslands of this subregion have been cultivated and only small, scattered remnants are still in native cover.

Cretaceous shales, siltstones and sandstones outcrop along major rivers. However, because of extensive slumping, outcrops are not common since most of the valleys are covered with colluvial, slumped materials. Surficial deposits are predominantly glaciolacustrine silts and clays.

Climate

The mean annual precipitation of the Peace River Parkland is 350-440 mm. The mean May - September temperature is 13°C and the frost-free period averages 95 days. The climate of this subregion has shorter, cooler summer and longer, colder winters than the other parkland subregions. It also has higher precipitation, less wind and lower evaporation.

Soils

The soils of the grasslands are mostly Solonetzic while those of the forested portion are mostly Luvisolics. The Solonetzic soils are an important factor in maintaining the grasslands here with fire and, possibly, climate playing a secondary role.

Vegetation

The upland forests of the Peace River Parkland occur mostly on till deposits and are virtually indistinguishable from those of the surrounding Mixedwood Boreal Forest. They are dominated by aspen and white spruce with lesser amounts of balsam poplar especially on wetter sites. The grasslands, on Solonetzic soils, are dominated by sedges, oat grass, western porcupine grass, slender wheatgrass, inland bluegrass, old man's whiskers, and low goldenrod.

Grasslands on steep, south-facing slopes are dominated by western porcupine grass, sedges, and pasture sagewort. Other common species include columbia needle grass, June grass, green needle grass, bastard toad flax and mountain goldenrod.

More northerly grasslands occur on both fluvial and glaciolacustrine sites and are best characterized as a wheatgrass-sedge type. These grasslands are dotted with willow groves and dense thickets of buckbrush and common wild rose.

The grasslands of the Peace River Parkland are most closely related to those of the Northern Fescue Subregion. The absence of rough fescue is perhaps not surprising since it is often absent from Solonetzic soils in the Central Parkland and Northern Fescue subregions.

These isolated grasslands are also notable for their disjunct occurrence and the presence of species which have a more southerly or westerly distribution. These include brittle prickly pear cactus, Richardson's needle grass, columbia needle grass, Drummond's thistle, and groundsel.

Wildlife

Wildlife of the Peace River Parkland Subregion is similar to that of the adjacent boreal forest mixedwood subregions. Few animals of Central Parkland grassland habitats are present. Three species of fish barely range into Alberta along the upper Peace River: redside shiner, northern squawfish and largescale sucker.

Protected Areas Networks

Current Levels of Protection

The protected area network of northwest Alberta is comprised of lands designated, in order of increasing protection, as provincial parks, natural areas, ecological reserves, and national parks. No wildland parks or wilderness areas exist in this region. A full description of permissible and non-permissible landuse activities within each category of provincial protected area is provided in Table 41. The location of the existing protected areas in northwest Alberta is shown in Table 42. The size of individual protected areas range from 1 to 518,000 ha (Table 42) with existing protected areas dominated in frequency by sites of 1,000–10,000 ha and in area by that portion (518,000 ha) of Wood Buffalo National Park residing in northwest Alberta. The total area of the protected network is 544,521 ha which represents 3.6% of northwest Alberta (Figure 76, Figure 77). The proportion of each natural subregion currently offered protection in the network is shown in Table 43 and Table 44. In order of declining proportional protection, the ranking order is Wetland Mixedwood, Boreal Highlands, Subarctic, Peace River Parkland, Central Mixedwoods, with no level of protection offered for Peace River Lowlands, Upper Foothills, and Lower Foothills.

Descriptions of the Protected Areas Legislative Framework in Alberta

(provided by Archie Landals of the Department of Environmental Protection)

The Provincial Parks Act, the Willmore Wilderness Park Act and the Wilderness Areas, Ecological Reserves and Natural Areas Act are the existing legislation which protected areas are designated under.

- **Ecological Reserves** are samples of functioning ecosystems protected for scientific research, education and heritage appreciation. Road access and facilities are not developed in Ecological Reserves.
- **Wilderness Areas** are large areas that retain their primeval character, unaffected by human influences. Visitors travel on foot to experience solitude and personal interaction with nature.
- **Wilderness Parks** encompass large areas of natural landscape where human developments and interference with natural processes are minimized. Wildland Parks, similar to Willmore Wilderness Park, accommodate a wider range of outdoor recreation pursuits than Wilderness Areas, including hunting, fishing, and the use of horses.
- **Provincial Parks** are provincially significant natural and historical landscapes and features. A range of facilities along with interpretive and educational programs enhances opportunities for visitors to explore, understand, appreciate and respect the natural environment.
- **Natural Areas** protect special and sensitive natural landscapes of local and regional significance while providing opportunities for education, nature appreciation and low intensity recreation. Facilities are limiting to staging areas, trails and signs.
- **Recreation Areas** cater to a wide range of intensive recreation pursuits in natural, modified or man-made settings. Most Recreation Areas have little or no preservation value due to the levels of facility development, intensity of visitor use and frequently small size. Recreation areas are generally not counted toward achieving the Level 1 preservation targets.

Each of these categories or classes of Protected Areas have varying degrees of protection and use as broadly reflected in the above definitions or purpose statements. Determining the appropriate legislative designation or class for a particular site is crucial. The level of protection afforded must ensure that biodiversity is retained over the long term. In many instances Protected Areas may serve multiple goals for preservation, heritage appreciation, outdoor recreation and tourism/economic development. In these instances it may be appropriate to establish several of the legislated categories adjacent to one another thus providing for varying levels of management while also protecting larger areas. This could, for example, result in highly protected core areas surrounded by buffers where higher levels of use are permitted. The Athabasca River Sandhills Protection and Access Management Plan illustrates this approach. Several categories of Protected Areas are proposed in combination with other land use designations to accommodate a wide range of activities while achieving the Protected Areas goals: preservation, heritage appreciation, outdoor recreation and tourism/economic development. Figure 75 illustrates the spatial relationship of the various categories as well as the relationship to surrounding land managed for forestry, agriculture or privately owned lands.

Table 41. Descriptions of permissible and non-permissible land-uses in wilderness areas, wildland parks, provincial parks, natural areas and recreation areas in Alberta.

Land-Use Activity	Classification	Description of permissible or non-permissible activities.
Oil and Gas Development	Ecological Reserves	New developments are prohibited by legislation. Developments that exist at time of reserve establishment continue until resource is depleted.
		New subsurface rights may be sold subject to a no surface access addendum.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Existing commitments honoured. New mineral sales subject to no surface access addendum.
	Provincial Parks	Existing commitments honoured. New mineral sales subjected to a no surface access addendum. Conditions always applied to minimize impact.
	Natural Areas	Determined on a case by case basis. Activity must be compatible with intent to protect sensitive and scenic land. Conditions always applied.
	Recreation Areas	Ongoing oil and gas development is permitted subject to specific terms and conditions intended to minimize conflict with recreation use.
Mining – Coal, Gravel, etc.	Ecological Reserves	Prohibited by legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Prohibited by policy.
	Provincial Parks	Prohibited by policy.
	Natural Areas	Prohibited by policy.
	Recreation Areas	Prohibited by policy.
Commercial Logging	Ecological Reserves	Prohibited by legislation. Non-commercial sanitation forestry may be carried out if required to control insects or disease or if specifically set out as a management strategy to achieve a stated object.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Prohibited by legislation in Willmore. Precluded in new wildlands except as required to manage infestation that may be a threat to adjacent commercial forests.
	Provincial Parks	Precluded by policy and intent of legislation. Canopy management occurs in campgrounds for visitor safety. Non-commercial logging may be used to achieve specific management objectives such as fire hazard reduction or disease control.
	Natural Areas	Precluded by policy and intent of legislation. Non-commercial logging may be used for management purposes but this has not occurred to date.
	Recreation Areas	Most existing Recreation Areas are too small. In new larger Recreation Areas small-scale logging could occur where it is compatible with recreation objectives.
Domestic Livestock Grazing	Ecological Reserves	Permitted as part of the ongoing management regime. Will continue in grassland and parkland areas that are currently being grazed. Would not be introduced to Boreal, Alpine or other environments where grazing is

Land-Use Activity	Classification	Description of permissible or non-permissible activities.
		not currently occurring as part of the management regime.
	Wilderness Areas	Normally precluded. Would not be introduced to new wildlands that are not currently under grazing dispositions. Wildlands may be established where grazing currently occurs and this would continue. Management guidelines would address related issues such as fencing, dugouts, cattle movement, etc.
	Provincial Parks	Occurs as part of the ongoing management of parks in the Grassland region. Used as a management tool along with haying to periodically reduce fire hazard in some parks. Would not be introduced in Boreal, Alpine or other environments where grazing currently does not exist.
	Natural Areas	Usually precluded by intent of legislation, i.e., public access for recreation. Occurs as management tool in some grassland areas.
	Recreation Areas	Most areas are too small. Occurs as a promoted activity in Blackfoot including improved pasture. Could occur in new Recreation Areas where it is compatible with recreation use.
Cultivation	Ecological Reserves	Precluded by legislation.
	Wilderness Areas	Precluded by legislation.
	Wildland Parks	
	Provincial Parks	
	Natural Areas	
	Recreation Areas	May occur in larger Recreation Areas such as Blackfoot where it is compatible with intent of area.
Auto Access Camping	Ecological Reserves	Precluded by legislation.
	Wilderness Areas	Inconsistent with intent of areas. Campground should occur in adjacent Recreation Areas.
	Provincial Parks	Support facility in most parks but may be precluded where inconsistent with management of specific sites.
	Natural Areas	Normally not consistent with the intent of Natural Areas.
	Recreation Areas	Primary rationale for most Recreation Areas.
Primitive Camping	Ecological Reserves	Not consistent with intent of legislation.
	Wilderness Areas	Consistent with intent of the Act – facilities are not provided.
	Wildland Parks	Consistent with intent – facilities should be confined to those required to minimize impact.
	Provincial Parks	Consistent with intent where Parks are large enough. Facilities may be provided to minimize impact, e.g. Peter Lougheed.
	Natural Areas	Not encouraged and facilities not provided but may occur where use levels are low and impact minimal.
	Recreation Areas	Most areas are too small but consistent with intent of larger areas such as Lakeland. Facilities may be provided to localize impact.

Land-Use Activity	Classification	Description of permissible or non-permissible activities.
Power Boating	Ecological Reserves	Prohibited by legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Generally inconsistent with intent. May occur where major rivers run through a new wildland.
	Provincial Parks	Frequently associated with existing water based parks but generally on adjacent water bodies. Many of these Parks, i.e., Sylvan Lake, Aspen Beach, Wabamun Lake, etc. should more appropriately be Recreation Areas. Small lakes subject to speed restrictions.
	Natural Areas	Generally not consistent with intent of Natural Areas.
	Recreation Areas	Consistent with intent of Recreation Areas and accommodated.
Non-Power Boating/Canoeing	Ecological Reserves	Recreational activities are not encouraged but could occur where use levels are very low and conflicts with scientific value minimal.
	Wilderness Areas	Consistent with intent but opportunity does not exist in existing three Wilderness Areas.
	Wildland Parks	Consistent with intent and promoted.
	Provincial Parks	Consistent with intent and promoted.
	Natural Areas	Consistent with intent of areas but generally not promoted.
	Recreation Areas	Consistent with intent and promoted where conflicts with power boating are minimal.
Use of Horses	Ecological Reserves	Recreational use is not consistent with intent of the legislation. Promoted for management use in Grassland regions where domestic grazing occurs.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Appropriate and promoted use, however, there may be sensitive areas where use is inappropriate – for example, major wetland complexes in the Boreal Forest could be established as Wildland Parks. Subject to management plans; use may be limited to designated trails.
	Provincial Parks	Permitted activity. Promoted in a few larger Parks. Many existing Parks are too small to attract or accommodate horse use.
	Natural Areas	Permitted in some Natural Areas. Many are too small. Some are too sensitive. Decision made on a case by case basis.
	Recreation Areas	Most existing Recreation Areas are far too small. Promoted in Blackfoot and Lakeland where the land base is large enough and would occur in new larger recreation areas.
Hunting	Ecological Reserves	Permitted as a management activity as required.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Appropriate and promoted use.
	Provincial Parks	Used as a management tool where required to control wildlife populations. Most existing Parks are too small. Prohibited within 400 meters of facilities.
	Natural Areas	Permitted activity in most Natural Areas.
	Recreation Areas	Most Recreation Areas are too small. Appropriate in larger Recreation

Land-Use Activity	Classification	Description of permissible or non-permissible activities.
		Areas. Prohibited within 400m of facilities.
Fishing	Ecological Reserves	Inconsistent with legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Appropriate and promoted attraction.
	Provincial Parks	Appropriate and promoted attraction.
	Natural Areas	Appropriate but usually not promoted.
	Recreation Areas	Appropriate and promoted attraction.
Off-Highway Vehicle Use	Ecological Reserves	Prohibited by legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Designated routes may be considered to ensure continuity of regional trail systems or to provide access to specific destinations.
	Provincial Parks	Prohibited by existing policy. Park facilities may act as staging areas for adjacent lands providing there are no conflicts with other users and natural values are not compromised.
	Natural Areas	Generally not appropriate. May occur on designated route. Existing Natural Areas that are heavily used by OHV's should be redesignated as Recreation Areas.
	Recreation Areas	Appropriate and accommodated activity where land base is large enough.
Snowmobiling	Ecological Reserves	Prohibited by legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	May be considered on designated routes to ensure continuity of regional trails or to provide access to specific destinations. Maya occur on major rivers through wildlands.
	Provincial Parks	Prohibited by existing policy. Park facilities may act as staging areas to access adjacent lakes or trail systems providing there are no conflicts with other users and natural and cultural resources are not compromised.
	Natural Areas	Generally not appropriate. May occur on designated route identified in management plans.
	Recreation Areas	Appropriate and promoted where land base is large enough.
Resorts/Golf Courses/Ski Hills	Ecological Reserves	Prohibited by legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Inconsistent with the intent of Wildland Parks.
	Provincial Parks	May be permitted providing it is consistent with the primary intent of preserving the natural landscape. Major facilities of this nature are more appropriately developed in Recreation Areas which may be adjacent to Provincial Parks.
	Natural Areas	Inconsistent with the intent of Natural Areas.

Land-Use Activity	Classification	Description of permissible or non-permissible activities.
	Recreation Areas	Consistent with the intent of Recreation Areas and promoted where the land base is suitable.
Concessions – Food Service and Equipment Rental	Ecological Reserves	Prohibited by legislation.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Generally inconsistent with the intent of Wildlands but specific equipment rental from staging areas may be considered to support appropriate wildland recreation.
	Provincial Parks	Consistent with the intent of Provincial parks providing facilities are compatible with the management intent of the specific park.
	Natural Areas	Generally inconsistent with the low-key intent of Natural Areas.
	Recreation Areas	Consistent with the intent of the class but opportunities are frequently precluded by the small size of most existing Recreation Areas.
Cycling/Cycle Trails	Ecological Reserves	Developed trails not consistent with intent of legislation. Cycling generally not consistent with intent. Cycling may be permitted on existing routes as specified in the management plant. Ongoing monitoring must ensure that preservation of natural values is not compromised.
	Wilderness Areas	Prohibited by legislation.
	Wildland Parks	Designated routes to specific designations may be considered if compatible with other recreation uses.
	Provincial Parks	Consistent with intent of parks. Hardened trails may be provided to enhance opportunities and protect the environment.
	Natural Areas	Consistent with intent of Natural Areas at low use levels. Extensive trail surfacing is not normally provided.
	Recreation Areas	Consistent with intent of Recreation Areas and promoted where opportunities exist. Hardened trails may be provided to enhance opportunities.

Table 42. Protected areas network (provincial parks, natural areas, ecological reserves) in northwest Alberta. Data Source: Department of Environmental Protection 1998.

Protection Area Type	Name	Size (ha)	Latitudinal Centre	Longitudinal Centre
Provincial Park	Notikewin	9,697	57° 12’ 49” N	117° 9’ 9” W
Provincial Park	Twelve Foot Davis	1	56° 14’ 20” N	117° 15’ 16” W
Provincial Park	Queen Elizabeth	86	56° 13’ 28” N	117° 40’ 33” W
Natural Area	Hot Pot	65	59° 15’ 48” N	117° 29’ 9” W
Natural Area	Watt Mountain	998	58° 41’ 47” N	117° 22’ 0” W
Natural Area	Ponton River	1,123	57° 12’ 49” N	117° 9’ 9” W
Natural Area	Caribou River	883	58° 29’ 21” N	115° 51’ 43” W
Natural Area	Boyer Reserve	130	58° 26’ 5” N	116° 9’ 43” W
Natural Area	Child Lake Meadows	389	58° 25’ 13” N	116° 33’ 10” W
Natural Area	Harper Creek	2,620	58° 11’ 17” N	114° 17’ 26” W
Natural Area	Keg River	418	57° 44’ 14” N	117° 45’ 40” W
Natural Area	Burning Sulphur	130	57° 32’ 1” N	115° 38’ 23” W
Natural Area	Hawk Hills	141	57° 12’ 49” N	117° 15’ 53” W
Natural Area	Heart River	3,158	56° 5’ 39” N	117° 14’ 57” W
Natural Area	Sand Lake	2,844	56° 10’ 2” N	118° 35’ 31” W
Natural Area	Highland Park	293	56° 10’ 2” N	118° 56’ 4” W
Natural Area	Peace / Smoky Islands	34	56° 10’ 38” N	117° 20’ 24” W
Natural Area	Shaftesbury	57	56° 9’ 59” N	117° 26’ 20” W
Natural Area	Fairview	364	56° 7’ 24” N	118° 19’ 32” W
Natural Area	Shaftesbury Islands	31	56° 9’ 59” N	117° 29’ 3” W
Natural Area	Pouce Coupe	195	56° 3’ 2” N	119° 50’ 23” W
Natural Area	Fourth Creek	969	56° 3’ 54” N	118° 57’ 8” W
Ecological Reserve	Silver Valley	1895	56° 12’ 39” N	119° 29’ 15” W
National Park	Wood Buffalo	518,000°	not applicable	not applicable
Total Provincial Park Area		9,784		
Total Natural Area		14,842		
Total Ecological Reserve Area		1,895		
Total National Park Area		518,000		
Total Protected Area		544,521		

° only that portion of Wood Buffalo National Park within northwest Alberta (56–60°N, 114–120 °W).

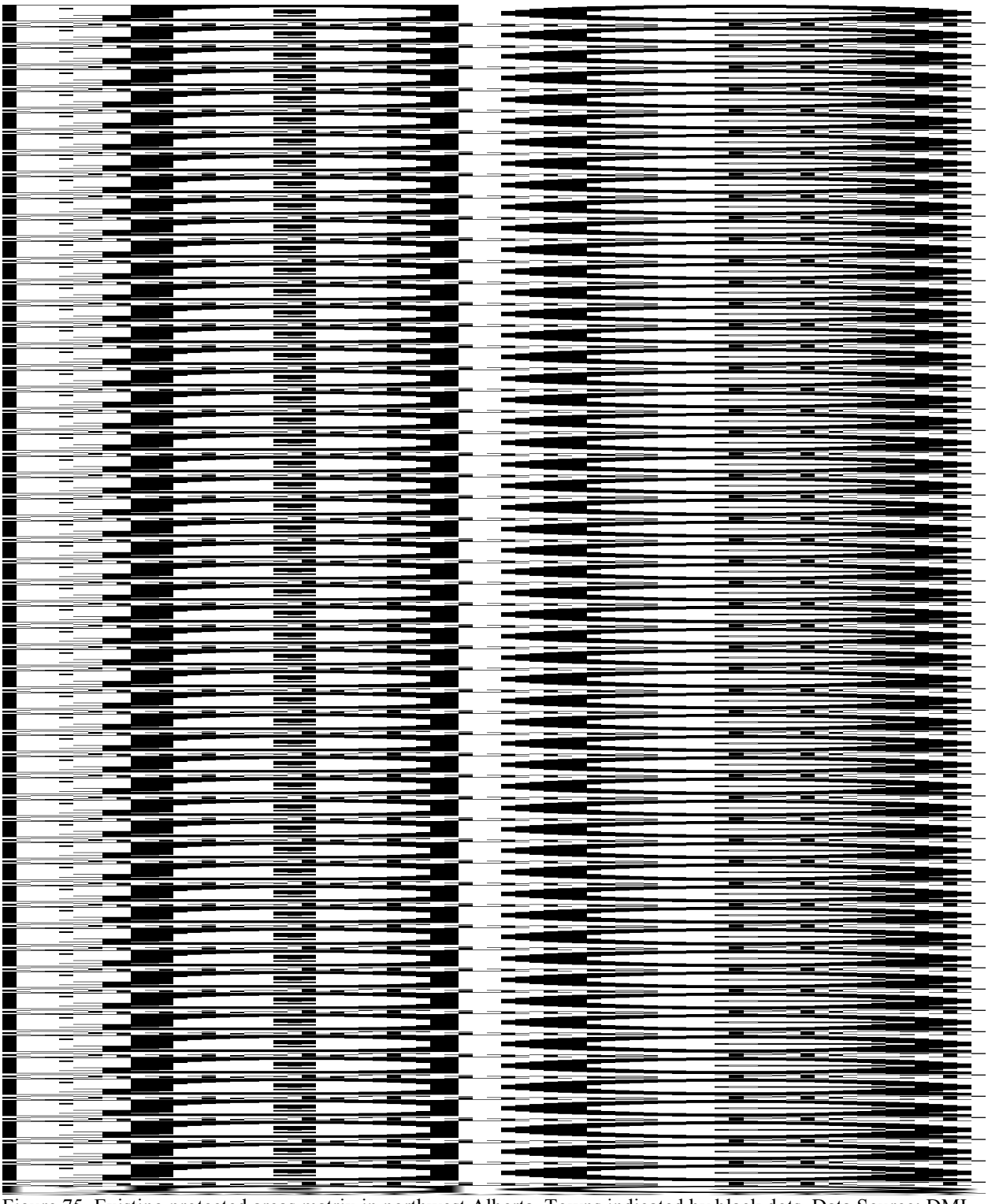

Figure 75. Existing protected areas matrix in northwest Alberta. Towns indicated by black dots. Data Source: DMI GIS Library.

The Special Places 2000 Initiative

DMI recognizes that current levels of protection in northwest Alberta are inadequate in terms of their capacity to serve as ecological benchmarks against which the commercial forest landscape can be compared and have supported some nominated sites within the Special Places 2000 initiative. The general boundaries of currently nominated sites is shown in Figure 78, Figure 79, and Figure 80. Some of the nominated sites have been identified as candidates sites through the SP2000 process. The size and contribution of sites to various natural regions is shown in Table 45.

A Continental Perspective

Based on the classification of protected areas in North America made by the World Wildlife Fund, it is apparent that a small area of the mixedwood and foothills natural subregion are currently protected (Figure 81). The World Wildlife Fund is completing a biophysical classification system of North America which is published on the internet at www.wwf.org/forests/maps. North America is divided into 116 ecoregions which are nested within 10 major habitat types. WWF classifies ecoregions and major habitat types as follows: "ecoregions are a relatively large parcel of land that harbors a characteristic set of species, communities, dynamics, and environmental conditions". Ecoregion boundaries were derived largely from Omernik (1995), the Ecological Stratification Working Group (1995), and Gallant *et al.* (1995). A major habitat type is a set of ecoregions that have comparable climatic regimes, similar vegetation structure and spatial patterns of biodiversity, and contain flora and fauna with similar guild structure and life histories". Of the 116 North American ecoregions, 52 were classified as forest ecoregions based on estimated original extent of the dominant vegetation type; however, many ecoregions had a mosaic of non- forest habitats as well. Forest ecoregions were the primary conservation unit evaluated in this analysis. WWF is now mapping intact forest coverages to determine more precisely present forest conditions.

Forest Ecoregions of the U.S. and Canada:

The forest ecoregions in the U.S. and Canada are listed below by major habitat type. Only five percent of these ecoregions are legally protected from logging and mining activities–the percent of protected area in each ecoregion is listed in parentheses.

<u>Temperate Coniferous Forests</u>

- Alberta Mountain Forests (63.6%)
- Northern Transitional Alpine Forests (1.2%)
- Alberta/British Columbia Foothills Forests (0.0%)
- North Central Rockies Forests (16.3%)
- South Central Rockies Forests (23.0%)

<u>Boreal Forest/Taiga</u>

- Northern Cordillera Forests (8.1%)
- Muskwa/Slave Lake Forests (5.6%)
- Northern Canadian Shield Taiga (5.9%)

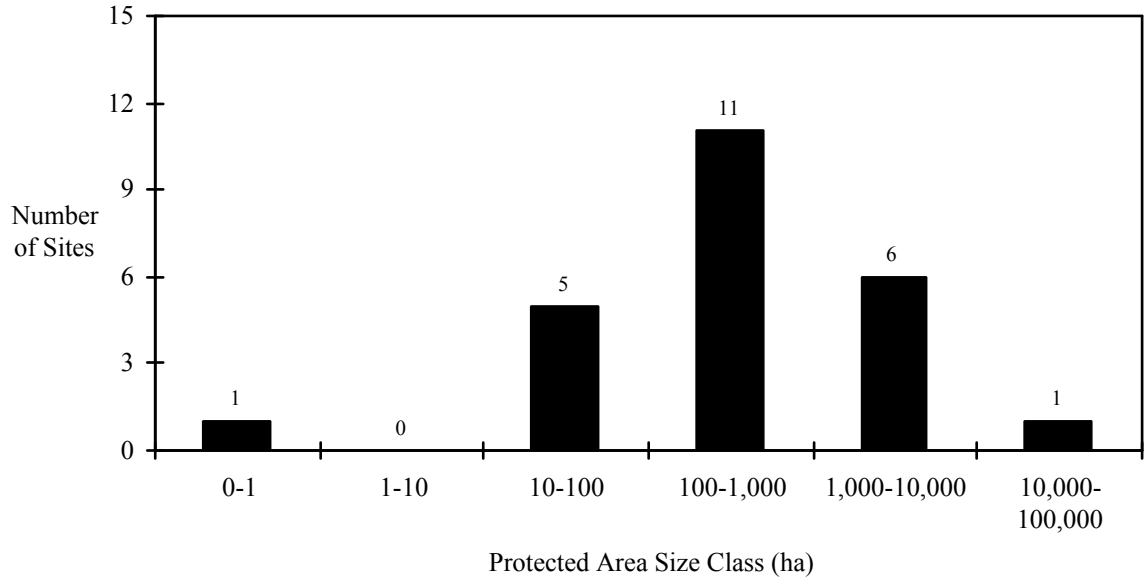

Figure 76. Frequency of existing protected areas in different size classes in northwest Alberta. Data Source: Department of Environmental Protection 1998.

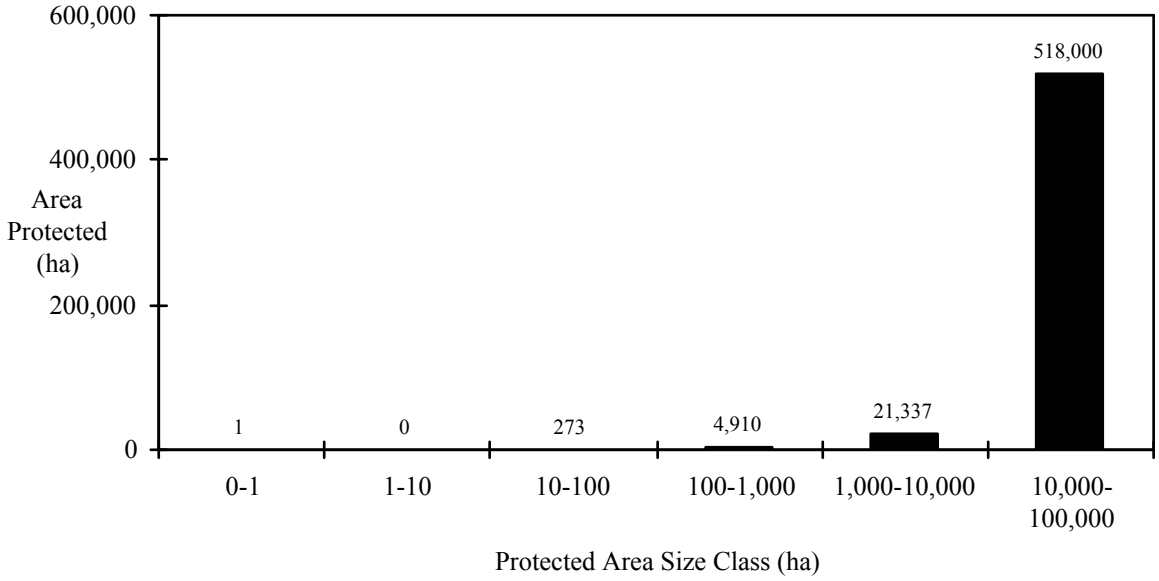

Figure 77. Total area of existing protected areas in different size classes in northwest Alberta. Data Source: Department of Environmental Protection 1998.

Table 43. Area (ha) of northwest Alberta located within each protected category for each natural subregion. Data Source: Department of Environmental Protection 1998.

Natural Subregion	Area in northwest Alberta	Area in Provincial Park	Area in Natural Area	Area in Ecological Reserves	Area in National Park	Total Area Protected
Peace River Lowlands	29,572	0	0	0	0	0
Peace River Parkland	75,517	1	969	0	0	970
Upper Foothills	168,435	0	0	0	0	0
Boreal Highlands	1,112,712	0	0	0	62,352	62,352
Subarctic	1,724,544	0	0	0	81,537	81,537
Lower Foothills	2,158,144	0	0	0	0	0
Wetland Mixedwood	3,055,369	0	1,063	0	374,111	375,174
Central Mixedwoods	3,240,357	0	2,750	0	0	2,750
Dry Mixedwoods	3,472,210	9,783	10,060	1,895	0	21,738
Totals	15,036,858	9,784	14,842	1,895	518,000	544,521

Table 44. Proportion of each natural subregion in northwest Alberta included within each protected category. Data Source: Department of Environmental Protection 1998.

Natural Subregion	Northwest Alberta (ha)	Provincial Park (%)	Natural Area (%)	Ecological Reserves (%)	National Park (%)	Total Area (%)
Peace River Lowlands	29,572	0	0	0	0	0
Peace River Parkland	75,517	<0.1	1.3	0	0	1.3
Upper Foothills	168,435	0	0	0	0	0
Boreal Highlands	1,112,712	0	0	0	5.6	5.6
Subarctic	1,724,544	0	0	0	4.7	4.7
Lower Foothills	2,158,144	0	0	0	0	0
Wetland Mixedwood	3,055,369	0	0.1	0	12.2	12.3
Central Mixedwoods	3,240,357	0	<0.01	0	0	<0.01
Dry Mixedwoods	3,472,210	0.3	0.3	<0.1	0	0.7
Totals	15,036,858	0.1	0.1	<0.1	3.4	3.7

Table 45. Size (km^2) of selected nominated Special Places 2000 sites within each natural subregion in northwest Alberta [1]. Data Source: Special Places Program, Department of Environmental Protection 1998.

Natural Region	Chinchaga	Liege	Caribou Mountains	Notikewin Sand Dunes	Hungry Bend Sand Hills
Upper Foothills	145	0	0	0	0
Lower Foothills	630	0	0	0	0
Boreal Highlands	0	170	480	0	0
Boreal Subarctic	0	0	3,420	0	0
Wetland Mixedwood	0	0	3,170	0	0
Central Mixedwood	0	20	0	0	0
Dry Mixedwood	0	0	0	910	1,440
Total Area	775	190	7,070	910	1,440

- Chinchaga site is based on the boundaries forwarded to local committee, not the original nomination
- Liege site is based only on the portion of the nomination that falls within the boundaries of NW Alberta (west of 114 degrees)
- Caribou Mountains (317), Notikewin (345), Hungry Bend Sandhills (261) sites are based on the original nominations. Numbers represent the SP2000 nomination number for boundary reference.
- This list does not include all of the nominated sites, rather some of the major sites which would contribute significantly to SP2000 objectives and ecological benchmarks if approved.

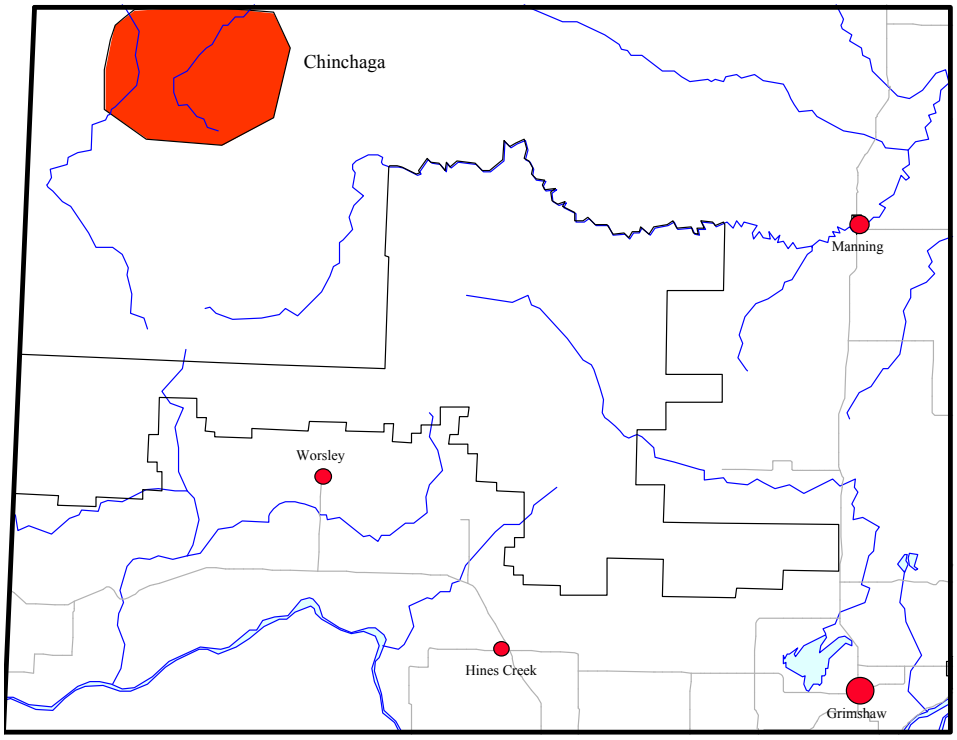

Figure 78. Selected Special Places 2000 nominated or candidate sites in the P1 and P2 FMU. Data Source: DMI GIS Library.

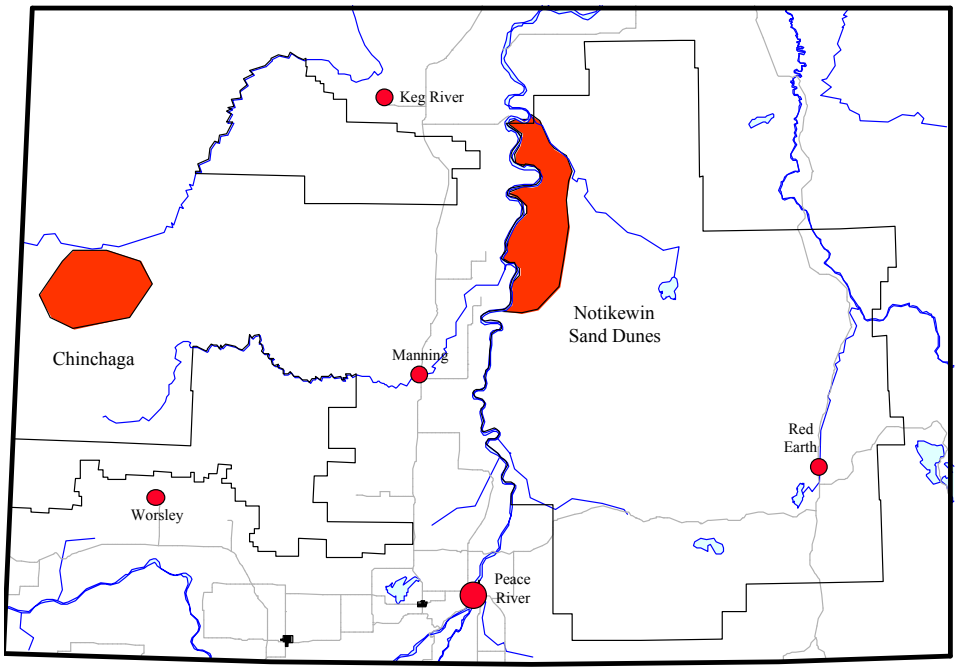

Figure 79. Selected Special Places 2000 nominated or candidate sites in the PRPD FMA of northwest Alberta. Data Source: DMI GIS Library.

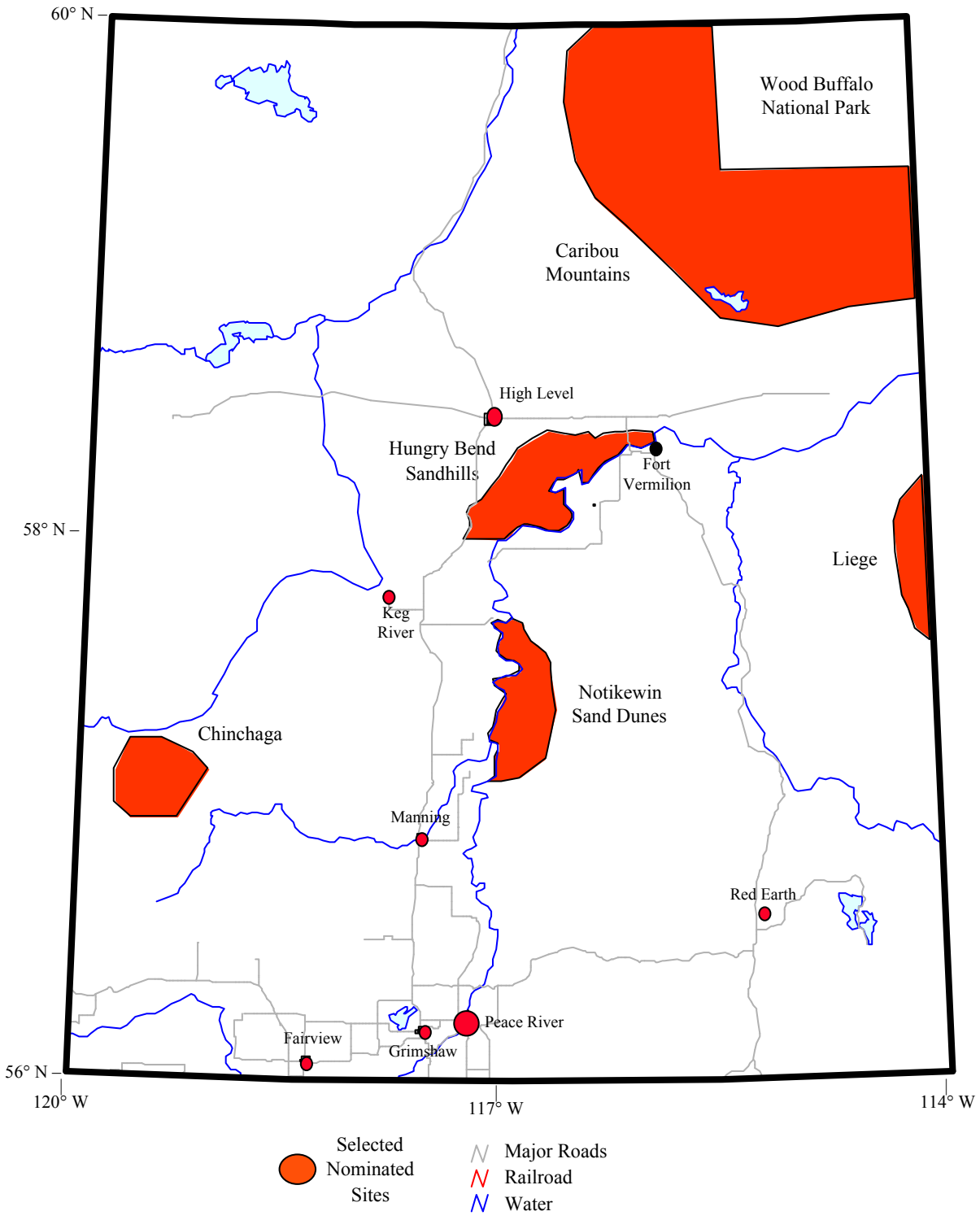

Figure 80. Selected Special Places 2000 nominated or candidate sites in northwest Alberta. Data Source: DMI GIS Library.

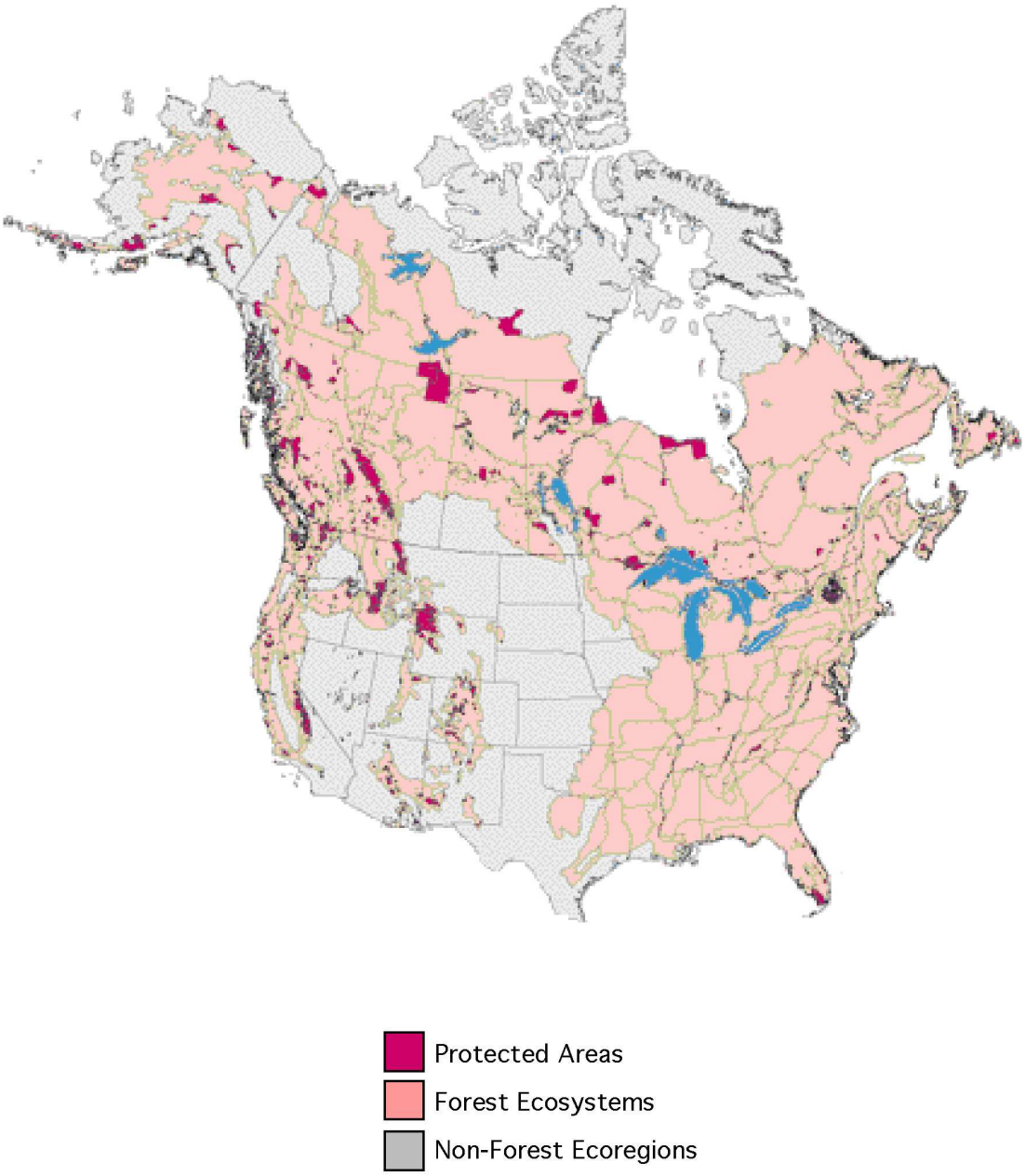

Figure 81. Current status of protected network of forest in North America as evaluated by the World Wildlife Fund. Extracted from web page: www.wwf.org/forests/maps/map2.htm. Data Source: Ricketts, T., E. Dinerstein, D.M. Olson, C. Loucks, P. Hedao, K. Carney, S. Walters, and P. Hurley. 1997. A conservation assessment of terrestrial ecoregions of North America. World Wildlife Fund, Conservation Science Program. Washington, D.C. In preparation.

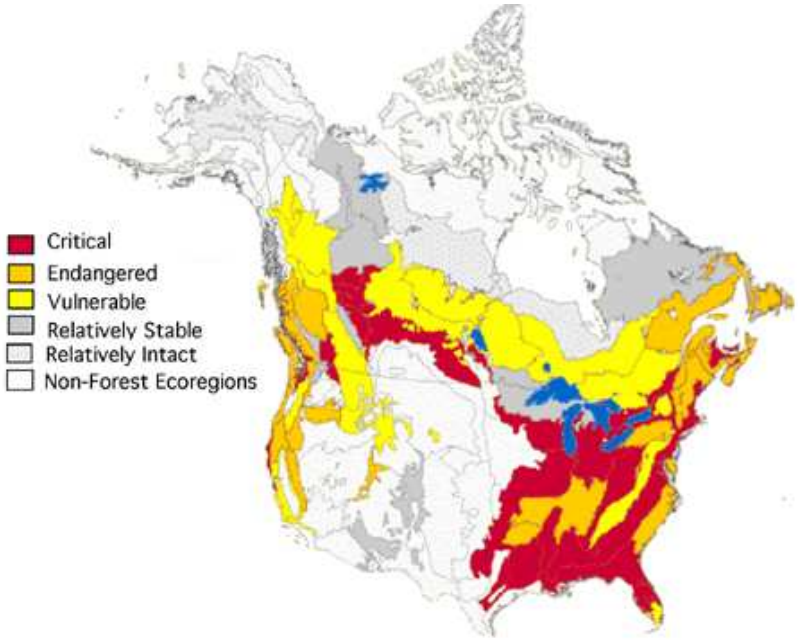

Figure 82. Conservation status of forests in North America as evaluated by the World Wildlife Fund. Extracted from web page: www.wwf.org/forests/maps/map2.htm. Data Source: Ricketts, T., E. Dinerstein, D.M. Olson, C. Loucks, P. Hedao, K. Carney, S. Walters, and P. Hurley. 1997. A conservation assessment of terrestrial ecoregions of North America. World Wildlife Fund, Conservation Science Program. Washington, D.C. In preparation.

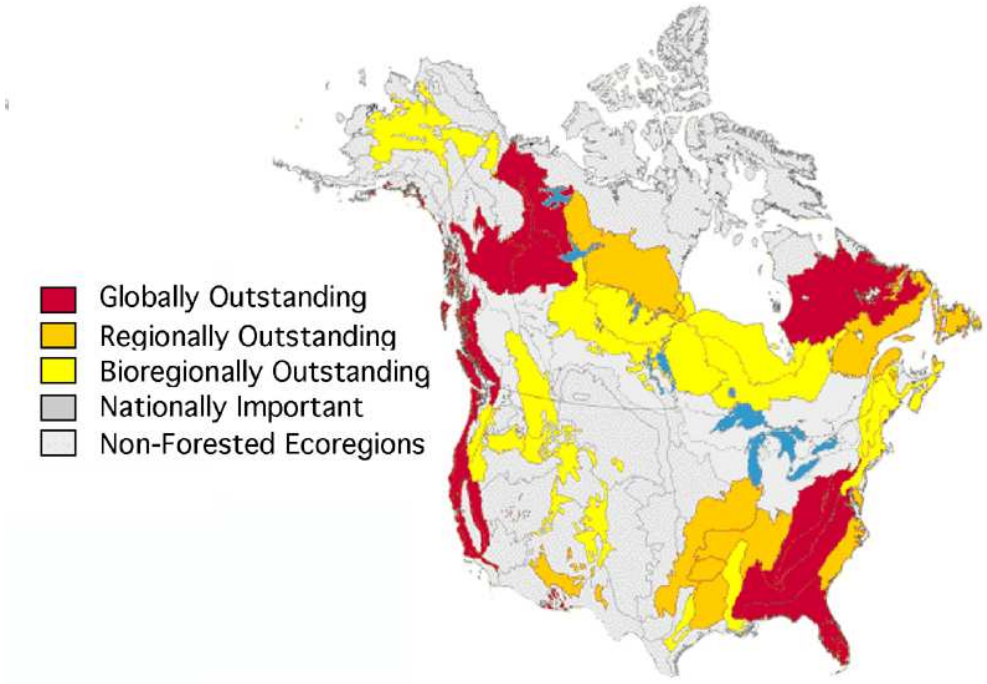

Figure 83. Geographic importance of forests in North America as evaluated by the World Wildlife Fund. Extracted from web page: www.wwf.org/forests/maps/map2.htm. Data Source: Ricketts, T., E. Dinerstein, D.M. Olson, C. Loucks, P. Hedao, K. Carney, S. Walters, and P. Hurley. 1997. A conservation assessment of terrestrial ecoregions of North America. World Wildlife Fund, Conservation Science Program. Washington, D.C. In preparation.

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