

# **APPENDIX L**

## **ECOREGION NARRATIVES**

# **1 ECOREGIONS ALONG THE NORTHERN BORDER**

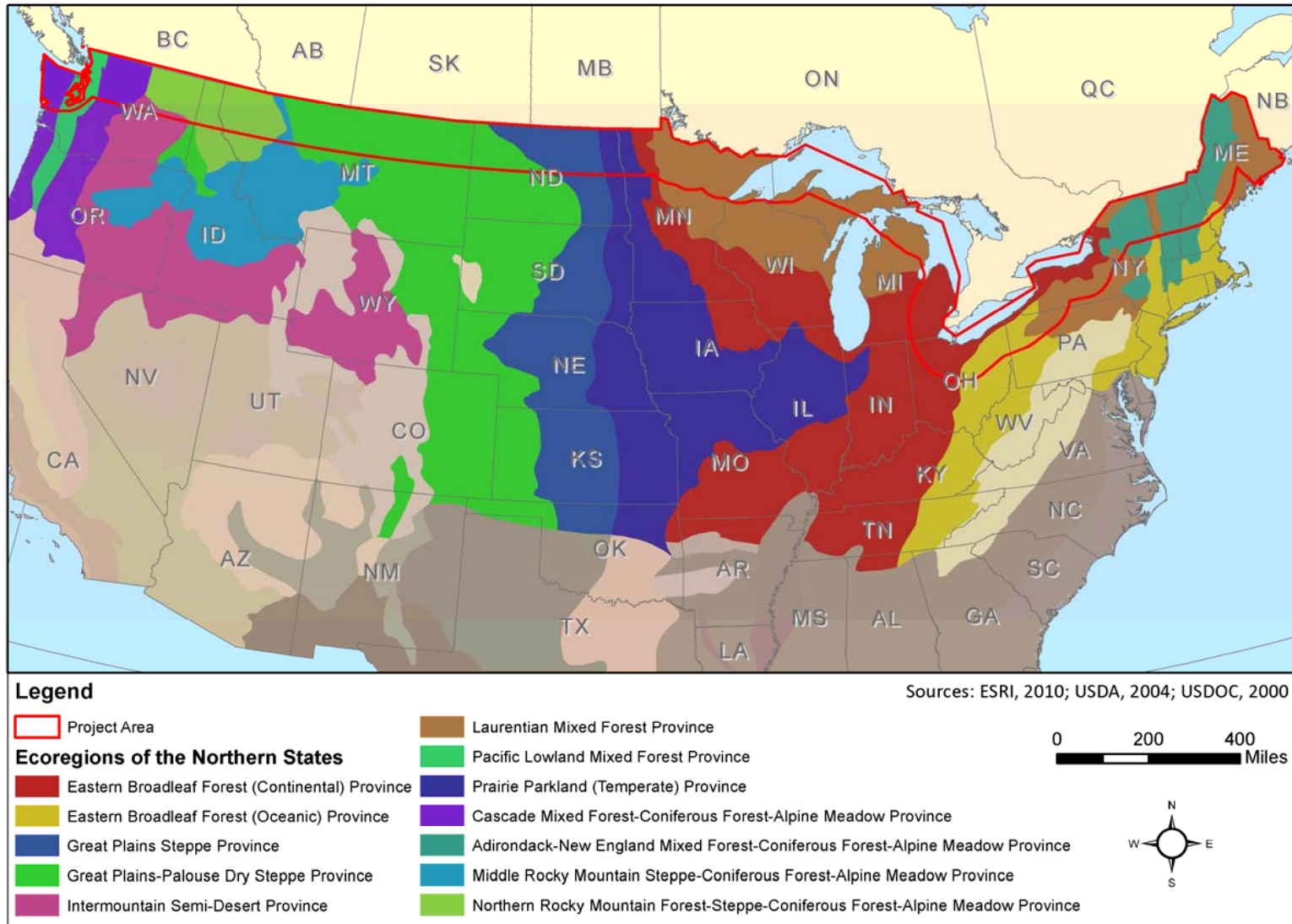
An ecoregion is a large area encompassing similar climate and ecosystem patterns. The similarities include types of plant and animal species, natural habitat types, climate, soils, and the general topography of the landscape. Dr. Robert G. Bailey, a geographer for the U.S. Forest Service (USFS), developed one of the most accepted systems to describe and map ecoregions (Bailey, 1995). Federal agencies and non-governmental organizations, including the USFS, U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), The Sierra Club, and The Nature Conservancy, use this ecoregion-based land classification system. The ecoregion conceptual framework is used for projects such as biodiversity analysis, landscape planning, and regional forest planning.

Twelve ecoregions make up the northern border (Figure L-1), ranging from the Pacific Lowland Forests of Washington to the Laurentian Mixed Forests in Maine. Map resources for all the ecoregion figures in this Programmatic Environmental Impact Statement (PEIS) were developed using U.S. Census, USGS, and Economic and Social Research Institute (ESRI) data.

Each ecoregion has a unique set of biological, climatic, and topographic characteristics, along with unique challenges and opportunities for the U.S. Customs and Border Protection (CBP). Each ecoregion description presented here begins with a general overview of those unique characteristics followed by:

- Blocks of Regionally Significant Habitat;
- Sensitive Habitats;
- Threatened and Endangered Species;
- Wildlife;
- Vegetative Habitat;
- Wetlands and Waterways; and,
- Aquatic Resources.

**Figure L-1. Ecoregions along the Northern Border**

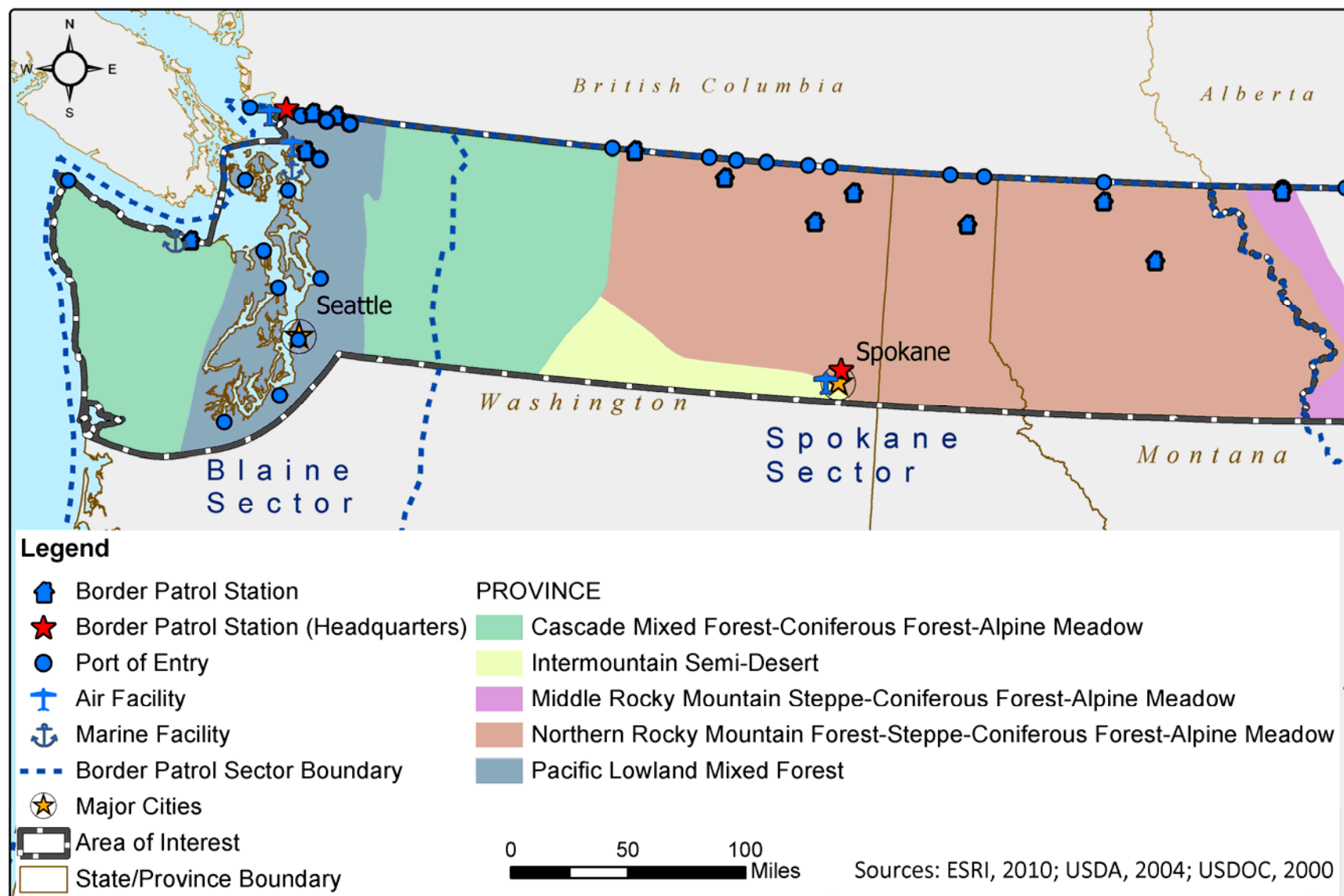


## **1.1 CASCADe MIXED FOREST–CONIFEROUS FOREST–ALPINE MEADOW ECOREGION (M242)**

The Cascade Mixed Forest Ecoregion encompasses a rugged mountain region with a narrow coastal plain (Figure L-2). Mountains along the coast have elevations of up to 5,000 feet (1,500 meters) above sea level. The interior Cascade Range Mountains average 8,000 to 9,000 feet (2,400 to 2,700 meters), with a series of volcanoes of greater elevation (Bailey, 1995). Mt. Rainier, an immense volcano, towers more than 14,000 feet (4,300 meters) high. Some portions of this ecoregion have been extensively glaciated.

Washington is the only state within the 100-mile boundary in this PEIS.

Figure L-2. Ecoregions in the West of Rockies Region



Modified by its proximity to the Pacific Ocean, this ecoregion has milder temperatures that average 35 to 50 degrees Fahrenheit (2 to 10 degrees Celsius) throughout the year. Precipitation comes mostly as rain, with totals ranging from 30 to 150 inches (77 centimeters to 380 centimeters) per year, and the majority falling during winter. Further south, winter precipitation is primarily rain with little or no snow. Coastal fog provides some summer moisture (Bailey, 1995). In the ecoregion's north, summer conditions remain dry for a shorter period and the area experiences more snowfall in winter. On the eastern side of the Cascades, conditions are drier than the western slopes; as little as 20 inches (51 centimeters) of precipitation falls on eastern slopes each year.

A high proportion of the land within the 100-mile northern border region in Washington is either publically owned or part of a Native American reservation. Much of the public land is either national forest (USFS) or National Park Service (NPS) land (North Cascades National Park), with smaller parcels managed by the U.S. Department of Defense and U.S. Bureau of Land Management (BLM).

Marine and coastal waters form the northwestern portion of the U.S.-Canada border. The exposed coast along the Pacific stretches south from Cape Flattery to the mouth of the Columbia River. Much of this area has relatively shallow waters over the continental shelf; shorelines vary from sand beaches to heavily forested rocky shores. Much of this outer rocky shore is characterized by thick kelp beds, which constitute key habitat for many marine organisms, including sea otters (*Enhydra lutris*) and abalone (*Haliotis* spp.).

### **1.1.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat below are relatively undeveloped and intact habitats that are protected as wilderness, state parks, and state and national forests. Regionally significant or intact habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private land.

Selected regionally significant blocks that represent this region include:

- Mount Rainier National Park;
- Olympic National Park;
- North Cascades National Park;
- Mount Baker Wilderness;
- Glacier Peak Wilderness;
- Pasayten Wilderness;
- Lake Chelan-Sawtooth Wilderness;
- Stephen Mather Wilderness; and,
- Salmo-Priest Wilderness.

## Mount Rainier National Park



(NPS)

### 1.1.2 SENSITIVE HABITATS

The Washington Department of Fish and Wildlife (WA DFW) designates certain areas as “priority habitats,” which are habitat types with unique or significant value to many species. These habitats typically have a comparatively high fish and wildlife density or species diversity; contain important breeding habitat, seasonal ranges, or movement corridors; have limited availability or high vulnerability to habitat alteration; or provide habitat for unique species (WA DFW, 2008). Priority habitat designation can inform regulatory decisions (e.g., planning requirements under the Growth Management Act and Shoreline Management Act), but does not carry regulatory significance on its own. For each of these habitat types, certain features are considered priority due to their wildlife value.

Sensitive areas within this ecoregion include the following:

- Aspen stands—Pure or mixed stands of aspen greater than 0.4 hectare (1 acre);

## Aspen Stand



- Biodiversity areas and corridors– Biologically diverse areas, or cities or urban growth areas with habitat valuable to fish or wildlife, mostly with native vegetation; corridors are zones of relatively undisturbed and unbroken tracks of vegetation that connect fish and wildlife habitat conservation areas, priority habitats, or areas identified as biologically diverse or valuable within city or urban growth areas;
- Eastside steppe–Non-forested vegetation dominated by forbs, perennial bunchgrasses, or a combination;
- Herbaceous balds–Variable-size patches of grasses and forbs on shallow soils over bedrock, commonly fringed by forest or woodland;
- Inland dunes–Sand dunes away from coastal areas;
- Juniper savannah–Juniper woodlands with a grassy understory;
- Old growth/mature forest–Forests of great age exhibiting specialized structural characteristics and rich biodiversity;
- Oregon white oak woodlands–Stands of oak or oak/conifer associations in which canopy coverage of the oak component exceeds 25 percent;
- Riparian–Areas adjacent to flowing or standing freshwater aquatic systems;
- Shrub-steppe–Non-forested vegetation consisting of one or more layers of perennial bunchgrasses and a conspicuous, but discontinuous, layer of shrubs;
- Westside prairie–Herbaceous, non-forested plant communities; either dry or wet prairie;
- Freshwater wetlands and fresh deepwater–lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or shallow water covers the land; deepwater habitats are permanently flooded lands below the deepwater boundary of wetlands;
- Coastal nearshore–Relatively undisturbed, nearshore estuaries of Washington’s outer coast; and,
- Open coast nearshore–Relatively undisturbed, non-estuarine nearshore areas of Washington’s outer coast



### 1.1.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the Federal and state-listed threatened and endangered species.

Each region of the USFS designates certain fish and wildlife species as sensitive. Sensitive species on USFS lands are species for which population viability has become a concern due to a significant downward trend in population or habitat capacity. These species require special management to maintain and improve their status on national forests and grasslands and prevent listing under the Endangered Species Act. The BLM also has a designation for sensitive species on their lands.

A prime example of a marine-endangered species is the leatherback turtle (*Dermochelys coriacea*), the only sea turtle capable of surviving in cold waters. It ranges more widely than other sea turtles, including in the Pacific Ocean north to the coasts of Washington and British Columbia. Leatherbacks live almost all of their lives in the marine environment, although females must return to shore to lay eggs. In the United States, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service has jurisdiction over sea turtles at sea; the USFWS has jurisdiction of them on land (nesting beaches). Leatherbacks are listed as endangered in both the United States and Canada.

#### Leatherback turtle hatchlings



(Coral Reef Alliance)

The grizzly bear, a prominent, federally listed species in this ecoregion, requires contiguous, relatively undisturbed, mountainous habitat with significant vegetative and topographic diversity. Its habitat needs include valley bottoms, wetland and riparian areas, rugged montane areas, and alpine meadows. The USFWS identified recovery zones needed for revitalization of the grizzly bear population (USDOI, 2009). In Washington, there are two grizzly bear recovery zones: the northern Cascades zone, and the Selkirk zone in northeast Pend Oreille County. The northern Cascades zone currently has a remnant population of fewer than 20 bears (USDOI, 2010a), but is capable of supporting a larger population.

Also in this region are the federally listed spotted owl (*Strix occidentalis*) and the marbled murrelet (*Brachyramphus marmoratus*); both are species that depend on old-growth conifer forest habitat for breeding.

#### 1.1.4 WILDLIFE

The Cascade Mixed Forests of this ecoregion are home to many wildlife species, including game (legally hunted) species, such as deer and elk, and non-game (legally protected, but not endangered or threatened) species, including birds and mammals, reptiles and amphibians, and invertebrates. Many bird species migrate into or out of this province in spring and fall each year, although avian migration here is not as temporally or geographically concentrated as many areas of the eastern United States. Several mammals and many permanent resident bird species remain in the province throughout the year.

##### Mountain lion



(NPS)

In the dominant coniferous forest habitats within the Cascade Province, elk (*Cervus canadensis*), mountain lion (*Puma concolor*), Townsend's warbler (*Dendroica townsendi*), and varied thrush (*Ixoreus naevius*) are a few of the sensitive species typical of this ecoregion. Steller's jay (*Cyanocitta stelleri*), chestnut-backed chickadee (*Poecile refescens*), and black-backed woodpecker (*Picoides arcticus*) are examples of permanent resident (non-migratory) bird species in the conifer forests. The black bear (*Ursus americanus*), boreal toad (*Anaxyrus boreas*), rough-skinned newt (*Taricha granulosa*), and brown elfin butterfly (*Callophrys augustinus*) offer additional examples of wildlife species living in various habitats of this ecoregion.

#### 1.1.5 VEGETATIVE HABITAT

The Cascade Province is mountainous, with elevations varying from sea level to above 5,000 feet (1,500 meters). Douglas-fir (*Pseudotsuga menziesii*) is the most abundant species at low elevations in the region. At the lowest elevations, dense conifer forests of Douglas-fir, western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), silver fir (*A. amabilis*), Sitka spruce (*Picea sitchensis*), and Alaska-cedar (*Chamaecyparis nootkatensis*) grow. Numerous shrub species thrive in this forest and at its margins. In many places, this vegetation is practically impenetrable.

A dry forest of ponderosa pine (*Pinus ponderosa*) grows along the dry eastern slopes of the Cascades — typically open forest mixed with grass and shrubs. The high, snowcapped mountains of the Cascades have a well-marked subalpine forest belt that reaches into British Columbia. Important trees are mountain hemlock (*Tsuga mertensiana*), subalpine fir (*Abies*

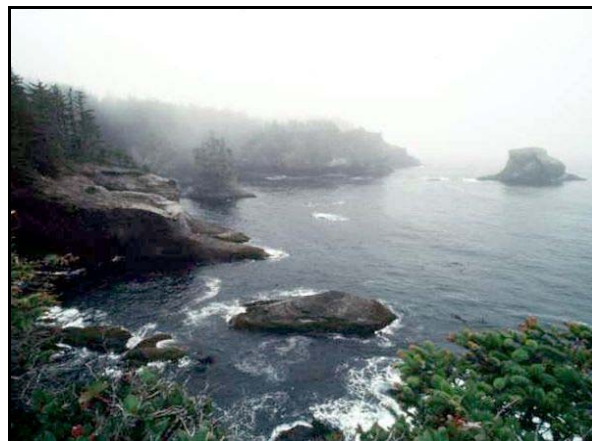
*lasiocarpa*), white-bark pine (*P. albicaulis*), and Alaska cedar or Nootka cypress (*Callitropsis nootkatensis*).

To the north, the subalpine forest becomes fragmented or disappears completely. Riparian forests in the Pacific Northwest provide an exception to the general rule that conifers dominate the region. Broadleaf species, such as black cottonwood (*Populus trichocarpa*) and red alder (*Alnus rubra*), grow along the many rivers and creeks.

Examples of invasive plants in this ecoregion include the following species, which have already caused or are expected to cause problems: wild chervil (*Anthriscus sylvestris*), absinth wormwood (*Artemisia absinthium*), kochia (*Kochia scoparia*), plumeless thistle (*Carduus acanthoides*), nodding thistle (*C. nutans*), slenderflower thistle (*C. pycnocephalus*), and longspine sandbur (*Cenchrus longispinus*) (USDA, 2010). Non-native invasive plant species can negatively affect natural areas, agriculture, and horticulture (Simberloff, 1996).

### 1.1.6 WETLANDS AND WATERWAYS

#### Rocky coastline typical of Washington



(National Geographic)

Wetlands in the Cascade Mixed Forest–Coniferous Forest–Alpine Meadow Province portion of the project area include approximately: 129,535 acres of forested or scrub-shrub wetland; 51,500 acres of emergent wetlands; 12,595 acres of ponds; 133,635 acres of lakes; and 45,275 acres of riverine habitats. Since this province extends around Puget Sound to the Pacific Ocean, it also includes 340 acres of marine and estuarine deepwater habitats and 6,025 acres of marine and estuarine wetlands (USDOI, 2010b).

In the study area, marine habitats are associated with the Strait of Juan de Fuca, Puget Sound (most of which lies within the Pacific Lowland Mixed Forest Province described in section 3.3.1.12), Haro Strait, Boundary Pass, the Strait of Georgia, and the Pacific Ocean. Overall, Washington State has 127 Marine Protected Areas that cover 6 million feet of coastline (Van Cleve et al., 2009).

The Skagit River, which crosses this province and the Pacific Lowland Mixed Forest Province, is a designated Wild and Scenic River. Lakes and reservoirs protected under the Washington

Shoreline Management Act in this province include Rock Island Pool, Wenatchee Lake, Chelan Lake, Wells Reservoir, Ozette Reservoir, and Baker Lake.

### **1.1.7 AQUATIC RESOURCES**

The marine and coastal areas of northwest Washington form a complex marine border with the Canadian Province of British Columbia. The 100-mile area south from the Canadian border includes (from west to east) the outer coast of the Olympic Peninsula and the Pacific Ocean, and the Strait of Juan de Fuca between the Olympic Peninsula and Victoria Island. In general, 12 nautical miles off the coast is considered territorial waters of the United States; however, since the marine waters between Washington and British Columbia never surpass 24 nautical miles wide, the border is designated as the middle of the water body (i.e., less than 12 nautical miles from the shore). Washington State ownership extends three miles from its coastline.

The outer exposed coast along the Pacific stretches 150 miles south from Cape Flattery to the mouth of the Columbia River. Much of this area has relatively shallow waters over the continental shelf and shorelines that range from sand beaches to heavily forested rocky shores. Many areas are bordered by steep cliffs with isolated sea stacks and rugged headlands. Much of this outer rocky shore has thick kelp beds — key habitat for many marine organisms, including sea otters and abalone.

Rocky intertidal shorelines are shallow areas (by definition, exposed at some time between high and low tides) along rocky coasts that are usually steeper where wave action is so strong that sediment cannot accumulate. They provide important habitat for many marine organisms, such as chitons (class–Polyplacophora), sponges (phylum–Porifera), limpet (saltwater/freshwater snails), marine worms, anemones (order–Actiniaria), octopus (order–Octopoda), crabs (infraorder–Brachyura), and many rockfish (*Sebastes* spp.).

Sand beaches also occur along the outer Pacific Coast of Washington. Fewer animals live on sand and gravel beaches than on rocky shores, due to the lack of solid substrate for attachment. Several fish — important prey for salmon — lay eggs on high spring tides on sand beaches in Washington, including sand lance (family–Ammodytidae), smelt (family–Osmeridae), and herring (*Clupea harengus*).

### Pacific harbor seal



(The Marine Mammal Center)

In Washington, straits and estuaries have abundant eelgrass (*Zostera* spp.) communities that are highly productive for marine life and many birds. The Pacific harbor seal (*Phoca vitulina*) largely relies on estuaries and frequently hauls out in these areas.

The rivers of this ecoregion province are generally excellent freshwater fish habitat — high in dissolved oxygen and largely unpolluted — and provide ideal conditions for the Pacific Northwest's salmon and trout species. Fisheries and aquatic resources are of great importance in this ecoregion and the neighboring Pacific Lowland Ecoregion. Stream and river fishing for trout and salmon remain quite important in western Washington. From 2003 to 2004, Washington residents purchased 318,079 freshwater fishing licenses. State anglers catch large numbers of salmon and several trout species annually (State of Washington, 2003). Agricultural production that allows animals access to streams and rivers can cause streambank erosion and result in nutrient loading, which has a harmful effect on water quality and the habitat of salmon and trout (Knight, 2009).

Aquatic invasive species are a concern within estuaries, wetlands, and rivers. Many species have accidentally been introduced through release of ship ballast water. Aquatic invasive plants of concern include caulerpa seaweed (*Caulerpa taxifolia*), Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), parrotfeather (*M. aquaticum*), common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), and water chestnut (*Trapa natans*). Aquatic invasive animals include mitten crab (*Eriocheir sinensis*), New Zealand mud snail (*Potamopyrgus antipodarum*), northern snakehead (*Channa argus*), nutria (*Myocastor coypus*), rusty crayfish (*Orconectes rusticus*), zebra mussel (*Dreissena polymorpha*), and quagga mussel (*D. rostriformis bugensis*). Viral hemorrhagic septicemia (VHS) is a deadly fish virus of great concern in this region.

## 1.2 PACIFIC LOWLAND MIXED FOREST ECOREGION (242)

The Pacific Lowland Mixed Forest Ecoregion sits in a narrow north-south longitudinal depression between Washington's Coast Range and Cascade Mountains (Figure L-2). Elevations in this narrow band vary from sea level to approximately 1,500 feet (460 meters). The valley



adjacent to the Puget Sound is a tableland covered by older glacial and lake deposits. The ecoregion incorporates some ranges of isolated hills and low mountains.

This ecoregion province includes part of Washington State within 100 miles of the northern border.

Lying near the Pacific Ocean, the Pacific Lowland Mixed Forest Province has a climate that is mild and generally without dramatic extremes throughout the year. Annual temperatures range between 48 and 55 degrees Fahrenheit (9 to 13 degrees Celsius). Rainfall is highest in winter; summer is dry by comparison. Mean annual rainfall varies from 15 to 60 inches (38 to 153 centimeters), but mostly ranges between 30 to 45 inches (76 to 115 centimeters). A mild rain-shadow effect caused by the coastal mountains produces the drier climatic conditions. Fog brings some moisture to the forests in this ecoregion during the summer dry period (Bailey, 1995).

The region's principal trees are western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and Douglas-fir (*Pseudotsuga menziesii*). The coniferous forest is less dense in interior valleys than along the coast and often contains deciduous trees, such as bigleaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), and black cottonwood (*Populus trichocarpa*). The prairies support open stands of oak or are broken by groves of Douglas-fir and other trees; principal indicator species are Oregon white oak (*Quercus garryana*) and Pacific madrone (*Arbutus menziesii*). Poorly drained sites with swamp or bog communities are also abundant.

Estuaries characterize much of this ecoregion in Washington State, including Puget Sound, Nisqually Delta, and Grays Harbor. Puget Sound is a large fjord formed by the retreat of glaciers, and contains many fingers. Estuaries feature a mixture of salt and fresh waters; they are extremely productive biologically and important to marine life. The state's estuaries contain deltas, mudflats, and salt marshes — all coastal wetlands.

#### Shorebirds on a mudflat



(USFWS)

### **1.2.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

No major extensive or sizable blocks of regionally significant habitat remain in this heavily urbanized part of Washington State.

### **1.2.2 SENSITIVE HABITATS**

Within the 100-mile zone adjacent to the U.S.-Canada border are several ecological communities described as sensitive habitats prone to disturbance. The WA DFW) has designated certain habitats as “priority habitats” — a type of habitat with unique or significant value to many species. These habitats typically have a comparatively high fish and wildlife density and/or species diversity; contain important breeding habitat, seasonal ranges, or movement corridors; have limited availability or high vulnerability to habitat alteration; or provide habitat for unique species (WADFW, 2008). Priority habitat designation may be used to inform regulatory decisions (e.g., planning requirements under the Growth Management Act and Shoreline Management Act), but does not carry regulatory significance on its own. Within each of these habitat types, certain features are also considered priority due to their wildlife value. Priority habitat features include caves, cliffs, snags and logs, and talus (WADFW, 2008).

Sensitive areas in this ecoregion include the following:

- North Pacific maritime mesic-wet Douglas-fir/western hemlock forest –A component of the lowland and lower-elevation montane forests of western Washington; not typical of drier sites; Douglas-fir and western hemlock especially common here;
- North Pacific lowland riparian forest and shrubland– Most abundant throughout low elevations west of the Cascades; includes red alder and bigleaf maple as dominant species;
- Oregon white oak woodlands – Stands of Oregon white oak or oak/conifer associations in which oaks comprise 25 percent of the trees in a given patch, or where the total canopy coverage of a given site is less than 25 percent, but oaks make up more than 50 percent of the canopy (WADFW, 2008);
- Riparian –Area adjacent to flowing or standing freshwater aquatic systems;
- Shrub-steppe –Non-forested vegetation type with one or more layers of perennial bunchgrasses and a conspicuous, but discontinuous, layer of shrubs;
- Freshwater wetlands and fresh deepwater–Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or shallow water covers the land; deepwater habitats are permanently flooded lands below the deepwater boundary of wetlands;
- Instream–Combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources; and,
- Puget Sound nearshore–Relatively undisturbed nearshore Puget Sound, including the Strait of Juan de Fuca, Admiralty Inlet, the San Juan Islands, and Hood Canal.

### 1.2.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species in this ecoregion. The USFWS designates certain fish and wildlife species as sensitive. Sensitive species on USFS lands are those species for which population viability is a concern, evidenced by a significant downward trend in population or habitat capacity. These species need special management to maintain and improve their status on national forests and grasslands to prevent listing under the Endangered Species Act. The BLM also has a designation for species considered sensitive and occurring on its lands. These species are in danger of extinction on all or part of their range.

Chinook are the largest salmon in North America, occupying Pacific and Arctic waters (Page and Burr, 1991). As anadromous fish, they return to freshwater streams and rivers to spawn after several years spent foraging in marine waters. In the project area, much of Puget Sound, the Strait of Juan de Fuca, Georgia Basin, and associated streams and rivers in Washington constitute critical habitat for the Chinook salmon (NOAA, 2007).

Many coniferous forests contain both Federal and state-listed species in this ecoregion. These species include the marbled murrelet (*Brachyramphus marmoratus*), spotted owl (*Strix occidentalis*), grizzly bear (*Ursus arctos horribilis*), and Canada lynx (*Lynx canadensis*).

Although some species are listed as endangered or threatened at either the Federal or state level, others are categorized differently as species of “conservation concern” or “special concern.”

### 1.2.4 WILDLIFE

The Pacific Lowland Mixed Forests of this ecoregion province are home to several wildlife species, which include game (legally hunted) species such as deer, and non-game (legally protected, but not endangered or threatened) species, including birds, mammals, reptiles, amphibians, fish, and representative species of other taxa. Many bird species migrate into or out of this province in spring and fall each year, although avian migration is generally not as temporally or geographically concentrated as the eastern United States. Many mammals and permanent resident bird species remain in the province throughout the year.

In the dominant lowland coniferous forest habitats in the Pacific Mixed Forest Province, Townsend’s warbler and varied thrush are a few of the sensitive species that could be affected, especially during the breeding season (generally from March through July). The riparian deciduous forest in this ecoregion is inhabited by sensitive species that include Hutton’s vireo (*Vireo huttoni*) and Wilson’s warbler (*Wilsonia pusilla*).



### A flock of snow geese



(USFWS)

Thousands of snow geese (*Chen caerulescens*) and trumpeter swans (*Cygnus buccinator*) winter in the Skagit River estuary. The waterfowl feed on aquatic plants and crops in nearby agricultural fields. Wide arrays of migratory bird species use the wetlands and coastal areas in the province in spring and autumn. Mild weather allows many species, including seabirds, waterfowl, raptors, gulls and terns, shorebirds, and some relatively winter-hardy songbirds, to overwinter here. Other inhabitants include black bear (*Ursus americanus*), raccoon (*Procyon lotor*), ringneck snake (*Diadophis punctatus*), and northwestern garter snake (*Thamnophis ordinoides*).

### 1.2.5 VEGETATIVE HABITAT

The Lowland Mixed Forest Province is situated primarily between prominent mountain ranges, varying in elevation from sea level to above 1,500 feet (460 meters). In Washington State, this area has been largely modified by human use and cultivation. At the lowest elevations with native forest cover, however, dense conifers include western red cedar, western hemlock, and Douglas-fir.

In the Puget Sound region and interior valleys, coniferous tree species are less abundant than in coastal areas. In these habitats, deciduous trees, such as bigleaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), and black cottonwood (*Populus trichocarpa*), become more common. Some remaining prairies have oaks, but also include groves of Douglas-fir. Oregon white oak (*Quercus garryana*) and Pacific madrone (*Arbutus menziesii*) also occur as do wetlands with swamp or bog plant communities (WWF, 2001).

Scotch broom (*Cytisus scoparius*) poses a serious threat to oak forests. An invasive shrub, scotch broom currently grows on more than 700,000 acres in the northwest coastal regions of the western coastal states. It displaces native plants, creating a serious dilemma for reforestation. Native to Europe and North Africa, this plant is a competitive species with the capacity to dominate a forest-shrub community and form dense monotypic stands.

### Scotch broom



(University of California, Berkeley)

Examples of invasive species that have already caused or are expected to cause problems in this province include: wild chervil (*Anthriscus sylvestris*), absinth wormwood (*Artemisia absinthium*), kochia (*Kochia scoparia*), plumeless thistle (*Carduus acanthoides*), nodding thistle (also known as musk thistle, *C. nutans*), slenderflower thistle (*C. pycnocephalus*), and longspine sandbur (*Cenchrus longispinus*), Russian knapweed (*Acroptilon repens*), and common bugloss (*Anchusa arvensis*) (USDA, 2010). Non-native invasive plant species can negatively affect natural areas, agriculture, and horticulture (Simberloff, 1996).

#### 1.2.6 WETLANDS AND WATERWAYS

Wetlands within the Pacific Lowland Mixed Forest are abundant and include approximately 1,831,340 acres of marine and estuarine deepwater (namely, the Puget Sound); 78,035 acres of marine and estuarine wetlands; 109,290 acres of forested or scrub-shrub wetland; 83,120 acres of freshwater emergent wetlands; 11,820 acres of ponds; 90,000 acres of lakes; and 88,770 acres of riverine habitats (USDOI, 2010b).

Puget Sound and its associated habitats represent an important marine resource in the project area and form the focus of multi-agency, multi-disciplinary, conservation efforts (Puget Sound Partnership, 2009).

The Skagit River is a designated Wild and Scenic River. Lakes and reservoirs protected under the Washington Shoreline Management Act within this province include Mud Mountain Reservoir, Chester Morse Lake Reservoir, along with Washington, Sammamish, Alder, American, Tapps, Shannon, and Whatcom lakes.

#### 1.2.7 AQUATIC RESOURCES

The marine and coastal portion of Washington forms a complex marine border with the Canadian Province of British Columbia. The 100-mile area south of the Canadian border within the Pacific Lowland Mixed Forest Province includes (from west to east): the Strait of Juan de Fuca between the Olympic Peninsula and Victoria Island; Haro Strait between the San Juan Islands and Victoria Island; Boundary Pass between the San Juan Islands and Salt Spring Islands; the Strait of Georgia between the Washington coast near Bellingham and Blaine; and the Salt Spring

Islands of Canada. The U.S.-Canada border is the halfway point of these bodies of water. In general, the 12-nautical-mile zone off the coast makes up the territorial waters of the United States; however, since the marine waters between Washington and British Columbia never reach 24 nautical miles wide, the border is the middle of the water body (i.e., less than 12 nautical miles from the shore).

Also included within 100 miles of the Canadian border are many parts of Puget Sound and contiguous water bodies, such as Hood Canal. The area from the outer Pacific Coast to the Strait of Georgia (also called Georgia Basin) is a rich, productive, cold-water environment for many marine and coastal organisms. Much of it is also an area of considerable human use with extensive shipping channels, commercial and sport fisheries, and ferryboats.

Large estuaries, including Puget Sound, Nisqually Delta, and Grays Harbor, are located in this ecoregion province. Estuaries feature a mixture of salt and fresh water; they are biologically productive and important to marine life. Included in the estuaries of Washington State are deltas, mudflats, and salt marshes. Many estuaries have abundant eelgrass communities, which are also highly productive for marine life and many birds. The Pacific harbor seal largely relies on estuaries and frequently hauls out in these areas.

The fast-flowing major rivers of the Pacific Lowland Mixed Forest Province constitute important habitat for various salmon and trout species. Chum (*Oncorhynchus keta*), coho (*O. kisutch*), pink (*O. gorbuscha*), sockeye (*O. nerka*), and Chinook salmon species, along with steelhead, are among the Pacific Northwest's most sought-after fish. Rivers, such as the Skagit and Skykomish, are of great economic importance to the region's population and are also important for native salmon and steelhead. The Skagit, for example, is the only large river system in Washington that hosts all of the native salmon species and two trout species. Portions of the Skagit River in the project area are designated as a National Wild and Scenic River, in part because of abundant bald eagles (*Haliaeetus leucocephalus*) and an excellent fishery.

### Sockeye salmon



(National Geographic)

Aquatic invasive species are a concern in estuaries, wetlands, and rivers with many species introduced from ballast water. Aquatic invasive plants of concern include caulerpa seaweed

(*Caulerpa taxifolia*), Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), parrotfeather (*M. aquaticum*), and common reed (*Phragmites australis*). Aquatic invasive animals include Atlantic salmon (*Salmo salar*), bullfrog (*Rana catesbeiana*), green crab (*Carcinus maenas*), mitten crab (*Eriocheir sinensis*), nutria (*Myocastor coypus*), rusty crayfish (*Orconectes rusticus*), zebra mussel (*Dreissena polymorpha*), and quagga mussel (*D. rostriformis bugensis*). VHS is a deadly fish virus of great concern in this region.

### 1.3 INTERMOUNTAIN SEMI-DESERT PROVINCE (342)

The Intermountain Semi-Desert Province sits in the northwestern United States and includes a narrow portion of Washington State within the 100-mile project area (Figure L-2).

**Intermountain semi-desert**



(USFS)

The Intermountain Semi-Desert Province includes broad plains and plateaus (mesas) of the Columbia/Snake River. These plateaus incorporate most of the northwest expanses of lava fields. Holocene Epoch lava flows covered areas adjacent to the plateaus and folded into ridges.

The mean elevation is approximately 3,000 feet (900 meters). Towards the south of this ecoregion, the basins between mountain ranges jointly form a stream-dissected plateau.

Latitude and landscape features differentiate this area from nearby ecoregions with similar plant associations, such as the Great Basin Shrub Steppe (occupying parts of Nevada, Idaho, Utah, and northeastern and eastern California). The Intermountain Semi-Desert Ecoregion sits at a lower elevation. The Snake/Columbia River basin region lacks the plant diversity typical of the Great Basin Ecoregion province (Bailey, 1995).

The ecoregion is situated within the rain shadow of the Cascade Mountains, limiting precipitation. Mean precipitation varies from less than 10 inches (26 centimeters) in the west (within the rain shadow of the Cascade Range) to 20 inches (51 centimeters) in the east.



Precipitation is distributed throughout the seasons, but summer routinely has the lowest amount of rain.

Fire and cattle grazing, along with wide variations in rain, snowfall, and temperature, are sources of ecological disturbances in the ecoregion. Fire may stimulate the growth of grasses and hold back the spread of sagebrush, but the long-term decline of perennial grass species is an ecological problem driving biodiversity decline in this ecoregion (WWF, 2001).

The climate of the ecoregion is semiarid with a mean annual temperature of approximately 50 degrees Fahrenheit (10 degrees Celsius).

### **1.3.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

No large, regionally significant areas occur in this ecoregion within 100 miles of the northern border.

### **1.3.2 SENSITIVE HABITATS**

Several ecological communities include sensitive habitats in this ecoregion. The sensitive habitats described here are home to many of the threatened and endangered species in the next section. For example, sagebrush steppe occurs in many areas in this broad geographic region and is home to rare plant species, such as the Piper's daisy (*Erigeron piperianus*), as well as a wide variety of common plant species, such as Indian ricegrass (*Oryzopsis hymenoides*). Some habitat names used below, such as eastside steppe, describe habitats across several regional boundaries and are more general. Others, such as the microphytic crust or cryptogams (a type of microscopic plant community), define much more specific ecological associations.

**Piper's daisy**



(University of Washington Botanic Gardens)

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on habitats enumerated and described by the World Wildlife Fund (WWF) (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Columbia Plateau steppe and grassland–Fires inhibit shrub re-growth and largely determine the vegetative habitat of this system. A microphytic or cryptogam crust (a collection of microscopic plants forming a crust) is a unique feature in this plant community.
- Eastside steppe–Dominated by ground-layer plants (those species which are not grasses are sometimes referred to as forbs), perennial bunchgrasses, or both. Shrubs other than sagebrush (in some sections) are absent or occasionally scattered.
- Juniper savanna–Dominated by Utah juniper (*Juniperus osteosperma*) interspersed with species of perennial bunch grasses and forbs. Species of sagebrush are also common (Washington Natural Heritage Program, 2007; WADFW, 2008).

### 1.3.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 itemizes Federal and state threatened and endangered species. The pygmy rabbit (*Brachylagus idahoensis*) and showy stickseed (*Hackelia venusta*) are federally listed endangered species in this ecoregion. Other important species include the northern spotted owl (*Strix occidentalis caurina*) and grizzly bear (*Ursus arctos horribilis*), which are federally listed threatened species and are also state-listed endangered species in this ecoregion. The upland sandpiper (*Bartramia longicauda*), and ferruginous hawk (*Buteo regalis*) are state-listed species; the populations of these species are in decline and have become increasingly rare. In the dominant sagebrush and grassland habitats within the ecoregion, the golden eagle (*Aquila chrysaetos*) and burrowing owl (*Athene cunicularia*) are state candidate species for threatened status listing. Both are considered sensitive species in this area.

### 1.3.4 WILDLIFE

Wildlife species in the Intermountain Semi-desert Ecoregion are similar to those in the Great Basin to the east. The sagebrush steppe, subalpine forests, and high-elevation grasslands in this ecoregion province are home to several wildlife species, which include game (legally hunted) and non-game (legally protected, but not endangered or threatened) species. Many bird species migrate into or out of this province in spring and fall each year. Several mammals and some permanent resident bird species remain in the region throughout the year. Common species are the white-tailed jackrabbit (*Lepus townsendii*), black-tailed prairie dog (*Cynomys ludovicianus*), and Brewer's sparrow (*Spizella breweri*), all of which are widespread throughout sagebrush habitat. Among reptiles, the western or prairie rattlesnake (*Crotalus viridis*) is fairly common and the bullsnake (*Pituophis catenifer sayi*) is more common.

### Black-tailed prairie dog



(National Geographic)

#### 1.3.5 VEGETATIVE HABITAT

The vegetation of this ecoregion, sometimes called sagebrush steppe, is largely sagebrush, the majority of which is big sagebrush (*Artemisia tridentata*) and shadscale (*Atriplex confertifolia*), with some short grasses. In many areas, ground-layer vegetation makes up less than 25 percent of the total cover so shrubs constitute the dominant vegetation. Greasewood (*Sarcobatus vermiculatus*) often grows in wetter alkaline areas. Adjacent to streams near the mountains, willows (*Salix* spp.) and sedges line the valleys; greasewood and other alkaline-tolerant plants may replace them farther away from the mountains (McNab and Avers, 1994).

Various bunchgrass species vegetate areas in the Columbia River Basin that receive more than 10 inches (26 centimeters) of rainfall per year. In cultivated areas, these landscapes have been used successfully for growing wheat.

Bluebunch wheatgrass (*Pseudoroegneria spicata*) is especially common, as is Idaho fescue (*Festuca idahoensis*). Rough fescue (*F. campestris*) and Sandberg bluegrass (*Poa secunda*) are also important grassland components.

Forests of Douglas-fir (*Pseudotsuga menziesii*), subalpine fir (*Abies lasiocarpa*), and aspen (*Populus* spp.) cover the wetter parts of the mountain ranges. Cottonwoods (*P. deltoids* and other cottonwood species) and willows (*Salix* spp.) often border the riparian zones.

Invasive plants can harm native vegetation, wildlife, and entire ecosystems along the northern border, as elsewhere in the United States. These invasive species often displace native plants, degrade habitat for wildlife and livestock, and diminish opportunities for outdoor recreation. They can affect soils and increase the frequency of fire. Invasive plants threaten the existence of endangered plants and negatively modify biodiversity. One estimate suggests that invasive plant species have affected 420,000 acres of national forests and grasslands in the Pacific Northwest (Pacific Northwest Invasive Plant Council, 2010). Examples of invasive species in this ecoregion include: yellow starthistle (*Centaurea solstitialis*), velvetleaf (*Abutilon theophrasti*), Russian knapweed (*Acroptilon repens*), jointed goatgrass (*Aegilops cylindrica*), camelthorn (*Alhagi maurorum*), garlic mustard (*Alliaria petiolata*), blackgrass (*Alopecurus myosuroides*), and indigo bush (*Amorpha fruticosa*).

### Velvetleaf



(University of Wisconsin, Stevens Point)

### 1.3.6 WETLANDS AND WATERWAYS

Wetlands within the Intermountain Semi-desert Province portion of the project area include approximately: 840 acres of forested/scrub-shrub wetland; 11,655 acres of emergent wetlands; 1,810 acres of ponds; 93,590 acres of lakes; and only 430 acres of riverine habitat. The small acreages are due to the smaller amount of this ecoregion within the study area, but also the arid climate.

Washington State identifies some 300+ rivers, creeks, and other waterways as protected under the Shoreline Management Act. The Washington Administrative Code, Chapter 173-18, defines specific protected reaches of these waterways.

Lakes and reservoirs protected under the Washington Shoreline Management Act in this province include the Wanapum Dam Reservoir, Sprague Lake, and Stevens Lake. These lakes are protected under the State of Washington's Shoreline Management Act.

### 1.3.7 AQUATIC RESOURCES

Due to the arid nature of this ecoregion, surfacewater is of critical importance to fish and aquatic wildlife. Alpine lakes and streams, along with lakes and rivers of the Intermountain Semi-desert Province, are susceptible to disturbance from construction, which can affect water quality as well as fish and other aquatic organism populations. These activities can negatively influence streambed sedimentation, water quality, and invertebrates.

Stream, river, and lake fishing for trout, salmon, walleye, and other freshwater fish remain important in southeastern Washington. During 2003 to 2004, Washington residents purchased 318,079 freshwater fishing licenses. Between April 1, 2003 and March 31, 2004, a total of 342,884 salmon were caught in the state's fresh waters (State of Washington, 2003). State anglers also caught large numbers of several trout species, walleye, and bass.



## **1.4 NORTHERN ROCKY MOUNTAINS STEPPE–CONIFEROUS FOREST–ALPINE MEADOW PROVINCE (M333)**

The Northern Rocky Mountain Steppe–Coniferous Forest–Alpine Meadow Ecoregion is largely composed of mountainous terrain with elevations up to 9,000 feet (2,700 meters) (Figure L-2). Most of the region has prominent glacial features. The Rocky Mountain trenches have broad, flat-bottomed valleys, some of which are several miles in width (Bailey, 1995).

This ecoregion occupies sections of the northwestern states, including parts of Montana, Idaho, and Washington.

Severe winters are typical of this ecoregion. The average temperature of the coldest winter month is below 32 degrees Fahrenheit (0 degrees Celsius); the average temperature of the warmest summer month is below 72 degrees Fahrenheit (22 degrees Celsius). Summer days are very warm. Precipitation of annual rain and snow averages between 20 to 40 inches (51 to 102 centimeters), falling primarily in fall, winter, and spring. Summers are usually much drier. These factors result in a climate gradient from north to south and from east to west. Snowfall during winter is typically heavy, especially at higher elevations.

Natural areas in this ecoregion include intermountain valley systems, large rivers and their tributaries, riparian areas and associated wetlands, and alpine habitats. Denning habitat exists for bears (*Ursus* spp.), wolverines (*Gulo gulo*), and other carnivores; the lower-elevation valleys provide winter range for ungulates. A variety of mixed-forest habitats offer shelter, forage, migration routes, breeding habitat, and cover for diverse sensitive species. Many of these natural areas have enhanced wildlife value due to their remote locations and rugged topography, with little or no human disturbance.

### **1.4.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat listed below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. “Intact habitat” or regionally significant habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Bob Marshall Wilderness–Montana;
- Part of Glacier National Park–Northern Montana;
- Selway-Bitterroot Wilderness–Northeastern Idaho; and,
- Cabinet Mountains Wilderness–Northwestern Montana.

## Glacier National Park



(NPS)

### 1.4.2 SENSITIVE HABITATS

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities that represent sensitive habitats. The sensitive habitats described here also exist in many of the larger intact habitat areas in the prior section, and are home to many of the threatened and endangered species in the next section. For example, these sensitive habitats house rare or protected species such as the lyre-leaf rockcress (*Arabidopsis lyrata*), as well as a wide variety of common plant species such as the shooting star (*Dodecatheon* spp.). Some habitat names used below, such as alpine meadows, describe habitats across several regional boundaries and are more general in meaning. Others, such as subalpine forest (a type of plant community), define much more specific ecological associations.

- Alpine meadows – Open meadows at and above the timberline;
- Great Plains ponderosa pine woodland and savanna – Ponderosa pine woodlands surrounded by grasslands;
- Rocky Mountain riparian woodland and shrubland – Within the flood zone of rivers, on islands, bars, and adjacent streambanks;
- Northern Rocky Mountain montane Douglas-fir forest and woodland – Mixed deciduous/coniferous montane forest;
- Rocky Mountain subalpine-montane fen – Mountain wetland fed by mineral-rich surface water or groundwater; below alpine areas in elevation;
- Subalpine forest – Northern Rocky Mountain subalpine dry parkland, Rocky Mountain lodgepole pine forest, Rocky Mountain subalpine dry-mesic spruce-fir forest and woodland;
- Rocky Mountain subalpine mesic spruce-fir forest and woodland – Forest of spruce and fir with a moderate moisture regime, just below timberline;
- Rocky Mountain wooded vernal pool – Temporary pools, usually devoid of fish, that allow development of natal amphibian and insect species;

- Alpine dwarf-shrubland – Dwarf shrubs or dwarf willows that form a heath-type ground cover;
- Spring Creek Canyon Natural Area Preserve (Washington) – Douglas-fir and ponderosa pine forest, as well as shrub-grassland ecosystems;
- Barker Mountain Natural Area Preserve (Washington) – Shrub-grassland ecosystems (“shrub-steppe”), including antelope bitterbrush/Idaho fescue habitat;
- Dry conifer forest – Northern Rocky Mountain western larch woodland; found in mountainous regions at 2,000 to 9,800 feet elevation;
- Northern mesic conifer forest – Northern Rocky Mountain hemlock-western red cedar forest
- Palouse prairie – Columbia Basin, western portion of north-central Idaho, on gentle, rolling terrain at elevations of 2000 to 3000 feet; and,
- Riparian woodland – Columbia Basin foothill riparian woodland and shrubland.

In Montana, Glacier National Park and the Bob Marshall Wilderness Area provide thousands of acres of habitat for a vast array of wildlife species, including endangered species such as the grizzly bear (*Ursus arctos horribilis*).

Approximately half of the land along the border in Idaho is federally owned; most of that is national forest. BLM has one wilderness study area (WSA): the Selkirk Crest WSA encompasses 720 acres about 18 miles northwest of Bonners Ferry.

The Selkirk Mountain area along the northern Idaho border has great value for wildlife. Adjacent to the Salmo-Priest Wilderness Area in Washington, it also extends into British Columbia. This area provides habitat for several federally listed threatened or endangered species, including bull trout (*Salvelinus confluentus*), grizzly bear (*Ursus arctos horribilis*), gray wolf (*Canis lupus*), and mountain caribou (*Rangifer tarandus caribou*).

### Grizzly bear



(National Geographic)

Only one USFWS National Wildlife Refuge exists in the 100-mile buffer zone within Idaho: the Kootenai National Wildlife Refuge.

Wildlife Management Areas (WMAs) are established in the project area of this ecoregion. These areas are managed for the protection of wildlife and recreation. In Idaho, the WMAs include Boundary Creek, McArthur Lake, Pend Oreille, Farragut, Coeur d'Alene River, St. Maries, and Snow Peak. In Montana, the WMAs include Kootenai Falls and Bull River. In Washington, the WMAs include Sherman and LeClerc creeks.

### 1.4.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists threatened and endangered species in this ecoregion. Montana lists some species as “Species of Concern.” The status represents a separate category, described as, “Potentially at risk because of limited and/or declining numbers, range and/or habitat, even though it may be abundant in some areas” (MTFWP, 2010).

Idaho does not list species as state endangered or threatened, but defers to Federal listings. The Idaho equivalent state ranking for species of concern is S2; an Idaho state rank of S1 denotes “Critically imperiled: at high risk because of extreme rarity.”

Prime examples of endangered wildlife in this ecoregion are the grizzly bear (*Ursus arctos horribilis*) and the Selkirk Mountains population of the woodland caribou (*Rangifer tarandus caribou*). The grizzly bear population in the Selkirk recovery zone is estimated at 40 to 50 individuals (USDOI, 2010a). Woodland caribou in the Selkirks are at risk because their numbers are very low and they have a slow reproductive rate (Zager et al., 1995).

#### Woodland caribou



(Canadian Parks and Wilderness Society)

Although some species are listed as endangered or threatened at either the Federal or state level, others are categorized differently as species of “conservation concern” or “special concern” by both state and Federal agencies.

#### 1.4.4 WILDLIFE

Wildlife species in the Northern Rocky Mountains Steppe Ecoregion are similar to those living elsewhere in the Rockies to the north and south. The alpine meadows, subalpine forests, and high-elevation grasslands are home to many wildlife species, including game and non-game species. Many songbird species migrate into or out of this province in spring and fall each year.

A wide variety of mammals and some permanent resident bird species remain in the province throughout the year. Common mammals in this ecoregion include mule deer (*Odocoileus hemionus*), yellow-bellied marmot (*Marmota flaviventris*), and pika (*Ochotona princeps*).

In forested habitats within the province, common birds include Steller's jay (*Cyanocitta stelleri*), black-headed grosbeak (*Pheucticus melanocephalus*), and broad-tailed hummingbird (*Selasphorus platycercus*). The northern goshawk (*Accipiter gentilis*), flammulated owl (*Otus flammeolus*), and black-backed woodpecker (*Picoides arcticus*) are several of the more uncommon or sensitive species in this ecoregion. Mammals include mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*). Common reptiles and fish include the common garter snake (*Thamnophis sirtalis*), spiny softshell turtle (*Apalone spinifera*), bull trout (*Salvelinus confluentus*), and chum salmon (*Oncorhynchus keta*).

#### 1.4.5 VEGETATIVE HABITAT

Mixed evergreen-deciduous forest is dominant in this ecoregion. The forests are primarily composed of fir (*Abies* spp.), cedar (*Thuja* spp.), and hemlock (*Tsuga* spp.). Well-marked altitudinal zones create a prominent feature of this ecoregion. No trees grow in the alpine zone. Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) dominate the subalpine zone, just below the alpine zone.

**Engelmann spruce**



(University of British Columbia Botanical Garden)

In some sections of this ecoregion, mountain hemlock (*Tsuga mertensiana*) is the climax tree of the subalpine zone. Lodgepole pines grow primarily in the eastern part of the region. On the west side of the continental divide and below the zone of Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*) becomes dominant, making up a relatively drier forest. Grand fir (*Abies grandis*), western hemlock (*T. heterophylla*), western red cedar (*Thuja plicata*),



mountain hemlock, and western white pine (*P. monticola*) also grow in the forested areas of this ecoregion. Larch (*Larix* spp.) invades areas that have experienced fire or been logged. White pine may eventually outcompete larch, which is then replaced by hemlock, red cedar, and lowland white fir (*A. concolor*). Depending on latitude, lower slopes and valleys of the montane belt may be covered with grasses and sagebrush; these often constitute a “semi-desert” vegetation of sagebrush or grass-covered steppe (Bailey, 1995).

Conditions to the east of the Bitterroot Mountains are more arid; as a result, forests grow mostly on the northern and eastern slopes. Although the south and west-facing slopes receive similar amounts of rain or snowfall, temperatures are warmer. Fewer forests grow there due to the drier conditions, so shrubs and grasses dominate.

In addition to the extensive conifer forests, this ecoregion contains several other vegetation community types: alpine meadows, grasslands, wooded riparian stands, and higher-elevation tree-line and alpine communities. The consequences of the dramatic elevation changes include rain shadows, effects of prevailing winds, and thermal inversions (Peet, 1988).

Non-native invasive plant species can negatively impact natural areas, agriculture, and horticulture (Simberloff, 1996). Examples of invasive species in this ecoregion include: buffalo burr (*Solanum rostratum*), common crupina (*Crupina vulgaris*), eggleaf spurge (*Euphorbia oblongata*), goat’s-rue (*Tephrosia virginiana*), Johnson grass (*Sorghum halepense*), and Vochin knapweed (*Centaurea nigrescens*) (Idaho Weed Coordinating Committee, 2005; Washington State Noxious Weed Control Board, 2010).

#### **1.4.6 WETLANDS AND WATERWAYS**

Wetlands within the ecoregion project area include approximately: 72,735 acres of forested/scrub-shrub wetlands; 144,875 acres of emergent wetlands; 13,280 acres of ponds; 470,220 acres of lakes; and 28,110 acres of riverine habitats (USDOI, 2010b).

The Kootenai River is a major river in this province that flows from Canada to Montana, into Idaho, and then back across the Canadian border. Dammed near Libby, Montana, the river forms a large reservoir, Lake Koocanusa, which backs up into Canada.

## Kootenai River



(Montana Department of Natural Resources and Conservation)

The Flathead Wild and Scenic River designation includes three forks within 100 miles of the northern border. The North Fork Flathead is designated from the Canadian border downstream to its confluence with the Middle Fork; the Middle Fork Flathead is designated from its headwaters to its confluence with the South Fork; and the South Fork Flathead is designated from its origin to the Hungry Horse Reservoir.

Other major rivers in the project area include a portion of the Clarke Fork, the Moyie River (which flows south from Canada), and the Flathead River system, along with the Coeur d'Alene, Pack, and Priest rivers. The Clark Fork River drains into Lake Pend Oreille; the Pend Oreille River drains out of Lake Pend Oreille.

The Similkameen River valley runs north-south across the northern border near the boundary of the Cascade Mixed Forest–Coniferous Forest–Alpine Meadow Province and the Northern Rocky Mountain Forest Steppe–Coniferous Forest–Alpine Meadow Province. One of the most biologically diverse ecosystems in Canada, the Similkameen River valley is also one of Canada's three most endangered natural systems (British Columbia Parks, 2010). The Ministry of Parks in British Columbia is an active participant in the South Okanogan-Similkameen Conservation Program.

Major lakes in the project area within this province include Lake Pend Oreille, along with Rufus Wood, Banks, Long, Palmer, Osoyoos, Callispell, Sullivan, Priest, and Hayden lakes, Boundary Reservoir, a portion of Coeur d'Alene Lake, and Little Bitterroot, Swan, Flathead, Whitefish, and Medicine lakes. Glacier National Park has a series of large lakes including Kintla, Bowman, Logging, McDonald, Sherburne, Mary, and Waterton, which crosses the northern border into Waterton Park in Canada. Within the Blackfeet Reservation (east of Glacier National Park) are Lower Saint Mary and Duck lakes. Major reservoirs include Lake Koocanusa and Hungry Horse Reservoir. Lakes in the State of Washington are protected under the state's Shoreline Management Act.

#### **1.4.7 AQUATIC RESOURCES**

Fisheries and aquatic resources are of great importance in this province. Idaho, Washington, and Montana are famous for their high-quality fishing. Anglers in the Rocky Mountain region increased 8.3 percent between 1991 and 1996, with 3,303,000 persons holding licenses in 1996 (USDOL, 2004). Numerous large natural lakes and reservoirs in these three states offer a variety of fishing opportunities for warm and cold-water species, including salmon and steelhead trout. Idaho's mountains contain more than 1,500 alpine lakes (IDFG, 2010).

Two river systems within the project area are designated as National Wild and Scenic Rivers: the Flathead and Missouri rivers (see Wetlands and Waterways, above). The BLM's Lewistown Field Office manages these segments of the Missouri River in Montana.

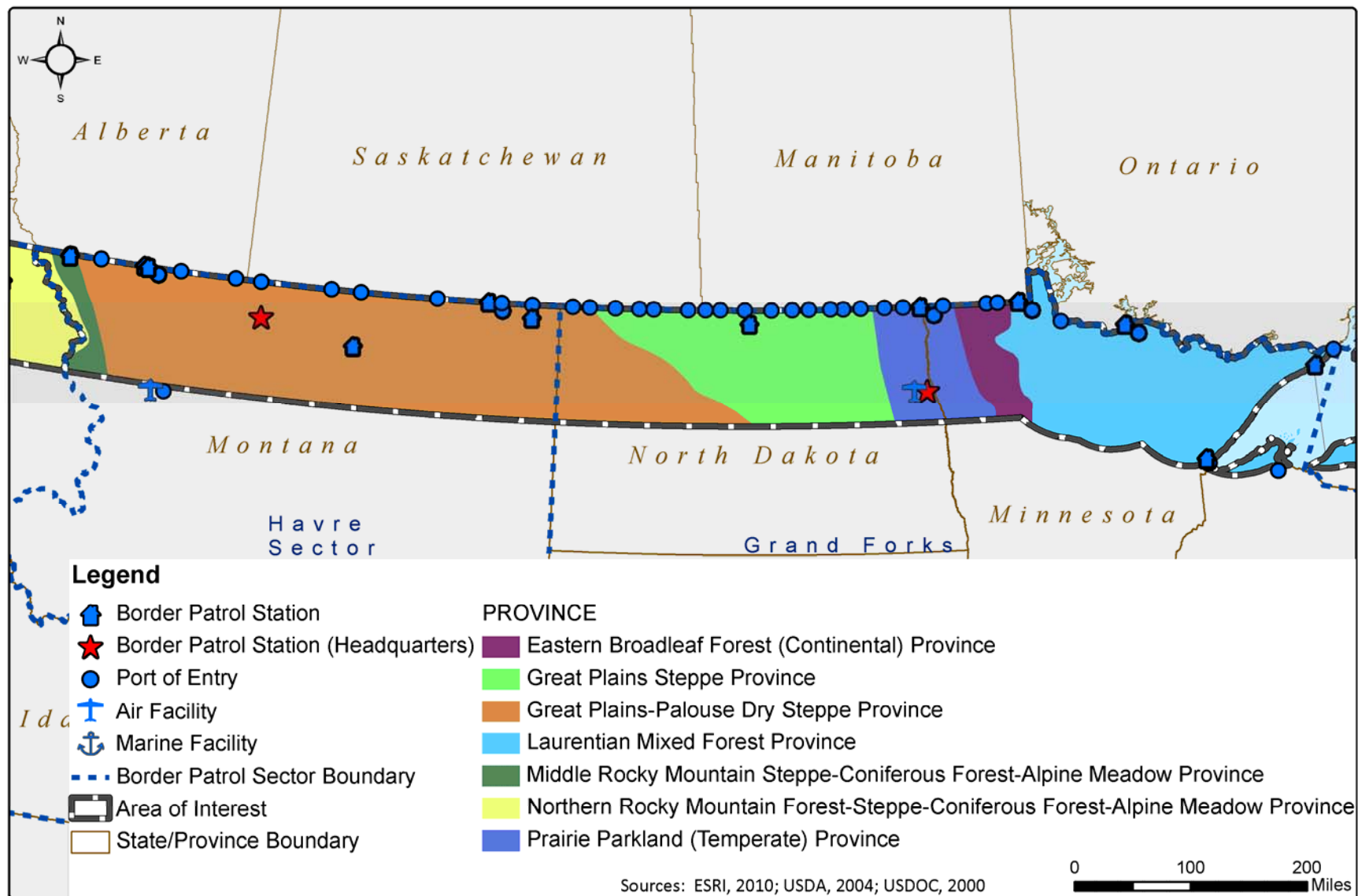


## **1.5 MIDDLE ROCKY MOUNTAIN STEPPE–CONIFEROUS FOREST– ALPINE MEADOW ECOREGION (M332)**

The mountainous region of the Middle Rocky Mountain Steppe–Coniferous Forest–Alpine Meadow Ecoregion has a great deal of landscape diversity (Figure L-3). A small portion of this ecoregion lies within 100 miles of the U.S-Canada border in Montana. The landscape is characterized by block fault mountain ranges and further shaped by glaciers. The ecoregion includes the eastern edge of Glacier National Park, part of the Lewis and Clark National Forest, and portions of the Blackfeet Indian Reservation.

The study area in this ecoregion includes parts of Montana.

Figure L-3. Ecoregions in the East of the Rockies Region



The Rocky Mountain front is mountainous with limestone ridges and many glacial features. Elevations vary from 5,500 to 8,500 feet (1,678 to 2,593 meters).

Despite the northern latitudes and high altitudes of this region, its climate is relatively mild due to the Pacific Ocean's proximity, with average annual temperatures of about 36 to 45 degrees Fahrenheit (2 to 7 degrees Celsius) and intense fluctuations of winter temperatures. The length of the growing season averages 120 days—about the same as a similar latitude on the Great Plains. Temperature and snowfall vary dramatically with change in altitude. Winds are predominately westerly, with much of their moisture precipitating on the eastern side of the ranges. As a result, much of this portion of the Rocky Mountains is characterized by semiarid climatic conditions. Valleys receive less than 20 inches (51 centimeters) of rain and snow each year, while up to 30 inches (77 centimeters) is typical in the mountains, mostly as snow. The climatic effects of topographic relief (for example, rain-shadow effects, effects of prevailing winds, and other climatic influences) similarly bear on altitudinal zonation (Peet, 1988; Bailey, 1995).

### **1.5.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. Regionally significant or intact habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks), often crossing state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Part of Glacier National Park—Montana;
- Parts of Lewis and Clark National Forest—Montana; and,
- Wetland areas on the Blackfeet Indian Homeland/Reservation—Montana.

### **1.5.2 SENSITIVE HABITATS**

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities that represent sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section, and are home to many of the threatened and endangered species in the next section. For example, alpine meadows grow in many open areas above the timberline in this geographic region and house protected species, such as the three-flowered rush (*Juncus triglumis*), as well as a wide variety of other species, such as the Iceland lichen. Some habitat names used below, such as alpine meadows, describe habitats that occur across several regional boundaries and are more general in meaning. Others, such as Rocky Mountain subalpine-montane fen (a type of wetland community), define much more specific ecological associations.

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the World Wildlife Fund (WWF) (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Alpine meadows–Open meadows at and above timberline;
- Great Plains ponderosa pine woodland and savanna–Ponderosa pine woodlands surrounded by grasslands;
- Rocky Mountain riparian woodland and shrubland–Within the flood zone of rivers, on islands, bars, and adjacent streambanks;
- Middle Rocky Mountain montane Douglas-fir forest and woodland–Mixed deciduous/coniferous montane forest;
- Rocky Mountain subalpine-montane fen–Mountain wetland fed by mineral-rich surface water or groundwater, below alpine areas in elevation;
- Rocky Mountain wooded vernal pool–Temporary pools, usually devoid of fish, that allow natal amphibians and insects to develop; and,
- Alpine dwarf-shrubland–Dwarf-shrubs or dwarf willows which form a heath-type ground cover.

### **Ponderosa pine woodland**



(U.S. Forest Service)

Portions of several preservation areas of national and regional importance lie within this ecoregion, including Glacier National Park. Disturbance of grasslands, savannas, and shrub-dominated landscapes has altered the species composition of formerly intact natural communities. Aggressive burning and fire suppression can also dramatically affect ecological community structure and species composition.

Loss or deterioration of riparian forest habitats and associated water sources deleteriously affects wildlife. Permanent loss of keystone species, such as black-tailed prairie dogs (*Cynomys ludovicianus*), can cause major impacts on natural communities, of both animals and plants (Olson et al., 2000). These characteristics suggest that the sensitive ecological communities require additional safeguards when considering human activities that could disturb the habitat since disturbance regimes are catalysts of rapid ecological change (Turner, 2010).

The major ecological threats to this area include reduced connectivity among habitat blocks and additional human recreational activity due to increasing commercial development, mining, and energy resource use.

### 1.5.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species in this ecoregion. In forested habitats within the Middle Rocky Mountain Steppe–Coniferous Forest–Alpine Meadow Ecoregion, the northern goshawk (*Accipiter gentilis*), great gray owl (*Strix nebulosa*), and black-backed woodpecker (*Picoides arcticus*) are some of the area’s sensitive species. Examples of other rare species in Montana include the flammulated owl (*Otus flammeolus*), red-headed woodpecker (*Melanerpes erythrocephalus*), and yellow-billed cuckoo (*Coccyzus americanus*).

#### Great gray owl



(Idaho Fish & Game)

Although some species are listed as endangered or threatened at either the Federal or state level, others are categorized differently as species of “conservation concern” or “special concern.”

### 1.5.4 WILDLIFE

Wildlife species in the Middle Rocky Mountains Steppe Ecoregion are similar to those inhabiting the Rockies to the north and south; however, parts of this inter-mountain ecoregion have mountain ranges isolated by stretches of arid territory. A unique array of species often populate each set of mountain ranges; some of these species may be found only on a single range.

The alpine meadows, subalpine forests, and high-elevation grasslands in this ecoregion are home to several wildlife species, which include game (legally hunted) and non-game (legally protected, but not endangered or threatened) species. Many birds, such as the northern saw-whet owl (*Aegolius acadicus*), belted kingfisher (*Ceryle alcyon*), cliff swallow (*Petrochelidon pyrrhonota*), Cooper’s hawk (*Accipiter cooperi*), Swainson’s hawk (*Buteo swainsoni*) migrate into or out of this ecoregion in spring and fall each year or are permanent residents, although the avian migration is not as temporally concentrated as in many areas of the eastern United States.

A wide variety of mammals and some permanent-resident bird species remain in the province throughout the year, such as the coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and bobcat (*Lynx rufus*).

### 1.5.5 VEGETATIVE HABITAT

Altitudinal zones are prominent in this ecoregion. Below the subalpine zone, Douglas-fir (*Pseudotsuga menziesii*) is the dominant coniferous tree species. Grand fir (*Abies grandis*) is an important component on the west side of the continental divide and western red cedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) are the most typical species of the montane zone or belt. Lodgepole pines (*Pinus contorta*) grow primarily in the eastern area. On the west side of the continental divide and below the zone of Douglas-firs, ponderosa pine (*P. ponderosa*) becomes the dominant tree, making up a dry-forest type. Semi-desert vegetation of sagebrush or grass-covered steppe covers the lower-elevation slopes of the mountains and plains (Bailey, 1995).

**Sagebrush steppe**



(Montana Department of Natural Resource and Conservation)

Forests inhabit mostly northern and eastern slopes. Although the south- and west-facing slopes receive similar amounts of rain or snowfall, their temperatures are much warmer. They support few trees due to the drier conditions; instead, shrubs or grasses vegetate these slopes.

In addition to the extensive conifer forests, the ecoregion contains several other plant communities: alpine meadows, grasslands, wooded riparian stands, and higher-elevation tree-line and alpine communities. Vertical zonation of vegetation is typical and strongly evident. Secondary climatic effects of elevation change due to rain shadows, prevailing winds, and thermal inversions are also evident (Peet, 1988).

Examples of invasive species in this region include: spotted knapweed (*Centaurea maculosa*), leafy spurge (*Euphorbia esula*), Dalmatian toadflax (*Linaria dalmatica*), orange hawkweed (*Pilosella aurantiaca*), meadow hawkweed (*Hieracium caespitosum*), Canada thistle (*H. caespitosum*), yellow toadflax (*L. vulgaris*), Russian knapweed (*Acroptilon repens*), houndstongue (*Cynoglossum officinale*), field bindweed (*Convolvulus arvensis*), dyer's woad

(*Isatis tinctoria*), and perennial pepperweed (*Lepidium* spp.) (Center for Invasive Plant Management, 2010).

### **1.5.6 WETLANDS AND WATERWAYS**

Wetlands within the Middle Rocky Mountain Steppe Province portion of the project area include approximately: 13,515 acres of forested/scrub-shrub wetlands; 16,375 acres of emergent wetlands; 4,205 acres of ponds; 8,730 acres of lakes; and 2,210 acres of riverine habitats (USDOI, 2010b).

These acreages appear much lower than other ecoregions, but this is partially due to only a small portion of the province lying within the proposed project area. It is also partially due to the rugged topography.

Coeur d'Alene Lake is a large natural lake, which was enlarged in the early 20<sup>th</sup> century by a relatively small dam at the outlet (Post Falls Dam) that raised the water level about 8 feet and inundated a large area in the panhandle of Idaho. The lake extends between the boundary of this ecoregion and the Northern Rocky Mountain Forest Steppe–Coniferous Forest–Alpine Meadow Ecoregion.

### **1.5.7 AQUATIC RESOURCES**

Fisheries and aquatic resources are of great importance in this ecoregion. Montana is famous for fishing. Rocky Mountain anglers increased 8.3 percent between 1991 and 1996, with 3,303,000 persons holding licenses in the region in 1996 (USFWS, 2004). Mountains in this ecoregion contain alpine lakes with good fishing. Numerous large natural lakes and reservoirs in both states offer fishing for warm and cold-water species, including the northern pike (*Esox lucius*), goldeye (*Hiodon alosoides*), mountain whitefish (*Prosopium williamsoni*), and steelhead trout (also known as rainbow trout, *Oncorhynchus mykiss*).

## **1.6 GREAT PLAINS–PALOUSE DRY STEPPE ECOREGION (331)**

This region has rolling plains and tablelands in a broad swath that slopes gradually eastward from an altitude of 5,500 feet (1,520 meters) near the foot of the Rocky Mountains to 2,500 feet (760 meters) in the western Great Plains (Figure L-3). The plains are flat, but occasional valleys punctuate the plains with their associated canyons and buttes. In North Dakota and Montana, badlands and isolated mountains provide topographic relief (Bailey, 1995).

The states in this ecoregion are North Dakota, Montana, and Washington.

This region contains three distinct areas in North Dakota and Montana: the northern glaciated plains (to the northeast and east of the northwestern glaciated plains in North Dakota); the northwestern glaciated plains (the northern parts of Montana and North Dakota and extending east from the Missouri River); and the northwestern Great Plains (south of the northwestern glaciated plains and extending to the Missouri River in North Dakota). They are characterized by rolling, glacial-till plains shifting to gently sloping, rolling hills and dissected shale plains. The northern glaciated plains in eastern to central North Dakota have steep slopes adjacent to major stream valleys with elevations of 2,000 to 6,000 feet (610 to 1,830 meters). The northwestern glaciated plains include northwestern North Dakota and most of the northern border of Montana; they have steep slopes bordering some of the large rivers, and elevations of



2,500 to 5,000 feet (763 to 1,525 meters). The northwestern Great Plains, in southwest North Dakota east of the Missouri River and the east and central portions of Montana, contain gently sloping dissected shale plains with elevations from 1,500 to 3,900 feet (458 to 1,200 meters) (Bailey, 1995).

The Palouse Prairie portion of this ecoregion lies in western Washington at the southern end of the 100-mile zone of the northern border. This area consists of large, isolated hills and low mountains surrounded by igneous rocks, dissected loess-covered basalt basins, undulating plateaus, and river breaklands— areas of steep rocky slopes and strongly dissected topography. Elevations range from 1,200 to 6,000 feet (366 to 1,830 meters), with increasing elevation approaching the mountains.

### **North Dakota badlands**



(NPS)

Most of this ecoregion lies in the rain shadow east of the Cascade Range and the Rocky Mountains. The climate is cold continental with warm, dry summers. The winters are extremely frigid and have desiccating winds and snow. A minimum of 10 inches (25 centimeters) falls during the year with an average maximum of 20 inches (51 centimeters) in both the northern and northwestern glaciated plains; in the northwestern Great Plains, precipitation drops to 15 inches (38 centimeters). Average temperatures in these areas range from 37 to 48 degrees Fahrenheit (3 to 7 degrees Celsius). The growing seasons vary in each area. The northern glaciated plains have a growing season of 110 to 135 days; the northwestern glaciated plains run 100 to 130 days; and the season for the northwestern Great Plains lasts 110 to 160 days.

The climate of the Palouse Prairie is temperate-warm with a maritime influence. Summers in this area are relatively dry; however, approximately 10 to 30 inches (25 to 76 centimeters) of precipitation is evenly distributed through the fall, winter, and spring. Precipitation during the winter usually falls as snow. The growing season in this area lasts about 100 to 170 days (Bailey, 1995).



Dry-land farming and raising livestock are the ecoregion's primary economic activities. At least 85 percent of the northwestern Great Plains and about 90 percent of the Palouse Prairie are used for farming and grazing of livestock (McNab and Avers, 1994). Much of the natural vegetation of the northern Great Plains has been altered for crop production and rangeland (Donofrio and Ojima, 1997).

### **1.6.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. "Intact habitat" or regionally significant habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Considerable potential exists for habitat recovery of areas with only partially modified grazing lands in this ecoregion. While little to no unaltered habitat remains, the potential for rapid recovery still exists since much of the habitat is degraded rather than converted. A few exotic species have invaded; however, most of the dominant plant species still grow on rangelands. Many of the plant species of this ecoregion have evolved to withstand intense grazing by bison (*Bison bison*). It is not surprising, therefore, that previously dominant plants still persist and are likely to become reestablished with restoration efforts.

Selected regionally significant blocks that represent this region and are somewhat intact include:

- Audubon National Wildlife Refuge—Central North Dakota;
- Bowdoin National Wildlife Refuge—Northern Montana;
- Charles M. Russell National Wildlife Refuge—Northern Montana;
- Comertown Pothole Prairie Preserve—Montana;
- H.R. Morgan State Nature Preserve—North Dakota;
- Little Missouri National Grassland—Western North Dakota;
- Lostwood National Wildlife Refuge—Northwest North Dakota;
- Lower Yellowstone River—Eastern Montana (the largest section of intact Missouri River, undammed, and with a population of endangered paddlefish);
- Medicine Lake National Wildlife Refuge—Northeastern Montana;
- Missouri Coteau—South-central North Dakota;
- Northern Montana Prairies—Montana;
- Pine Butte Swamp Preserve—Montana; and,
- Theodore Roosevelt National Park, within the Little Missouri National Grassland—Western North Dakota.

### 1.6.2 SENSITIVE HABITATS

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities that represent sensitive habitats. The sensitive habitats described here occur in many of the larger intact or somewhat intact habitat areas in the prior section, and are home to many of the threatened and endangered species in the next section. For example, the H.R. Morgan State Nature Preserve houses protected species such as the lady-fern (*Athyrium filix-femina*), as well as a wide variety of common plant species, such as big bluestem (*Andropogon gerardii*). Some site names, such as the steppe, include a range of habitats found across a large area and are more general.

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Steppe–Sometimes referred to as short-grass prairie; and,
- Brush prairie– Sagebrush and rabbitbrush, with mixed, short grasses, with many gradations or combinations of these low-height shrubs and grasses.

### 1.6.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species in this ecoregion. Many grassland species, such as the peregrine falcon (*Falco peregrinus*), sharp-tailed grouse (*Tympanuchus phasianellus*), swift fox (*Vulpes velox*), and Western hognose snake (*Heterodon nasicus*) are sensitive species in this ecoregion. Some fish and mussel species also occur in areas where the Missouri River reaches into the 100-mile project area. Some of these species include blue sucker (*Cyprinostomus elongatus*), flathead catfish (*Pylodictis olivaris*), flathead chub (*Platygobio gracilis*), threeridge (*Amblema plicata*), and the Wabash pigtoe (*Fusconaia flava*).

The whooping crane (*Grus americana*) is an endangered and highly monitored species in both Montana and North Dakota; the sandhill crane (*G. canadensis*) is monitored and endangered in Washington. Both species inhabit open marshes and wetlands during breeding season as well as grain fields, shallow lakes, and meadows during the winter and while migrating. They feed on mollusks, crustaceans, small vertebrates, and waste grain.

North Dakota uses a system that ranks species by greatest need of conservation from Level I (greatest need) to Level III (moderate need). Within these ranks, North Dakota also denotes the abundance of these species as rare, uncommon, fairly common, common, and abundant. Some federally endangered or threatened species may be listed as Level I, II, or III, depending on the current funding and recovery plan status of that species. For example, the piping plover is a Level II uncommon species in North Dakota, meaning that it has a recovery plan in effect but still has a moderate to high priority of conservation.

### Whooping crane



(USFWS)

The gray wolf (*Canis lupus*) is also an endangered species in this ecoregion. Since this wolf is a federally listed species and is designated as a rare Level III species in North Dakota, national forests and wildlife refuges have plans in place for either monitoring or furthering the recovery of wolf populations (or both). These plans are on the North Dakota Game and Fish Department website.

#### 1.6.4 WILDLIFE

Both game (legally hunted) and non-game (legally protected but not endangered or threatened) animals live in the prairies and grasslands of this ecoregion. Over 300 species of birds — especially insectivorous species—breed in, migrate through, or winter in this ecoregion. A wide variety of wildlife remains in the ecoregion throughout the year.

Waterfowl, herons, and shorebirds are among the important bird species in the wetlands of this ecoregion. They most commonly inhabit open marshes and prairie pothole wetlands (Igl and Johnson, 1998). Many common mammals, reptiles, and amphibians also make this ecoregion their home. Examples include the thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), pronghorn (*Antilocapra americana*), northern pocket gopher (*Thomomys talpoides*), coyote (*Canis latrans*), common garter snake (*Thamnophis sirtalis*), northern leopard frog (*Rana pipiens*), and the Great Plains toad (*Bufo cognatus*).

#### 1.6.5 VEGETATIVE HABITAT

Several sections are delineated in this ecoregion: the Palouse Prairie; northwestern Great Plains; and northern glaciated plains.

Grasses, including typical grassland and meadow-steppe vegetation, dominate the Palouse Prairie. Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) are prominent in the arid western portion. In areas of higher precipitation, Idaho fescue and common snowberry (*Symphoricarpos albus*) dominate; however, these areas are still too dry to support forest vegetation on the deep loamy soils. Agricultural crops have replaced much of the native vegetation of this region.

The northwestern Great Plains house a wider array of natural prairie species than other ecoregions of similar type. Along with the previously mentioned common species are basin wild-rye (*Elymus cinereus*) and buffalo grass (*Bouteloua dactyloides*). In the more-shallow soils, side-oats grama (*B. curtipendula*) may also grow. Buffaloberry (*Shepherdia* spp.), chokecherry (*Prunus virginiana*), and sagebrush (*Artemisia* spp.) are all common shrubs growing in draws and along streams. Ponderosa pine (*Pinus ponderosa*), juniper (*Juniperus communis*), and some aspen may also grow in this area of North Dakota. About 90 percent of this meadow-steppe and grassland has been converted to cropland.

The northern glaciated plains are characterized by a group of grassland species that includes western wheatgrass (*Pascopyrum smithii*), needle-and-thread (*Hesperostipa comata*), green needlegrass (*Nassella viridula*), and blue grama (*Bouteloua gracilis*). Areas with sloping or thinner soils support little bluestem (*Schizachyrium scoparium*). In wetter parcels, prairie cordgrass (*Spartina pectinata*), northern reedgrass (*Calamagrostis stricta*), and slim sedge (*Carex acuta*) occur. Western snowberry (*Symphoricarpos occidentalis*) and prairie rose (*Rosa arkansana*) are the common shrubs (McNab and Avers, 1994).

#### North Dakota grasslands



(National Geographic)

Examples of invasive plants include the following species: yellow starthistle (*Centaurea solstitialis*), dyer's woad (*Isatis tinctoria*), flowering rush (*Butomus umbellatus*), Japanese knotweed complex (*Fallopia japonica*), purple loosestrife (*Lythrum salicaria*), rush skeletonweed (*Chondrilla juncea*), Eurasian watermilfoil (*Myriophyllum spicatum*), Scotch broom (*Cytisus scoparius*), curly pondweed (*Potamogeton crispus*), tansy ragwort (*Senecio jacobaea*), meadow hawkweed complex (*Hieracium caespitosum*), orange hawkweed (*Pilosella aurantiaca*), tall buttercup (*Ranunculus acris*), perennial pepperweed (*Lepidium latifolium*), blueweed (*Echium vulgare*), and hoary alyssum (*Berteroa incana*) (Center for Invasive Plant Management, 2010). Non-native invasive plant species can negatively affect natural areas, agriculture, and horticulture (Simberloff, 1996).

#### 1.6.6 WETLANDS AND WATERWAYS

Wetlands within the Great Plains Steppe Ecoregion of the project area include approximately: 6,190 acres of primarily scrub-shrub as opposed to forested swamp; 692,945 acres of emergent wetlands, occurring primarily as depression wetlands; 34,325 acres of ponds; 166,535 acres of

lakes; and 7,875 acres of riverine habitats. Prairie pothole wetlands are the most common type (USDOI, 2010b).

Major rivers within the state of Montana include the Missouri River (a portion of the river in the project area is protected under the Wild and Scenic Rivers Act, as are the three forks of the Flathead River). In eastern Montana, close to the North Dakota border, the Missouri River (though not designated here as Wild and Scenic) lies within 100 miles of the border. The entire Missouri River, including this section in eastern Montana, is under scrutiny by the Army Corps of Engineers (ACOE) (Omaha District) to improve its natural functioning through the ACOE's Missouri River Recovery Program.

Several other major rivers cross the northern border, including the Milk River in Montana, which flows north into Canada. After 168 miles, it flows back south across the northern border into eastern Montana. The St. Mary River originates in the alpine areas of Glacier National Park and flows through several large lakes in Montana and north into Canada. Other major rivers in the project area include the Marias River in Montana and North Dakota (it flows into the Wild and Scenic portion of the Missouri River), the Little Muddy and White Earth in North Dakota, the Yellowstone in both North Dakota and Montana, and the Judith and Teton rivers in Montana.

Further east in Montana are Lake Bowdoin on the Bowdoin National Wildlife Reserve and Medicine Lake, part of the Medicine Lake National Wildlife Refuge. Major reservoirs in Montana in the project area include the Tiber, Fresno, Lake Frances, and Nelson.

#### **Bowdoin National Wildlife Reserve**



(USFWS)

### **1.6.7 AQUATIC RESOURCES**

Several different types of aquatic resources occur across the northern glaciated plains, northwestern glaciated plains, and northwestern Great Plains of this ecoregion. In the northern glaciated plains, low-to-medium density, dendritic drainage leads to more complex, high-density drainage southeast through the northwestern glaciated plains in North Dakota, and into the northwestern Great Plains of North Dakota and Montana. The high-density, dendritic, drainage in the northwestern glaciated plains typically occurs in areas of exposed marine shales, leading towards the northwestern Great Plains where the high-density, first-order streams feed into long, structurally controlled second and third-order streams with low gradients.

The paddlefish (*Polyodon spathula*) is a primary large fish species of concern in the Missouri River of Montana and North Dakota. The cause of decline for this species is loss of habitat due to channelization and impoundment.

Fishing is important on the major rivers of this region; it is also an important activity on the reservoirs along the Missouri River, with these species of interest throughout the ecoregion: walleye (*Sander vitreus*), northern pike (*Esox lucius*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieu*), and paddlefish. Data for walleye at Fort Peck Lake, a large reservoir on the Missouri River, demonstrate the importance of the fishery. Approximately 40 million young walleyes are stocked in Montana annually (Montana Outdoors, 2006). The Montana Department of Fish, Wildlife & Parks manages the Fort Peck Reservoir fishery. Nearly 50 species of fish live in the reservoir, most of which are native to the Missouri River. Sixteen introduced species, mostly game fish, have been planted to enhance the fishing (MTFWP, 2002).

## **1.7 GREAT PLAINS STEPPE ECOREGION (332)**

The Great Plains Steppe Ecoregion consists of flat and rolling plains with a relief of less than 300 feet (90 meters) (Figure L-3). Elevations in this ecoregion range between 700 feet (214 meters) and 2,300 feet (704 meters). Glaciers covered this area during parts of the Pleistocene Epoch.

The state in this portion of the ecoregion is North Dakota.

The Great Plains Steppe Ecoregion, which encompasses much of central and northern North Dakota, is covered by nearly level to rolling glacial till and lake plains with steep slopes adjacent to rivers and streams and areas of pothole lakes. The sub-humid conditions give rise to a broad region of grassland transitional between tallgrass and short-grass prairie (Bailey, 1995). Extensive concentrations of temporary and seasonal wetlands create favorable conditions for waterfowl nesting and migratory stopover habitats. Though the glacial-till-derived soil is quite fertile, agricultural production varies due to annual climatic fluctuations. Much of the ecoregion has shifted to agriculture, and relatively few areas of native grassland remain outside of wildlife refuges or nature preserves—either federally or state-owned or in private ownership, such as The Nature Conservancy.

This ecoregion is intermediate in growing season length, vegetation structure, and rainfall with drier conditions persisting to the west and the more-moist tallgrass prairie to the east and southeast. Climate separates this region from the Central and Southern Mixed Grasslands; these more southerly ecotypes are characterized by warmer climates and longer growing seasons. The climate in the Great Plains Steppe has warm summers followed by cold winters, much as in the Great Plains–Palouse Dry Steppe Ecoregion to the west. Average temperatures typically range between 36 and 45 degrees Fahrenheit (2 to 7 degrees Celsius). Average precipitation in this area is 15 to 20 inches (38 to 51 centimeters) per year with more than half falling during the 100 to 140-day growing season. The rest of the precipitation usually falls as snow. Naturally occurring droughts and fires also take place—both of which play important roles in determining native vegetation (Bailey, 1995).



## Bison



(USFWS)

Fire regimes dramatically influenced the original development of northern Great Plains vegetation. Variation in precipitation across the region also determines the growth and expanse of trees and shrubs, shaping the grass-dominated native vegetation in areas where agriculture does not take place. In the short-grass and mixed-grass portions of the region, woody plants are primarily restricted to areas of higher elevation and areas with higher precipitation, including both riparian zones and north-facing slopes. Fire suppression has allowed woody plants to encroach in some areas where they did not exist for many centuries (Higgins et al., 2006).

### 1.7.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. Regionally significant or intact habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Turtle Mountain–Northern North Dakota/southern Manitoba, on the border of the ecoregion;
- J. Clark Salyer National Wildlife Refuge–North-central North Dakota;
- Pembina Gorge–Northeastern North Dakota;
- Mirror Pool Wildlife Management Area–Eastern North Dakota;
- Oakville Prairie–Eastern North Dakota;
- Sully’s Hill National Game Preserve–Eastern North Dakota;
- Forest River Biology Area–Eastern North Dakota; and,
- Gunlogson Arboretum Nature Preserve–Northeastern North Dakota.

### **Sandhill cranes (*Grus canadensis*)**

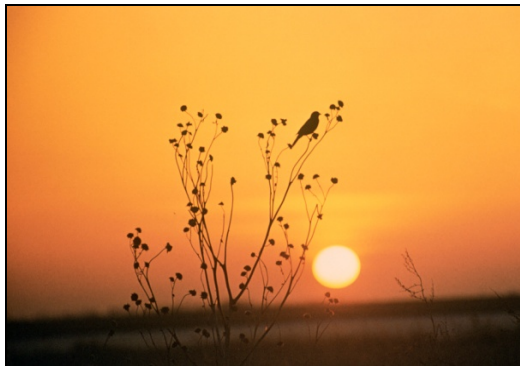


(USFWS)

## **1.7.2 SENSITIVE HABITATS**

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities that represent sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section, and are home to many of the threatened and endangered species in the next section. For example, Eastern Great Plains Tallgrass Aspen Parkland houses protected species, such as the western prairie fringed orchid (*Platanthera praeclara*), as well as a wide variety of common plant species, such as little bluestem (*Schizachyrium scoparium*). The habitat names used below, such as Northwestern Great Plains Mixed-grass Prairie, describe habitats found among very diverse areas of regional boundaries and represent specific ecological associations.

### **Tallgrass prairie**



(USFWS)

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Northwestern Great Plains Mixed-grass Prairie – Grassland type of medium-height grasses on fine-textured and well-drained soils;

- Eastern Great Plains Tallgrass Aspen Parkland–Mosaic or combination of tallgrass prairie, brush prairie, aspen-oak mixed woodlands, and wet prairie;
- Eastern Great Plains Wet Meadow, Prairie and Marsh–Distinguished from upland prairie systems by having seasonal inundation (wetlands with near-surface groundwater), in conjunction with silty, dense-clay, often hydric soils; and,
- Great Plains Sand Prairie–Often considered part of the tallgrass or mixed-grass regions in the Great Plains, with a mixture of elements from the Western Great Plains Short-grass Prairie, Central Mixed-grass Prairie, and Northwestern Great Plains Mixed-grass Prairie and soils derived from sandstone weathering.

Few extensive areas of native grassland still exist and these are relatively small compared to their original extent; for these reasons alone, the grasslands are threatened and of high ecological value. Conversion of native grassland to agriculture has been widespread throughout all Great Plains regions (WWF, 2001).

### 1.7.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species within this ecoregion. Many important grassland and wetland habitat species are sensitive to disturbance, including the whooping crane (*Grus americana*), peregrine falcon (*Falco peregrines*), and the Nelson’s sharp-tailed sparrow (*Ammodramus nelsoni*).

**Nelson’s sharp-tailed sparrow**



(Avian Research & Education Institute)

The gray wolf (*Canis lupus*) is an example of a rare species in North Dakota. Since this wolf is a federally listed species and is designated a rare Level III species in North Dakota, national forests and wildlife refuges already have plans in place for monitoring or recovery of wolf populations (or both). These plans are on the North Dakota Game and Fish Department website.

North Dakota uses a system that ranks species by the greatest need of conservation from Level I (greatest need) to Level III (moderate need). Within these ranks, North Dakota also designates the abundance of these species as rare, uncommon, fairly common, common, or abundant. Some federally endangered and threatened species may be listed in Level I, II, or III, depending on the current funding and recovery plan status of that particular species. For example, the piping

plover is listed as a Level II uncommon species in North Dakota, meaning that it has a recovery plan in effect, but still has a moderate to high priority of conservation.

#### **1.7.4 WILDLIFE**

Many birds, especially insectivorous species, migrate through this ecoregion twice each year. Some species, such as the greater prairie-chicken (*Tympanuchus cupido*), are year-round permanent residents. While the greater prairie-chicken is not threatened or endangered in North Dakota, it is an important bird in this ecoregion, with its populations in flux. An experimental hunting season has been held periodically, although it was closed for 2010. The wetlands and prairie grasslands in this ecoregion are home to a variety of wildlife, including both game (legally hunted) and non-game (legally protected but not endangered or threatened and not hunted) species.

Large game animals, such as deer, moose (*Alces alces*), elk (*Cervus canadensis*), and mountain lion (*Pumas concolor*), live in this ecoregion. The long-eared myotis bat (*Myotis evotis*), long-legged myotis bat (*M. volans*), northern prairie skink (*Eumeces septentrionalis*), silver chub (*Macrhybopsis storeriana*), pearl dace (*Margariscus margarita*), northern redbelly snake (*Storeria occipitomaculata*), yellow rail (*Coturnicops noveboracensis*), black-billed cuckoo (*Coccyzus erythrophthalmus*), and red-headed woodpecker (*Melanerpes erythrocephalus*) are other sensitive species in this ecoregion.

#### **1.7.5 VEGETATIVE HABITAT**

Vegetative cover within the Great Plains Steppe Ecoregion is dominated by nearly level and rolling plains habitats. Most of this land consists of young glacial drift and dissected till plains. Typical vegetative cover consists of various tall and short grasses, including little bluestem (*Schizachyrium scoparium*) and blue grama (*Bouteloua gracilis*). Other species include buffalograss (*B. dactyloides*), needle-and-thread grass (*Hesperostipa comata*), galleta (*Pleuraphis jamesii*), sunflower (*Helianthus annuus*), and goldenrods (*Solidago* spp.). Wetlands in this ecoregion include pothole lakes and streams where Kentucky bluegrass (*Poa pratensis*), Canada anemone (*Anemone canadensis*), and northern reedgrass (*Calamagrostis stricta*) thrive (Stewart and Kantrudi, 1972).

## Sunflower



(Missouri Plants)

Common invasive species of concern include saltcedar (*Tamarix* spp.), garlic mustard (*Alliaria petiolata*), Eurasian watermilfoil (*Myriophyllum spicatum*), Russian knapweed (*Acroptilon repens*), spotted knapweed (*Centaurea maculosa*), bull thistle (*Cirsium vulgare*), yellow sweet clover (*Melilotus officinalis*), reed canary grass (*Phalaris arundinacea*), curly pondweed (*Potamogeton crispus*), Siberian elm (*Ulmus pumila*), puncturevine (*Tribulus terrestris*), and black medic (*Medicago lupulina*) among others. New invasive species likely to become problems include orange hawkweed (*Pilosella aurantiaca*), meadow hawkweed (*Hieracium caespitosum*), two-leaf watermilfoil (*M. heterophyllum*), buckthorn (*Rhamnus* spp.), hybrid cattail (*Typha angustifolia*), Japanese knotweed (*Fallopia japonica*), and giant knotweed (*F. sachalinensis*) (Center for Invasive Plant Management, 2010; USDA, 2003a). The North Dakota Century Code lists at least seven noxious weeds in northern North Dakota counties, including Canada thistle (*C. arvense*), leafy spurge (*Euphorbia esula*), Russian knapweed, and spotted knapweed).

### 1.7.6 WETLANDS AND WATERWAYS

Wetlands within the Great Plains Steppe Ecoregion portion of the project area include approximately: 6,190 acres of primarily scrub-shrub as opposed to forested swamp; 692,945 acres of emergent wetlands, occurring primarily as depression wetlands; 34,325 acres of ponds; 166,535 acres of lakes; and 7,875 acres of riverine habitats. Prairie pothole wetlands are the most common type (USDOI, 2010b).

### Yellow-headed blackbird



(USFWS)

Of the relatively few major rivers in the ecoregion, the Des Lacs, Souris, and Sheyenne are the largest. Devils Lake, the largest lake in the 100-mile section south of the northern border, remains important to nesting wetland birds, especially the American white pelican (*Pelecanus erythrorhynchos*), which has a very large nesting colony here.

#### 1.7.7 AQUATIC RESOURCES

Aquatic resources are highly regarded within the Great Plains Steppe Ecoregion, luring hunters, anglers, and camping enthusiasts from all over the United States due to the abundance of ducks and other waterfowl.

The aquatic resources of the ecoregion support a diverse fishery. Notable fish species include walleye (*Sander vitreus*), perch (*Perca* spp.), and paddlefish (*Polyodon spathula*). Various native reptiles, amphibians, water birds, aquatic insects, mussels, and crustaceans also thrive in these waters.

Accidental introductions of invasive species create negative impacts on aquatic resources, damaging fisheries and native habitats. Common invasive aquatic plant species of concern include two-leaf watermilfoil (*Myriophyllum heterophyllum*), Eurasian watermilfoil (*M. spicatum*), hybrid cattail (*Typha x glauca*), reed canary grass (*Phalaris arundinacea*), curly pondweed (*Potamogeton crispus*), and Brazilian waterweed (also known as Brazilian elodea, *Egeria densa*). Invasive animal species of concern, called aquatic nuisance species, listed in North Dakota, include the grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), and rusty crayfish (*Orconectes rusticus*). The North Dakota Game and Fish Department also lists several species found close to North Dakota currently being watched for in wetlands, rivers, and lakes. These species include the round goby (*Neogobius melanostomus*), silver carp (*Hypophthalmichthys molitrix*), Asian clam (*Corbicula fluminea*), and spiny water flea (*Bythotrephes longimanus*) (USDA, 2003b).

#### 1.8 PRAIRIE PARKLAND (TEMPERATE) ECOREGION (251)

The Prairie Parkland (Temperate) Ecoregion is a formerly glaciated area with gently rolling plains and steep bluffs bordering the valleys (Figure L-3). Most of this area consists of alternating prairie and deciduous forest. Elevation ranges from 825 to 1,150 feet (250 to 350 meters) with a local relief of 3 to 25 feet (1 to 8 meters).



States in this ecoregion include Minnesota and North Dakota.

The Prairie Parkland (Temperate) Ecoregion has areas of intermingled prairie with deciduous forests near streams and on north-facing slopes. The forest cover consists of an oak-hickory association and prairies composed primarily of grasses. Aquatic resources include streams, wetlands, and dunes with a few lakes. Part of this province has limestone bedrock covered by thin soils that do not support tree growth; however, the floodplains and moist hillsides can support deciduous forests. Tall grasses are prominent and usually grow in bunches. Many of the prairies in this ecoregion appear to be areas that have not yet become forested. The Red River Valley, adjacent to the Red River separating Minnesota from North Dakota, has alluvial fans in the west where rivers once entered the glacial lakes. Beach and moraine ridges border the east.

Agriculture is the primary economic activity in this ecoregion and has replaced most areas of native prairie. The Red River Valley contains fertile soils, the building blocks of which were deposited by meltwater from Glacial Lake Agassiz. In the till plains, especially in the central dissected areas, about half of the land has been altered for agricultural use.

Summers are usually hot in the Red River Valley; the winters are particularly cold. The mean annual temperature ranges from 36 to 45 degrees Fahrenheit (2 to 7 degrees Celsius) with an average of 18 to 23 inches (47 to 58 centimeters) of precipitation. About 40 percent of this falls during the 111 to 136-day growing period. Precipitation during winter comes almost entirely from snow.

### **1.8.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. Regionally significant or intact habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

In this province, no large blocks of intact habitat remain in this ecoregion within 100 miles of the northern border. Most original native tallgrass prairies have been converted to cropland. A few areas of limited size include:

- Agassiz Beach Ridges—Northwestern Minnesota, fragmented glacial lake ridges;
- Pembina Trail Preserve—Western Minnesota; and,
- Malmberg Prairie—Western Minnesota.

### **1.8.2 SENSITIVE HABITATS**

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities representing sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section and are home to many of the threatened and endangered species in the next section. For example, prairie potholes occur in many grassy areas in this geographic region and house species such as the big bluestem (*Andropogon gerardii*) and Indian grass (*Sorghastrum nutans*). Some habitat names used below, such as wooded areas, describe

habitats found across regional boundaries and are more general in meaning. Others, such as the Red River Valley shoreline (an area of fertile soils), define much more specific ecological associations.

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- The Red River Valley shoreline—Area of fertile soils adjacent to the Red River that is subject to flooding;
- Prairie Potholes—Water-holding depressions of glacial origin, primary wetland habitat;
- Wooded areas—Commonly found on moist hillsides;
- Shorelines/dunes/cliffs/talus/rock outcrops—Sparsely vegetated native plant communities;
- Icelandic State Park—North Dakota; and,
- Bluestem Prairie Scientific and Natural Area—Native prairie that once covered a large area of western Minnesota and the Dakotas (The Nature Conservancy, 2010c).

#### **An aerial view of prairie potholes**



(NASA)

### **1.8.3 THREATENED AND ENDANGERED SPECIES**

Appendix F3 lists the threatened and endangered species within this ecoregional province.

Additional wildlife species sensitive to habitat loss include the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), loggerhead shrike (*Lanius ludovicianus*), and burrowing owl (*Athene cunicularia*), gray wolf (*Canis lupus*), and Canada lynx (*Lynx canadensis*), along with an array of invertebrate, mussel, and plant species. The piping plover is an example of a species with existing plans for monitoring or recovery. Both North Dakota and Minnesota list this bird as a federally threatened species since it is not part of the Great Lakes watershed in this ecoregion.

North Dakota uses a different system to rank species in greatest need of conservation from Level I (greatest need) to Level III (moderate need). Within these ranks, North Dakota also states the abundance of the species as rare, uncommon, fairly common, common, and abundant. Some federally endangered or threatened species may be listed in Level I, II, or III, depending on the current funding and recovery plan status of that particular species. For example, the piping plover is a Level II uncommon species in North Dakota, meaning it has a recovery plan in effect, but still has a moderate to high priority of conservation.

#### 1.8.4 WILDLIFE

Many birds, especially waterfowl such as the northern pintail (*Anas acuta*), green-winged teal (*A. crecca*), and American wigeon (*A. americana*), and songbirds, such as the chestnut-collared longspur (*Calcarius ornatus*), migrate through this province twice each year. Some other birds, mammals, reptiles, and amphibians remain in the province year-round. Species such as the canvasback (*Aythya valisineria*), while not threatened or endangered in Minnesota or North Dakota, could be affected by diminishing wetland habitat. The prairie pothole wetlands and grasslands in this ecoregion are home to a variety of wildlife species, including both game (legally hunted) and non-game (legally protected but not endangered or threatened and not hunted) species. Hunting remains an important economic activity (North Dakota Game and Fish Department, 2010).

Although not listed as endangered or threatened at either the Federal or state level, some rare or non-endangered or threatened species are categorized differently. Those species of “conservation concern” or “special concern” are potentially highly vulnerable to some activities. The marbled godwit (*Limosa fedoa*), black tern (*Chlidonias niger*), loggerhead shrike (*Lanius ludovicianus*), northern goshawk (*Accipiter gentilis*), and black-backed woodpecker (*Picoides arcticus*), lake sturgeon (*Acipenser fulvescens*), gophersnake (*Pituophis catenifer*), and the plains pocket gopher (*Geomys bursarius*) are some of these sensitive species.

##### Black tern



(Idaho Fish and Game)

Many fish, mammals, reptiles, and amphibians live in these areas, as well. The river otter (*Lontra canadensis*), white-tailed deer (*Odocoileus virginianus*), channel catfish (*Ictalurus punctatus*), lake sturgeon (*Acipenser fulvescens*), Canadian Toad (*Bufo hemiophrys*), common snapping turtle (*Chelydra serpentina*), and the northern redbelly snake (*Storeria occipitomaculata occipitomaculata*) are representative.

### 1.8.5 VEGETATIVE HABITAT

Vegetative cover within the Prairie Parkland (Temperate) Province is dominated by tallgrass prairie and some riparian deciduous forest habitats in areas where native plants persist. Typical grassland cover includes big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), and Indian grass (*Sorghastrum nutans*). Extensive areas of prairie-pothole wetlands and oak-hickory forests still remain. The original vegetation was primarily a mosaic of bluestem-dominated prairie grassland and oak-hickory forest, with the oak-hickory forest growing along rivers and streams. An estimated 60 percent of the land surface was bluestem (tallgrass) prairie, with bur oak (*Quercus macrocarpa*) and white oak (*Q. alba*) savannas interspersed and in transitional areas. Upland forest (white oak-shagbark hickory) occurred on more-dissected land, grading into bottomland forests and wet bottomland prairies along rivers.

**Big bluestem**



(University of British Columbia Botanical Garden)

Glacial Lake Agassiz was the last in a series of pro-glacial lakes to fill the Red River Valley. Thick beds of lake sediments on top of glacial till created the flat Lake Agassiz plain. Intensive row-crop agriculture has replaced the historic tallgrass prairie. The Red River Valley drains to the north; the area is flat, dry, and quite fire prone. Wooded communities grow only in the deepest river valleys. Marsh and wet meadow communities occupy river bottoms and shallow depressions.

Examples of invasive species of concern that cause problems for the natural biodiversity in this ecoregion include Russian knapweed (*Acroptilon repens*), absinth wormwood (*Artemisia absinthium*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*) (also known as nodding thistle), flowering rush (*Butomus umbellatus*), purple loosestrife (*Lythrum salicaria*), leafy spurge (*Euphorbia esula*), yellow star-thistle (*Centaurea solstitialis*), diffuse knapweed (*C. diffusa*), yellow toadflax (*Linaria vulgaris*), and spotted knapweed (*Centaurea maculosa*). Some new invasive species are Brazilian elodea (also known as Brazilian waterweed, *Egeria densa*), Eurasian watermilfoil (*Myriophyllum spicatum*), and yellow flag iris (*Iris pseudacorus*).

(Center for Invasive Plant Management, 2010; MNDNR, 2009; NRCS, 2003). Non-native invasive plant species can affect natural areas, agriculture, forestry, and horticulture negatively (Simberloff, 1996). Invasive aquatic species pose a similar threat to aquatic resources (USDA, 2010).

### **1.8.6 WETLANDS AND WATERWAYS**

Wetlands within the Prairie Parkland Temperate Ecoregion portion of the project area include approximately: 89,245 acres of forested and scrub-shrub wetlands; 72,635 acres of emergent wetlands; 39,450 acres of lakes; 13,330 acres of ponds; and 33,845 acres of riverine habitats (USDOL, 2010b). The wetlands are generally smaller and scattered, sitting in isolated depressions known as prairie potholes. Swamps tend to be scrub-shrub swamps rather than forested.

#### **Scrub-shrub wetland**



(Wisconsin Dept. of Natural Resources)

This region has high concentrations of temporary and seasonal emergent pothole and kettle wetlands that create favorable conditions for duck nesting and migration (Bryce et al., 1996; Woods et al., 2002). Flat plains with lakes, pothole and kettle wetlands, and ponds occur in the area to the west of the Red River Valley.

### **1.8.7 AQUATIC RESOURCES**

Aquatic resources are highly regarded within the Prairie Parkland (Temperate) Ecoregion. Wetlands with rivers and tributaries, along with small lakes, form the dominant aquatic features of this landscape. Many of the original wetlands in this area, however, have been drained for agricultural use. The remaining resources lure hunting and fishing enthusiasts. Many migratory game bird species also use the Red River Valley; abundant fish live in the Red River. Mollusks are well represented in the aquatic habitats (Northern Prairie Wildlife Resource Center, 2006) with 44 species accounted for with mapped ranges.

These aquatic resources support a diverse fishery. Notable fish species include channel catfish (*Ictalurus punctatus*), walleye (*Sander vitreus*), largemouth bass (*Micropterus salmoides*), rock bass (*Ambloplites rupestris*), and lake sturgeon (*Acipenser fulvescens*). The Red River has



become internationally renowned for its trophy-size catfish. International anglers also fish for carp, a common and highly desirable game fish in many parts of the world. A variety of native reptiles, amphibians, birds, aquatic insects, mussels, and crustaceans also thrive in and around these waters. The Canadian toad (*Bufo hemiophrys*), snapping turtle (*Chelydra serpentina*), northern prairie skink (*Eumeces septentrionalis*), smooth green snake (*Opheodrys vernalis*), silver-spotted skipper (*Hesperia comma*), sleepy duskywing (*Erynnis propertius*), great blue heron (*Ardea herodias*), killdeer (*Charadrius vociferous*), three-ridge mussel (*Amblema neislerii*), and giant floater mussel (*Pyganodon grandis*) are all species of aquatic habitats in this area, especially around the Red River.

### Snapping turtle



(USGS)

Common invasive plant species of concern include Eurasian watermilfoil (*Myriophyllum spicatum*), reed canary grass (*Phalaris arundinacea*), curly pondweed (*Potamogeton crispus*), and flowering rush (*Butomus umbellatus*). Invasive animal species of concern may include zebra mussel (*Dreissena polymorpha*) (recently found in the Red River, although south of the 100-mile buffer area), goldfish (*Carassius auratus auratus*), and rusty crayfish (*Orconectes rusticus*), among others.



## **1.9 EASTERN BROADLEAF FOREST (CONTINENTAL) ECOREGION (222)**

The Eastern Broadleaf Forest (Continental) Ecoregion is a deciduous forest with rolling hills and nearly flat areas (Figure L-3). Savanna-like in the northwesternmost region of Minnesota, it is dominated by drought-resistant oak-hickory forest. To the south, increasingly large areas of beech-maple forests inhabit formerly glaciated areas, such as Ohio. Glaciers once covered most of this area. Elevations range from 80 to 1,650 feet (24 to 502 meters) above sea level.

States in this ecoregion include New York, Pennsylvania, Ohio, Michigan, and Minnesota.

The Eastern Broadleaf Forest (Continental) Province is dominated by deciduous forest, favoring a drought-resistant oak-hickory association due to lower amounts of precipitation. Some formerly glaciated areas throughout the region have beech-maple forests where greater rainfall occurs. In these areas, oak and hickory grow on poorer sites with low fertility levels.

Silviculture is one of the dominant economic activities in the midwestern states of this province, especially in Minnesota and Michigan. These forests range from the cool, nearly boreal forests of northern Minnesota to the warm, oak-hickory forests of southern Michigan, and span both the Laurentian Mixed Forest and the Eastern Broadleaf Forest (Continental) ecoregions.

This ecoregion shares many characteristics with the oceanic broadleaf forest to the east; however, precipitation decreases in quantity and effectiveness inland. The average annual temperature in the northern portions is 40 degrees Fahrenheit (4 degrees Celsius) with 65 degrees Fahrenheit (18 degrees Celsius) as an average in the south. Summers are typically very warm, and this region experiences frequent tornadoes. Precipitation ranges from about 20 inches (51 centimeters) in northwestern Minnesota to approximately 40 inches (102 centimeters) annually in Ohio (Bailey, 1995).

### **1.9.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. Regionally significant or intact habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Hayes Lake State Park–Northern Minnesota;
- Zippel Bay State Park–Northern Minnesota;
- Garden Island State Recreation Area–Northern Minnesota;
- Seven Lakes State Park–Southeastern Michigan;
- Maybury State Park–Southeastern Michigan;
- Van Buren Lake State Park–Northern Ohio; and,

- Lake Erie Islands State Park –Northern Ohio.

### 1.9.2 SENSITIVE HABITATS

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities representing sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section and are home to many of the threatened and endangered species in the next section. For example, hardwood swamps exist in many forested areas in this broad geographic region where species such as green ash (*Fraxinus pennsylvanica*) and cattail sedge (*Carex typhina*), as well as a wide variety of other common plant species, such as sphagnum mosses (*Sphagnum* spp.), live. Some habitat names, such as hardwood swamp, describe habitats found across several regional boundaries and are more general in meaning. Others, such as Great Lakes shorelines (a type of wetland plant community), define much more specific ecological associations.

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Inland lake shorelines–Inland lakes with fluctuating water levels and specialized biota adapted to sandy or gravelly habitats;
- Great Lakes shorelines–Adjacent to margins of lakes Huron, Erie, and Ontario;
- Hardwood swamps–Dominated by trees with deciduous leaves;
- Wetlands–Marshes, swamps, or bogs characterized by wetness, soils, and specific vegetation;
- Prairies–Predominately treeless grasslands;
- Natural arches and bridges–Naturally formed bridges, such as Rockbridge in Ohio; and,
- Freshwater estuaries–Especially along the Great Lakes where lake waters meet river mouths.

#### Hardwood swamp



(Michigan State University)

### 1.9.3 THREATENED AND ENDANGERED SPECIES

Appendix M lists the threatened and endangered species in this ecoregion. An example of a state threatened or endangered species within this province that may be disturbed by human activity is the peregrine falcon (*Falco peregrinus*), which is listed as state endangered in Minnesota and Ohio and threatened in Michigan and New York. These falcons prefer open habitats around water, with tall cliffs where they nest on ledges jutting from bare, steep rock walls. Since the young are completely dependent on their parents, any disturbance during the breeding season may decrease nesting sites and local populations.

The piping plover (*Charadrius melodus*), a federally listed species, also occurs in this region. The piping plover offers a primary example of the interaction between threatened and endangered species and human activities. Since the piping plover is federally listed, wildlife refuges already have plans in place for monitoring or recovery of the piping plover's populations.

Other federally listed species in this province live in forested areas near lakeshores and marshes, including other bird species, such as the merlin (*Falco columbarius*), osprey (*Pandion haliaetus*), and whooping crane (*Grus americana*). Other mammals, reptiles, and insects also occur in these habitats, such as the Indiana bat (*Myotis sodalists*), bog turtle (*Glyptemys muhlenbergii*), and Karner blue butterfly (*Lycaeides melissa samuelis*), along with many species of mussels.

#### Whooping crane



(USFWS)

Although some species are listed as endangered or threatened at either the Federal or state level, others are categorized differently as species of “conservation concern” or “special concern.”

### 1.9.4 WILDLIFE

Both game (legally hunted) and non-game (legally protected, but not threatened or endangered) animals make their homes in the primary forests and wetlands of this ecoregion. Insectivorous species, among other birds, migrate into or out of this province twice each year. This province also contains a wide variety of year-round wildlife residents. Over 350 species of birds breed in, migrate through, or winter in this ecoregion (NYSOS, 2010).

The coniferous forests house numerous species. Some of the mammals include white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), fox, shrews, and squirrel. Common

amphibians include the spotted salamander (*Ambystoma maculatum*) and the American toad (*Bufo americanus*).

Broadleaf forests are rich in wildlife diversity. Red (*Tamiasciurus hudsonicus*), gray (*Sciurus carolinensis*), and fox squirrels (*S. niger*) as well as eastern chipmunk (*Tamias striatus*) are locally abundant. Various songbirds, woodpeckers, and owls also live in these forests, which provide good shelter, nesting, and foraging habitat.

### 1.9.5 VEGETATIVE HABITAT

Vegetative cover within the Eastern Broadleaf Forest Province is dominated by forested habitats, but also includes grasslands and wetlands. Typical cover consists mainly of oak-hickory forests with increasing numbers of maple-beech forests. Wetter sites can include elm (*Ulmus* spp.) and tulip tree (*Liriodendron tulipifera*). This province typically has a well-developed understory of flowering dogwood (*Cornus florida*), sassafras (*Sassafras albidum*), and hophornbeam (*Ostrya virginiana*), along with other shrubs, evergreens, and wildflowers. Existing wetland types include cattail marshes, wooded wetlands and swamps, and wet meadows (EOE, 2009).

**Tulip tree flowers**



(University of British Columbia Botanical Garden)

Land alterations have greatly affected oak trees (*Quercus* spp.) in this province. Changes due to climate, land use, and natural area disturbance have all contributed to the decline of white oak (*Q. alba*) trees (Abrams, 2003). Northern red (*Q. rubra*) and chestnut oaks (*Q. prinus*) have replaced white oaks in these areas; however, red oaks are more susceptible to a pathogen known as sudden oak death (*Phytophthora ramorum*) (McShea et al., 2007).

Common invasive species of concern include garlic mustard (*Alliaria petiolata*), honeysuckle (*Lonicera* spp.), common (*Rhamnus cathartica*) and glossy buckthorn (*R. frangula*), orange hawkweed (*Hieracium lachenalii*), common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), and Canada thistle (*Cirsium arvense*) among others.

New invasive species to watch for include autumn olive (*Elaeagnus umbellata*), leafy spurge (*Euphorbia esula*), giant hogweed (*Heracleum mantegazzianum*), Japanese knotweed (*Polygonum cuspidatum*), giant knotweed (*P. sachalinense*), and garden valerian (*Valeriana officinalis*) (Center for Invasive Plant Management, 2010; MNDNR, 2009; USDA, 2003a). For example, Minnesota has a list of prohibited invasive species, which includes the European wild

boar and a list of regulated invasive species, including the koi (*Cyprinus carpio*), goldfish (*Carassius auratus auratus*), rusty crayfish (*Orconectes rusticus*), and mute swan (*Cygnus olor*).

### 1.9.6 WETLANDS AND WATERWAYS

Wetlands within the Eastern Broadleaf Forest (Continental) Province portion of the project area include approximately: 2,316,695 acres of forested and scrub-shrub wetlands; 946,175 acres of emergent wetlands; 4,280,190 acres of lakes; 205,830 acres of ponds; and 174,395 acres of riverine habitats (USDOI, 2010b). All types of wetlands are prevalent, but lake habitat is especially abundant because this ecoregion encompasses shoreline along four of the five Great Lakes.

Major rivers include the Grand, Cuyahoga, Sandusky, and Maumee in Ohio, the Shiawassee in Michigan, and the Upper Mississippi, Crow Wing, and Rum in Minnesota. Numerous smaller rivers, streams, and tributaries flow through the area. In addition to the Great Lakes, numerous smaller lakes and ponds also dot the region.

### 1.9.7 AQUATIC RESOURCES

Aquatic resources are of high quality in the Eastern Broadleaf Province. Abundant lakes, rivers, ponds, and wetlands constitute dominant features of the landscape. Four of the Great Lakes border this province: Michigan, Huron, Erie, and Ontario. These resources attract many outdoor enthusiasts for hunting, fishing, and camping.

Many wetland habitats in this region have been disturbed, largely due to agricultural land use practices and urbanization. Wetlands are especially sensitive to disturbances, such as channelization and ditching.

The aquatic resources of this region support a diverse fishery. Notable fish species include walleye (*Sander vitreus*), northern pike (*Esox lucius*), muskellunge (*E. masquinongy*) the non-native coho (*Oncorhynchus kisutch*) and chinook salmon (*O. tshawytscha*), smallmouth (*Micropterus dolomieu*) and largemouth bass (*M. salmoides*), brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), yellow perch (*Perca flavescens*), and emerald shiner (*Notropis atherinoides*). Habitat for sunfish (*Lepomis* spp.), and mudminnows (*Umbra* spp.) also exists. A variety of native reptiles, amphibians, waterbirds, aquatic insects, mussels, and crustaceans thrive in these waters and wetlands.

#### Zebra mussels



(University of Michigan)

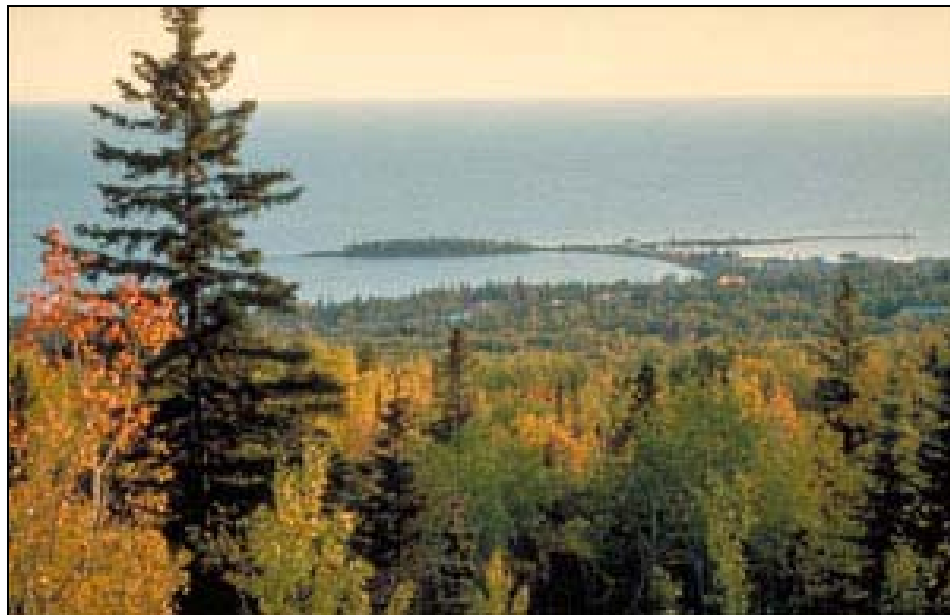
Accidental introductions of invasive species have serious impacts on aquatic resources, damaging fisheries and native habitats. These species pose a great threat to both aquatic and terrestrial resources (USDA, 2010). Common invasive plants of concern include marsh thistle (*Cirsium palustre*), purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), curly pondweed (*Potamogeton crispus*), and flowering rush (*Butomus umbellatus*). Invasive aquatic animal species of concern include the rusty crayfish (*Orconectes rusticus*), sea lamprey (*Petromyzon marinus*), round goby (*Neogobius melanostomus*), zebra mussel (*Dreissena polymorpha*), and quagga mussel (*D. rostriformis bugensis*) among others.

## **1.10 LAURENTIAN MIXED FOREST ECOREGION (212)**

The Laurentian Mixed Forest Ecoregion forms a “transition zone” between true boreal forest to the north (predominately coniferous northern forest type) and broad-leaved deciduous forest ecoregions to the south (Figure L-3, Figure L-4, and Figure L-5). It incorporates some characteristics of each.

States in this ecoregion include Maine, Vermont, New York, Pennsylvania, Michigan, Wisconsin, and Minnesota.

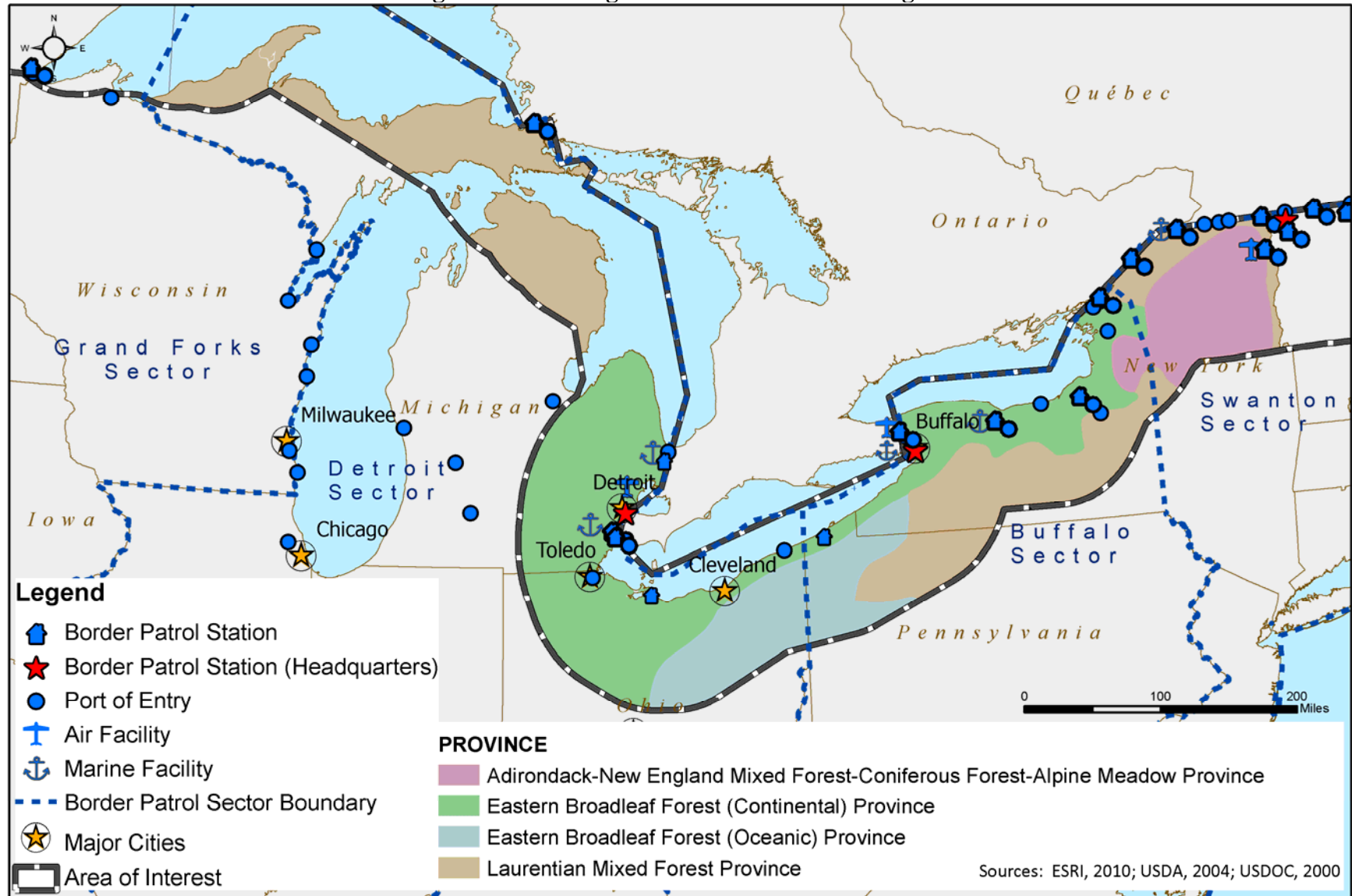
### **Laurentian Mixed Forest**



(University of Minnesota)



Figure L-4. Ecoregions in the Great Lakes Region



Most of this ecoregion is characterized by low relief, with rolling hills in many areas. Many large and small lakes, wetland depressions, moraines, eskers, kames, outwash plains, drumlins, and other glacial features make up the landscape. Glaciers covered this area during parts of the Pleistocene (Bailey, 1995).

The climate of the Laurentian Mixed Forest Ecoregion is moderated by proximity to the Great Lakes to the west and the Atlantic Ocean to the east. Winters in this ecoregion are moderately long and fairly severe, but more than one-third of the year has temperatures above 50 degrees Fahrenheit (10 degrees Celsius). Mean temperatures range from 35 to 50 degrees Fahrenheit (2 to 10 degrees Celsius). A brief growing season restricts agriculture; the frost-free season only lasts from 100 to 140 days. Snow generally persists all winter. Average annual precipitation is moderate, ranging from 24 to 45 inches (61 to 115 centimeters), with most precipitation falling in summer (Bailey, 1995).

Agriculture and forestry comprise two of the dominant economic activities in the Laurentian region. Common agricultural practices include row crop, dairy, grazing, orchard, and vegetable crop production. Silviculture and forestry practices are common on publically and federally owned hardwood and coniferous forests in the Great Lakes area as well as the northeastern states.

Approximately 20 percent of the Western Great Lakes Laurentian forests remain as intact habitat. Minnesota, for example, has 2630 square kilometers (650,000 acres) of extant old-growth forest, more than any other state in the eastern third of the nation (Davis, 1996). A large portion of this habitat is concentrated in the Boundary Waters/Quetico Provincial area, which is legally protected on both sides of the Minnesota-Ontario boundary. Similarly, with 17.7 million acres of forest, Maine is the most heavily forested state in the Nation with 90 percent still forested. The state's forest has remained essentially stable over recent decades (USDA, 2003c).

### **Boundary Waters Canoe Area Wilderness**



(Jim Brandenburg)

The historical forests of the Laurentian Mixed Forest Ecoregion were diverse due to the variety of landforms, soils, disturbance regimes, and reproductive strategies of the tree species in this area. Fires are part of an important disturbance regime in the region, particularly within coniferous stands. Fire suppression and human-induced changes in the composition and structure of the landscape have made modern fire rotations many times longer than those of the historical record for ecosystems in the Laurentian Ecoregion. In a Michigan study—representative of the ecoregion as a whole—natural fire rotations have increased from approximately 250 years in the postglacial past to approximately 3,000 years currently (Cleland et al., 2004).

Pines, especially jack pine, are often the pioneer species that revegetate burned areas or abandoned farmland. Fires from lightning storms are common in this ecoregion, particularly where sandy soils dominate.

A significant aspect of forest conversion in this ecoregion is the change from mature pine to aspen forest. Logging is the dominant cause of this conversion. Many thousands of hectares of the forest, outside of core, protected areas, have been converted to young successional stands.

In some areas, particularly in the northern reaches of the ecoregion, extensive areas of coniferous forest still exists, but much of the landscape has transitioned from its pre-European settlement status to that of an actively managed forest. The majority of the original white and red pine forest was logged in the last two decades of the 19<sup>th</sup> century and has been replaced by a mixed forest, with remnants of scattered pine species. This conversion has taken place across much of the region and caused extensive ecological change, with pre-settlement (“original”) plant communities replaced or extensively altered.

#### 1920s–1930s logging crew in Minnesota



(Corbis Images)

Mixed stands, by their nature, include additional coniferous and deciduous species, especially in the southern portions of the region. Some of these coniferous species are eastern red cedar (*Juniperus virginiana*) in New York, northern white cedar (*Thuja occidentalis*) in Vermont, and eastern hemlock (*Tsuga canadensis*) in Maine and New York.

### **1.10.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. Intact habitat or regionally significant habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Boundary Waters Canoe Area Wilderness–Northeastern Minnesota - (U.S. area is contiguous to Ontario’s Quetico Provincial Park);
- Quetico Provincial Park–Southeastern Ontario (on the U.S.-Canada border);
- Chequamegon/Nicolet National Forest–Northern Wisconsin;
- Superior National Forest–Northeastern Minnesota;
- Chippewa National Forest–Northern Minnesota;
- Ottawa National Forest–Northwestern Michigan;
- Hiawatha National Forest–Northwestern Michigan;
- Great Lakes: Lake Superior, Lake Michigan, and Lake Huron;
- Voyageurs National Park–Northern Minnesota;
- Isle Royale National Park–Northern Michigan;
- Apostle Islands National Park–Northern Wisconsin;
- Porcupine Mountains State Park–Northern Michigan;
- Baxter State Park–Maine;
- Finger Lakes –New York; and,
- Acadia National Park–Maine.

## Acadia National Park



(NPS)

### 1.10.2 SENSITIVE HABITATS

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities that represent sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section and are home to many of the threatened and endangered species in the next section. For example, cedar/tamarack swamps exist in many forested areas in this broad geographic region and house protected species, such as the ram's-head lady's slipper (*Cypripedium arietinum*), as well as various common plant species, such as sphagnum mosses (*Sphagnum* spp.). Some habitat names used below, such as the cedar/tamarack swamp, describe habitats found across several regional boundaries, and are more general in meaning. Others, such as calcareous fens (a rare type of wetland plant community), define much more specific ecological associations.

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Bogs–Wetland that accumulates acidic peat with deposits built of dead plant material;
- Calcareous fens–Rarest wetland community in Minnesota and Wisconsin, with input of alkaline mineral-rich groundwater;
- Cedar/tamarack swamps–Forested wetland characterized by one or both of these tree species;
- Sedge meadow–Wetland dominated by sedges growing on saturated soils typically composed of peat or muck;
- Hardwood swamps–Deciduous forested wetland;
- Flowages–Series of connected lakes;
- Freshwater estuaries–Ecological community where lake and river waters mix;

- Boreal forests—Predominately coniferous forest of the Northern Hemisphere;
- Great Lakes beaches and shorelines—Great Lakes beach natural community at the interface of land and water and found at margins of lakes Michigan, Huron, and Superior and often associated with sparsely vegetated dune systems; and,
- Inland lake shorelines—Beaches of inland lakes characterized by water-level fluctuations preventing development of stable shoreline plant communities, and instead supporting a more-specialized biota adapted to sandy or gravelly shorelines.

These sensitive ecological communities are less likely to withstand the effects of mechanized human activities and disturbance at a water-soil interface without sustaining damage than are broad agricultural zones, deciduous forests, grasslands, or other more generalized areas of vegetation or land use.

Wetlands can prove very sensitive to disturbance with a greater likelihood of slow repair (Maryland Dept. of Environment, 2010; Sheldon et al., 2005). Half of the nation's original 221 million acres of wetlands are estimated to have been lost (Feierabend, 1992).

### 1.10.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species in this ecoregion. The piping plover (*Charadrius melodus*), a federally listed species, is also found in this region, especially along the shores of the Great Lakes. Since this species nests on wide, flat, open sandy beaches, human activities that alter or disturb their habitat may affect populations nesting in or migrating through the area. Landscape alterations may also increase mortality of their young. The piping plover offers a primary example of the interaction between threatened and endangered species and human activities. Since this bird is a federally listed species, wildlife refuges have plans in place for monitoring or recovery of piping plover populations.

**Young piping plover**



(USFWS)

Federally listed endangered species in Wisconsin, Michigan, Pennsylvania, Ohio, and New York include the piping plover. Examples of state-listed endangered species in Wisconsin include the peregrine falcon, Caspian tern (*Sterna caspia*), and Forster's tern (*S. forsteri*). Michigan, Ohio, Pennsylvania, New York, and Wisconsin all list the loggerhead shrike (*Lanius ludovicianus*) in



the state endangered category. Development and other human activities may affect endangered or threatened species if impacts occur within the habitats used by these species. Also vulnerable are breeding colonies of common terns (*S. hirundo*), which breed and nest on sand beaches similar to those of the piping plover.

In forested habitats within the Laurentian Ecoregion, the merlin (*Falco columbarius*), Kirtland's warbler (*Dendroica kirtlandii* (found only locally in Michigan and Wisconsin), spruce grouse (*Falcipennis canadensis*), northern goshawk (*Accipiter gentilis*), and black-backed woodpecker (*Picoides arcticus*) are some of the sensitive species that could be affected by construction or other human disturbances, especially during the breeding season (generally from March through July).

Although some species are listed as endangered or threatened at either the Federal or state level, other species are categorized differently as of "conservation concern" or "special concern."

#### **1.10.4 WILDLIFE**

The primary forests and wetlands in this ecoregion are home to various wildlife species, including both game (legally hunted) species and non-game (legally protected but not endangered or threatened) species. Many birds, especially insectivorous species, migrate into or out of this ecoregion twice each year, with over 300 avian species throughout the year, either during breeding season, spring or fall migration, or winter (NYSOS, 2010). A wide variety of wildlife species remain in the ecoregion throughout the year.

The coniferous woodlands of the ecoregion are characterized by long winters and a short growing season. The forest stands provide good shelter, nesting, and foraging habitat. Common mammals include black bear (*Ursus americanus*), white-tailed deer (*Odocoileus virginianus*), fisher (*Martes pennanti*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), foxes, shrews, and squirrels. Amphibians include red-backed salamander (*Plethodon cinereus*), spotted salamander (*Ambystoma maculatum*), red-spotted newt (*Notophthalmus viridescens*), and American toad (*Bufo americanus*). Common garter snakes (*Thamnophis* spp.) and wood turtles (*Glyptemys insculpta*) are adapted to this northern climate.

#### **1.10.5 VEGETATIVE HABITAT**

Forests dominate the vegetative cover in the Laurentian Ecoregion. Mixed forest stands are comprised of several species of conifers, particularly white pine (*Pinus strobus*) in the Great Lakes region, along with a mix of deciduous species. Typical vegetative cover consists of mixed pine with aspen-birch (*Populus* spp. and *Betula* spp.); white pine and red pine (*P. resinosa*); jack pine (*P. banksiana*); black spruce (*Picea mariana*); eastern hemlock (*Tsuga canadensis*); balsam fir (*Abies balsamea*); northern white cedar (*Thuja occidentalis*); sugar maple (*Acer saccharum*); beech (*Fagus* spp.); birch (*Betula* spp.); white, red, and jack pine (*Quercus* spp.); and oak and hickory (*Carya* spp.) cover types among others.

### Ram's-head lady slipper, a state endangered plant in Maine



(Maine Natural Areas Program)

Mixed forest stands are common with species assemblages highly dependent on the soil. Deciduous species typically favor nutrient-rich soils, while conifers thrive in poor soils. Pine trees are common in areas frequented by fire. Shrub and herbaceous layers add to the vegetative diversity in each of these forests (Bailey, 1995; EOE, 2009). Mixed stands, by their nature, include additional coniferous and deciduous species, especially in the southern portions of the region. Such coniferous species include eastern redcedar (*Juniperus virginiana*) in the New York regions, northern white cedar in Vermont, and eastern hemlock in Maine and New York.

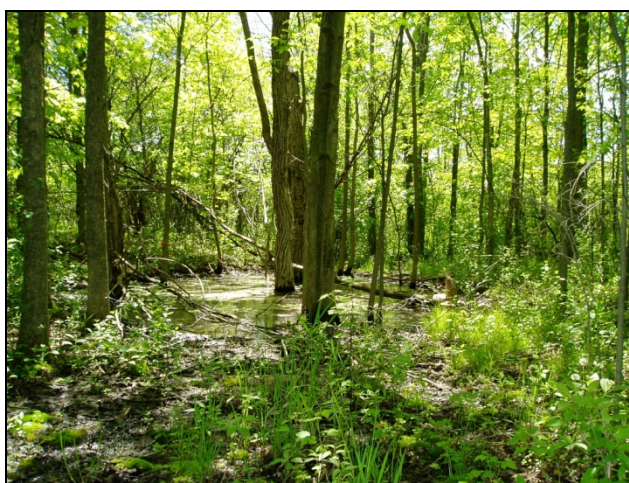
Land use changes in the region have led to broad-scale changes in forest patch or block sizes (Mladenoff et al., 1993), diminished plant and ecological community diversity (White and Mladenoff, 1994), and a general simplification of ecological communities, including the loss of some native species (Schultz et al. 2001, Anderson and Loucks, 1979). The landscape-wide, mixed coniferous-deciduous forest has, with a few exceptions, lost extensive areas of its conifers due to these changes.

Common invasive species of concern include garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), honeysuckle (*Lonicera* spp.), common buckthorn (*Rhamnus cathartica*), and glossy buckthorn (*Frangula alnus*), spotted knapweed (*Centaurea maculosa*), orange hawkweed (*Pilosella aurantiaca*), Canada thistle (*Cirsium arvense*), and sweet clovers (*Melilotus* spp.). New invasive species of increasing concern include wild chervil (*Anthriscus sylvestris*), purple crownvetch (*Securigera varia*), autumn olive (*Elaeagnus umbellata*), leafy spurge (*Euphorbia esula*), giant hogweed (*Heracleum mantegazzianum*), Dame's Rocket (*Hesperis matronalis*), Japanese knotweed (*Fallopia japonica*), giant knotweed (*F. sachalinensis*), and garden valerian (*Valeriana officinalis*). These plants are only representatives of a growing list (USDA, 2003a). For example, Minnesota has a list of prohibited invasive species that includes the sea lamprey (*Petromyzon marinus*), New Zealand mud snail (*Potamopyrgus antipodarum*), European wild boar (*Sus scrofa*), and tubenose goby (*Proterorhinus marmoratus*).

### 1.10.6 WETLANDS AND WATERWAYS

Wetlands within the project area of the Laurentian Mixed Forest Ecoregion include approximately: 143 acres of marine and estuarine deepwater habitats; 2,433 acres of marine and estuarine marshes, beaches, and intertidal flats; over 7,159,520 acres of palustrine forested/scrub shrub wetlands (swamps and wooded bogs); over 613,540 acres of palustrine emergent wetlands (marshes, fens, wet meadows, sedge meadows, wet prairies); 1,373,290 acres of lacustrine wetlands (lakes); 171,325 acres of palustrine open water (ponds); and 152,625 acres of riverine habitat (rivers and streams) (USDOI, 2010b). The marine and estuarine systems within the ecoregion occur along the southeast coast of Maine, a portion of which sits within the project area. The other wetland types are distributed widely with Maine, Michigan, and Wisconsin having the greatest share.

#### Forested wetland



(Cedarburg Science/Lesley Brotkowski)

Several different types of wetlands in this ecoregion not only contain some rare species, but also function as important aquatic resources. These wetlands include lacustrine shallow and open-water communities, which are especially important for waterfowl production, along with palustrine forested coniferous swamps. Some of the rare plant species in these wetlands are lake cress, autumnal water-starwort, prickly hornwort, ram's head lady slipper, and the round-leaved orchid. Estuarine wetlands can include algal beds, cordgrass, salt marshes, and rushes.

Several major rivers run through the northeast part of this ecoregion, including the Aroostook, Narragausus, St. Croix, and St. John in Maine; the White, Winooski, and Connecticut in Vermont; and the St. Lawrence, Black, and Raquette in New York. The large water bodies classified as lacustrine include the Cranberry, West Grand, and Big lakes in Maine. Wetlands of special significance include maritime slope bogs, coastal plateau bogs, circumneutral fens, peat bogs, and Atlantic white cedar wetlands. Wetlands such as the Appleton Bog in Maine are well known and draw visitors. Maine designates emergent wetlands over 20,000 square feet as wetlands of special significance (Maine Natural Areas Program, 2005).

In the Great Lakes part of the ecoregion, major rivers include the Allegheny in New York and Pennsylvania; the Black, Au Sable, and Ontonagon in Michigan; the St. Louis in Wisconsin and Minnesota; and the Big Fork, Little Fork, and Rainy in Minnesota. Several large lakes are within

the Minnesota portion of the project area: Mullet, Gogebic, Mud, Kabetogama, Rainy, Vermilion, Red Lakes, and Lake of the Woods.

### 1.10.7 AQUATIC RESOURCES

Aquatic resources are highly regarded within the Laurentian Ecoregion, luring outdoor enthusiasts to the region for hunting and fishing. Abundant lakes, rivers, ponds, and wetlands, along with the remnants of glacial recession, are dominant features on the landscape. Three of the Great Lakes (Superior, Michigan, and Huron), the St. Lawrence Seaway, and the Atlantic Ocean border portions of this ecoregion.

#### Forested Stream



(Cedarburg Science/Lesley Brotkowski)

These aquatic resources support a diverse fishery. Notable fish species include the lake sturgeon (*Acipenser fulvescens*), walleye (*Sander vitreus*), northern pike (*Esox lucius*), muskellunge (*E. masquinongy*), salmon (*Salmo salar*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*M. salmoides*), brook trout (*Salvelinus fontinalis*), lake trout (*S. namaycush*), yellow perch (*Perca flavescens*), white sucker (*Catostomus commersonii*), mottled sculpin (*Cottus bairdii*), common shiner (*Luxilus cornutus*), and creek chub (*Semotilus atromaculatus*). Various native reptiles, amphibians, waterbirds, aquatic insects, mussels, and crustaceans also thrive in these waters (NOAA, 2010).

While shifting water levels in the Great Lakes have an important ecological role, inlet and outlet controls within the basin have stabilized water levels to some degree, leading to significant changes in lakeshore ecology. These changes include alteration of spawning areas for some fish species. Natural raising and lowering of water levels allow some aquatic species to gain footholds for brief periods. With dropping water level, aquatic vegetation can grow farther from shore, providing new habitat for fish when water levels rise again.

Wetlands are also abundant within the Laurentian Ecoregion. Typical wetland habitats include bogs, coniferous swamps, hardwood swamps, and fens. These wetlands are high-quality natural areas that are particularly sensitive to disturbance. Dominant species include northern white

cedar (*Thuja occidentalis*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*, along with various shrubs, sedges, rushes, grasses, mosses, and forbs (WWF and TNC, 2008).

Communities, such as dunes, beaches, and upland marshes, characterize the Maine coast and may include American beachgrass (*Ammophila breviligulata*), bayberry (*Myrica pensylvanica*), beach plum (*Prunus maritima*), and annual marsh elder (*Iva annua* var. *annua*). Ocean tides strongly influence coastal regions in Maine, which is dramatically different from inland areas adjacent to the Great Lakes. For example, tides in the Lubec embayment in Maine reach six meters on full and new moon spring tides — the maximum tidal range on the U.S. East Coast. (Maine Geological Survey, 2005).

Accidental introductions of invasive species have negative impacts on aquatic resources, damaging fisheries and native habitats. Common invasive plant species of concern include marsh thistle (*Cirsium palustre*), purple loosestrife (*Lythrum salicaria*), spike water milfoil (*Myriophyllum spicatum*), reed canary grass (*Phalaris arundinacea*), curly pondweed (*Potamogeton crispus*), and flowering rush (*Butomus umbellatus*). Invasive animal species of concern include the rusty crayfish (*Orconectes rusticus*), sea lamprey (*Petromyzon marinus*), round goby (*Neogobius melanostomus*), zebra mussel (*Dreissena polymorpha*), quagga mussel (*D. rostriformis bugensis*), and water flea (*Daphnia pulex*) among others.

The Asian carp (*Hypophthalmichthys spp.*) poses a significant and highly visible threat to the aquatic resources of the Great Lakes region. This species has invaded the Illinois River, which lies outside of the Laurentian Ecoregion; however, it is nearing Lake Michigan and is a serious invasive threat. Zebra and quagga mussels have already seriously affected Great Lakes ecosystems, water treatment facilities, and water-based infrastructure and municipal equipment, with the potential for similar damage to inland waterways (Robinson, 2003).

### **1.11 EASTERN BROADLEAF FOREST (OCEANIC) ECOREGION (221)**

The Eastern Broadleaf Forest (Oceanic) Province is a beech-maple forest with rounded hills, ridges, and broad valleys (Figure L-4). Appalachian Oak, oak-hickory, northern hardwood, and mixed-deciduous forest also make up portions of this province. Elevations in this province range from 650 to 1,000 feet (200 to 300 meters) with local relief of 6 to 50 feet (2 to 15 meters).

States in this ecoregion include Maine, New Hampshire, New York, Pennsylvania, and Ohio.



### Eastern broadleaf forest



(Radford University)

The Appalachian Plateau portion (west of the Appalachian Mountains from New York into Ohio within the 100-mile project area) of the Eastern Broadleaf Forest (Oceanic) Province has extensive areas of deciduous forest cover. Aquatic resources range from small natural lakes to wetlands. Numerous steep headwater and low-gradient streams flow into the Ohio River and Lake Erie. Deep coarse sand and gravel underlie most of these streams. Deciduous trees in this province include beech (*Fagus* spp.), maple (*Acer* spp.), oak (*Quercus* spp.), and hickory (*Carya* spp.). Naturally occurring disturbances include flooding, droughts, and windstorms that may knock down trees.

The climate in the Eastern Broadleaf Forest (Oceanic) Province is moderated by the Atlantic Ocean to the east and has cold winters and warm summers. The average annual temperature is around 50 degrees Fahrenheit (10 degrees Celsius). Precipitation of either rain or snow is consistent year round and ranges from 35 to 40 inches (90 to 102 centimeters) per year in the Appalachian Plateau. The growing season runs for approximately 160 days with frost as a determining factor. About 50 percent of this region is used for agriculture and 25 percent is forested. Half of the forested areas are small woodlots.

The New England portion of the ecoregion, an area within the 100-mile project area in southern Maine and eastern New Hampshire, is very similar. The average annual temperature is influenced by elevation and proximity to the Atlantic Ocean and ranges from 45 to 50 degrees Fahrenheit (7 to 10 degrees Celsius). Annual precipitation ranges from 35 to 50 inches (82 to 127 centimeters) from both rain and snow. The amount of snow rises as elevation increases and varies from 36 to 100 inches (91.5 to 254 centimeters). The growing season usually extends from 120 to 180 days with elevation and frost creating some restrictions. Nearly 75 percent of this area is forested, with about 15 percent used for agriculture and 10 percent urbanized.

Rounded hills and valleys characterize most of the Appalachian Plateau. Glaciers covered this area approximately 8,000 to 10,000 years ago. This glaciation created the wide and dendritic drainages on the flat, homogenous, subsurface material. Gentle slopes cover about 50 to 80 percent of the area.



## Appalachian Plateau



(Emporia State University)

### 1.11.1 REMAINING BLOCKS REGIONALLY SIGNIFICANT HABITAT

The blocks of regionally significant habitat below are relatively undeveloped and intact habitat that are protected as wilderness, state parks, and state and national forests. Regionally significant or intact habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Kyle (Arthur) Woods State Nature Preserve—Ohio;
- Eagle Creek State Nature Preserve—Ohio;
- Bear Run Nature Reserve—Western Pennsylvania; and,
- Raccoon Creek State Park—Western Pennsylvania.

### 1.11.2 SENSITIVE HABITATS

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities representing sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section and are home to many of the threatened and endangered species in the next section. For example, hardwood swamps exist in many forested areas in this geographic region and house many plant species, such as Pennsylvania bitter cress (*Cardamine pensylvanica*), jack-in-the-pulpit (*Arisaema triphyllum*), and oakfern (*Gymnocarpium dryopteris*). Some habitat names, such as hardwood swamps, describe habitats found across several regional boundaries and are more general in meaning. Others, such as “black swamp” forest (a rare type of forest remnants), define much more specific ecological associations.

### Jack-in-the-pulpit



(Cedarburg Science, Lesley Brotkowski)

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Barrier beach and Great Lakes beaches–Great Lakes beach and dune complex characterized by pioneering beach and dune vegetation adjacent to lakes Michigan, Ontario, and Erie;
- Riverine marsh–Riverside deep-marsh wetland;
- Sedge meadow–Wetland dominated by sedges on saturated soils typically composed of peat or muck
- Wet prairie–Wet grassland habitat, dominated by sedges and rushes;
- “Black Swamp” forest–Forest remnants remaining from extensive post-glacial lake plains southwest of Lake Erie;
- Hardwood swamps–Deciduous forested wetland;
- Bogs–Wetland that accumulates acidic peat with deposits of dead plant material; and,
- Freshwater estuaries–Ecological community where lake and river waters mix

#### 1.11.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species in this ecoregion. The piping plover (*Charadrius melodus*) is a federally listed species in this region, especially on sandy beaches along lakes. The federally listed shortnose sturgeon (*Acipenser brevirostrum*) inhabits large rivers connected to marine estuaries. It is the smallest sturgeon species in eastern North America at a maximum length of about 4.7 feet, but is often mistaken for the Atlantic sturgeon. As an anadromous fish spending time in both marine and freshwater environments, human activities, such as boating and fishing, may disturb this species.

Other aquatic federally listed species in Maine, New Hampshire, New York, Pennsylvania, and Ohio include the northern riffleshell (*Epioblasma torulosa rangiana*) and clubshell (*Pleurobema*

*perovatum*) mollusks. The lake sturgeon (*A. fulvescens*) is a state-listed species in both Pennsylvania and Ohio.

#### Lake sturgeon



(USFWS)

In forested and wetland habitats, several other federally listed species exist, including the least bittern (*Ixobrychus exilis*), Canada lynx (*Lynx canadensis*), Karner blue butterfly (*Lycaeides melissa samuelis*), and eastern prairie fringed orchid (*Platanthera leucophaea*). Other state-listed species may include the short-eared owl (*Asio flammeus*), Persius duskywing butterfly (*Erynnis persius*), and Appalachian shoestring fern (*Vittaria appalachiana*).

Although some species are listed as endangered or threatened at either the Federal or state level, other species are categorized differently as of “conservation concern” or “special concern.”

#### 1.11.4 WILDLIFE

Many birds, especially species such as the white-throated sparrow (*Zonotrichia albicollis*), migrate through this province twice each year. Bird populations are diverse and include raptors, game birds, and songbirds. Wild turkey (*Meleagris gallopavo*), ruffed grouse (*Bonasa umbellus*), woodcock (*Scolopax minor*), bobwhite quail (*Colinus virginianus*), mourning dove (*Zenaida macroura*), and many passerines are common (USEPA, 2010). The Cooper’s hawk (*Accipiter cooperi*), sharp-shinned hawk (*A. striatus*), great horned owl (*Bubo virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), American toad (*Bufo americanus*), and painted turtle (*Chrysemys picta*) are other birds, mammals, amphibians, and reptiles that remain in the province year-round.

### American toad



(New York City Department of Parks & Recreation)

#### 1.11.5 VEGETATIVE HABITAT

Temperate deciduous forests dominate the vegetative cover in the Eastern Broadleaf Forest (Oceanic) Ecoregion. This mixed vegetative cover occupies moist and well-drained sites, especially in the New England portion. Species in these areas are American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), northern red oak (*Quercus rubra*), white oak (*Q. alba*), sweet buckeye (*Aesculus flava*), American basswood (*Tilia americana*), red cedar (*Juniperus virginiana*), and hemlock (*Tsuga* spp.) and white pine (*Pinus strobus*) species. Various oaks (*Quercus* spp.) are also common in some small oak-hickory (*Carya* spp.) associations in the Appalachian Plateau. Pine-oak forests grow on the Appalachian Plateau in dry sandy soils with thick shrubs beneath. Wetlands sit in areas with poorer drainage and generally have a smaller geographic extent.

Land use changes have increased erosion in the Midwest. Ohio's Hueston Woods State Park at the base of the Upper Four Mile Creek watershed, for example, is experiencing serious erosion problems due to row crops (Medley et al., 2003). These land-use alterations have also resulted in significantly more small, lower-diversity forest patches when compared to intact old-growth landscapes (White and Mladenoff, 1994).

Common invasive species of concern include garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), honeysuckle (*Lonicera* spp.), knotweed (*Polygonum* spp.), common and glossy buckthorn (*Rhamnus cathartica* and *R. frangula*), Eurasian watermilfoil (*Myriophyllum spicatum*), sweet clovers (*Melilotus* spp.), among others. New invasive species that require vigilance include spotted knapweed (*Centaurea stoebe*), kudzu (*Pueraria lobata*), mile-a-minute vine (*Persicaria perfoliata*), and leafy spurge (*Euphorbia esula*).

#### 1.11.6 WETLANDS AND WATERWAYS

Many of the dominant and important plant species in this province grow in different types of wetland communities. These wetlands include floodplain forests, shallow, open-water communities, and hardwood and coniferous swamps that include species such as silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), yellow birch (*Betula alleghaniensis*),

red maple (*A. rubra*), white water-lily (*Nymphaea odorata*), and sedges (*Carex* spp.). These areas are also important to many waterfowl species that may migrate through or nest in the area.

Wetlands in the Eastern Broadleaf Forest (Oceanic) Ecoregion portion of the project area include approximately: 365,390 acres of forested and scrub-shrub wetlands; 54,190 acres of emergent wetlands; 239,745 acres of lakes; 53,850 acres of ponds; and 38,355 acres of riverine habitats (USDOI, 2010b). This area sits too far from the coast to have any marine and estuarine systems.

### **Floodplain forest**



(NH Dept. of Forests and Lands)

The Batten Kill River, the Champlain Canal, and Cossayuna Lake in New York State are within this province and the project area.

The Ohio River in Ohio and Pennsylvania sits at the southern extreme of the study area and the upper Cuyahoga also flows through both of these states within the study area. Other rivers in Pennsylvania include the Shenango, Beaver, and Allegheny, and the French and Neshannock creeks. Other rivers in Ohio include Little Beaver and Sandy creeks, the Tuscarawas River, and the Mahoning River.

Important lakes in Pennsylvania include: the Shenango River, Mahoning Creek, Crooked Creek, and Woodcock Creek lakes, along with lakes Tionesta, Arthur, and Wilhelm. Important lakes in Ohio include Atwood, Berlin, Salt Fork, Piedmont, Mosquito Creek, Senecaville, Tappan, and Leesville.

### **1.11.7 AQUATIC RESOURCES**

Aquatic resources are highly regarded within the ecoregion due to the area's excellent fish diversity. The abundant rivers and estuaries offer fishing for many freshwater and marine species.

Accidental introductions of invasive species have negative impacts on aquatic resources, damaging fisheries and native habitats. Common invasive plant species of concern in this province include purple loosestrife (*Lythrum salicaria*), yellow loosestrife (*Lysimachia vulgaris*), reed canary grass (*Phalaris arundinacea*), curly pondweed (*Potamogeton crispus*), and flowering rush (*Butomus umbellatus*). Invasive animal species of concern include the Asian clam



(*Corbicula fluminea*), rusty crayfish (*Orconectes rusticus*), northern snakehead (*Channa argus*), zebra mussel (*Dreissena polymorpha*), and quagga mussel (*D. rostriformis bugensis*) among others. Species such as the rusty crayfish reduce the amount of aquatic vegetation and compete with native crayfish.

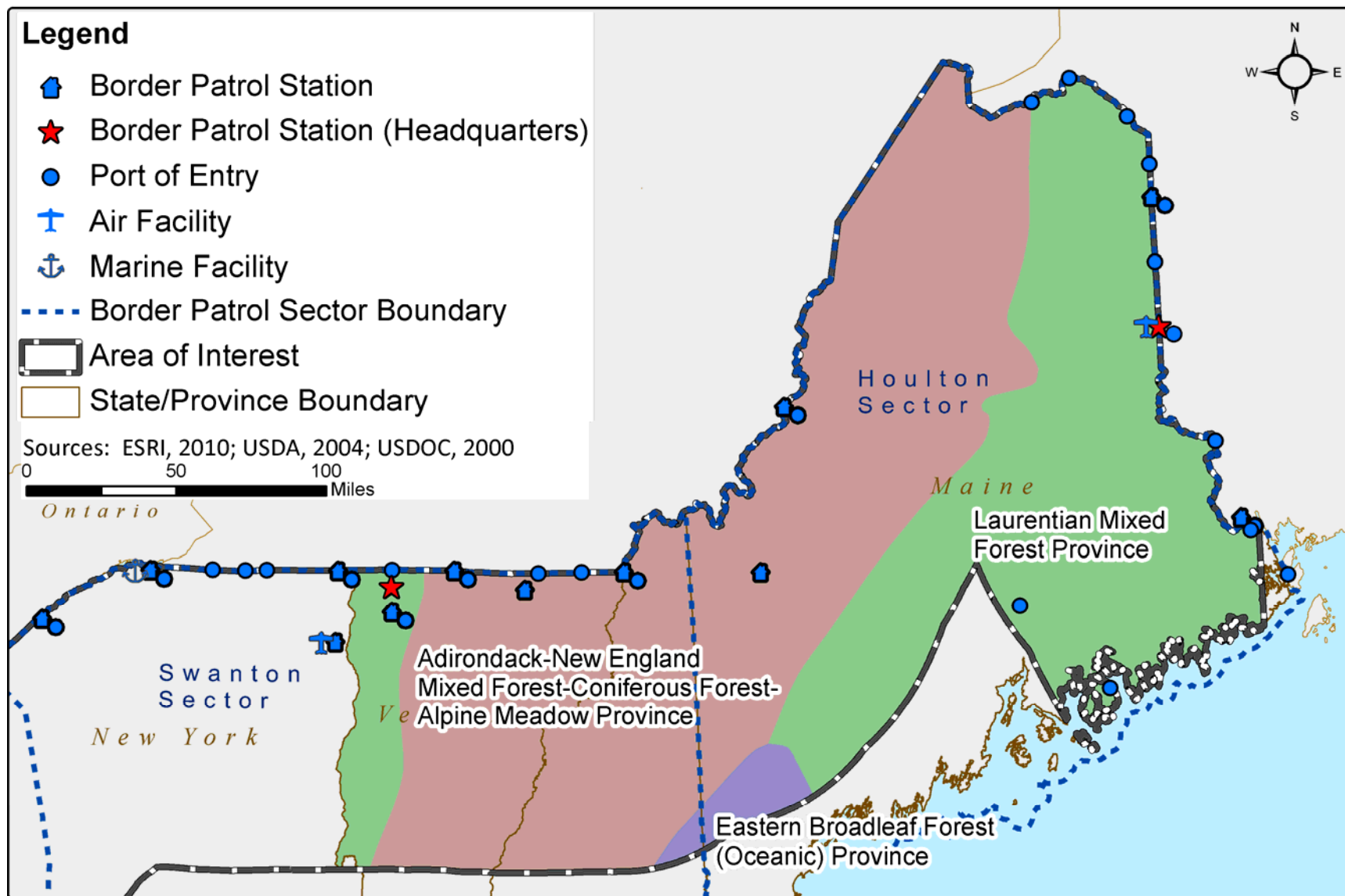
## **1.12 ADIRONDACK- NEW ENGLAND MIXED FOREST CONIFEROUS FOREST–ALPINE MEADOW ECOREGION (M212)**

The Adirondack–New England Mixed Forest–Coniferous Forest-Alpine Meadow Ecoregion has areas of both coniferous and deciduous forest cover with some alpine meadows near the timberline (Figure L-4 and Figure L-5). Aquatic resources, similar to those in the Laurentian region, range from lakes to conifer bogs and swamps

States in this province include Maine, New Hampshire, Vermont, and New York.



Figure L-5. Ecoregions in the New England Region



The Adirondack–New England Mixed Forest Coniferous Forest–Alpine Meadow Ecoregion is a mountainous region that transitions between true spruce–fir forest in the north to deciduous forest in the south. The growth forms and species of this forested province are similar to those further north, but red spruce (*Picea rubens*) grows here instead of white spruce (*P. glauca*). Vegetation zones occur, with both elevation and latitudinal aspects. Mountain slopes at lower elevations are mixed forest, typically composed of spruce, fir, maple (*Acer* spp.), and birch (*Betula* spp.). The effect of latitude is also noticeable; for example, from north to south, the approximate limit of spruce and fir is 500 feet (150 meters) on Mt. Katahdin, 2,500 feet (800 meters) in the White Mountains, 3,000 feet (900 meters) in the Adirondack Mountains, and 3,500 feet (1,100 meters) in the Catskills. A stunted forest zone occurs above the mixed-forest zone, with underdeveloped stands of balsam fir and red spruce at higher elevations.

### White Mountains in New Hampshire



(New Hampshire Historical Society)

The historic forests of the ecoregion are recovering from an array of previous disturbances, including forest clearing for agriculture, logging, and fires of the 18<sup>th</sup> and 19<sup>th</sup> centuries (Niering, 1998). Landscapes in this region have shifted from largely forested during pre-colonial times to agricultural in the 19th century; they are currently re-establishing as forest (Latty et al., 1994).

The climate of this province is defined by its warm summers and cold winters. Nearby moist air masses above the northwestern Atlantic cause precipitation to be fairly evenly distributed throughout the seasons. This aspect of the climate differs from that of the Laurentian Mixed Forest Province. Winters in this region are often severely cold, but moderate towards the ocean. Average annual temperatures range from 37 to 52 degrees Fahrenheit (3 to 11 degrees Celsius). The frost-free period is about 100 days on average. Precipitation near Albany, New York averages 35 inches (89 centimeters) per year, while snowfall averages above 100 inches (255 centimeters) each year.

Agriculture and silviculture comprise two of the dominant economic activities in the Laurentian region. Common agricultural practices include row crop, dairy, grazing, orchard, and vegetable

crop production. Silviculture is common on publicly and federally owned lands in hardwood and coniferous forests.

Historic fire regimes have been suppressed in forests in this area in recent times. These forests are characterized by large blowdowns from severe wind as well as smaller blowdowns. Higher-elevation forests often exhibit an even-aged windthrow disturbance known as fir waves. Insect and disease damage has resulted from gypsy moth (*Lymantria dispar*), Eastern spruce budworm (*Choristoneura fumiferana*), spruce beetle (*Dendroctonus rufipennis*), severe beech bark disease (*Nectria coccinea*), and butternut canker (*Sirococcus clavigignenti-juglandacearum*) infestations. Forests at lower elevations have been influenced by agriculture since colonial times and more recently by farm abandonment, as well as by selective logging of certain species (McNab and Avers, 1994).

Across this region, the distributions of both modern-day and pre-settlement forest types are similar, but 250 years of land use has affected forest structure and composition. Both selective and intensive logging has taken place for more than 200 years. Forest has been cleared and the land farmed dating to early Euro-American settlement. Since approximately the 1870s, land not suitable for farming has been abandoned and, in many cases, allowed to return to forest. Deciduous forests are more extensive now than in pre-settlement times due to logging of conifers through the start of the 20<sup>th</sup> century, followed by periods of fire.

### **1.12.1 REMAINING BLOCKS OF REGIONALLY SIGNIFICANT HABITAT**

The blocks of regionally significant habitat listed below are relatively undeveloped and intact habitat protected as wilderness, state parks, and state and national forests. “Intact habitat” or regionally significant habitat refers to areas of largely unfragmented habitat with few alterations or disturbances, such as roads or other development. Most areas listed are protected by law (wilderness areas, national parks) and often cross state and country boundaries, while others may occupy large expanses of private lands.

Selected regionally significant blocks that represent this region include:

- Adirondack Park–New York;
- Baxter State Park–Maine;
- Big Reed Forest–Maine;
- Green Mountains–Vermont;
- Mahoosuc Mountains–Maine;
- Nash Stream Forest–New Hampshire; and,
- White Mountains–New Hampshire.

## Adirondack Park



(New York Department of Conservation)

### 1.12.2 SENSITIVE HABITATS

Within a 100-mile zone adjacent to the U.S.-Canada border are several ecological communities that represent sensitive habitats. The sensitive habitats described here occur in many of the larger intact habitat areas in the prior section and house many of the threatened and endangered species in the next section. For example, hardwood swamps occupy many forested areas in this broad geographic region and are home to rare or protected species, such as the sharp-scaled manna-grass (*Glyceria acutiflora*), as well as a wide variety of common plants, such as cinnamon fern (*Osmunda cinnamomea*). Some habitat names used below, such as hardwood swamp, can describe habitats across several regional boundaries and are more general in meaning. Others, such as subalpine krummholz (stunted coniferous trees near the tree line), define much more specific ecological associations.

### Cinnamon fern



(Wisconsin State Herbarium)

Many of these habitats are very fine in scale and form a patchwork of biologically sensitive and diverse areas. The list of sensitive habitats is based on those enumerated and described by the WWF (2001), ecological system descriptions within the NatureServe.org database, and each state's respective natural resources agency.

- Hardwood swamps–Deciduous forested wetlands;
- Limestone bluff cedar-pine forests–Forests of these species on limestone bedrock;
- Alpine Meadow–Open areas on Adirondack Province mountains, generally above 3,500 feet where cold temperatures and high winds favor a community of ground-layer plants that can tolerate such conditions;
- Subalpine krummholz–Stunted wind-shaped coniferous forest below the timberline;
- Montane yellow birch-red spruce forest – Birch-fir forests on mountain slopes;
- Montane spruce-fir forest–Spruce-fir forest on mountain slopes;
- Cold-air talus woodland–Talus areas with large, ice-cooled boulders where the microclimate supports black and red spruce, heaths, and evergreen shrubs;
- Pitch pine-oak-heath rocky summit–Lower-elevation transition zone with pitch pine, oak, and an associated shrub zone;
- Acadian-Appalachian montane spruce-fir forest–Spruce-fir forest on mountain slopes;
- Acadian-Appalachian alpine tundra–Tundra vegetation above the timberline; and,
- Northeastern interior pine barrens–Dry pine forest on sandy, acidic, nutrient-poor soil

### 1.12.3 THREATENED AND ENDANGERED SPECIES

Appendix F3 lists the threatened and endangered species in this ecoregional province. Examples of federally listed species in this region include the Karner blue butterfly (*Lycaeides melissa samuelis*), Indiana bat (*Myotis sodalis*), and Canada lynx (*Lynx canadensis*). The eastern mountain lion (*Puma concolor*), a federally listed species, also lives in this region. Since the eastern mountain lion is a federally listed species, wildlife refuges already have plans in place for monitoring or recovery of the species' population.

Examples of state-listed endangered species include the peregrine falcon in Maine; the golden eagle (*Aquila chrysaetos*) and common nighthawk (*Chordeiles minor*) in New Hampshire; and the spruce grouse (*Falcipennis candensis*) in Vermont and New York.

#### Golden Eagle



(Kevin Kowalchuk)

Although some species are listed as endangered or threatened at either the Federal or state level, other species are categorized differently as of “conservation concern” or “special concern.”



#### 1.12.4 WILDLIFE

The spruce-fir forests of this province have a well-developed canopy. Examples of wildlife species using this habitat at higher elevations include grouse and woodpeckers. Black bear (*Ursus americanus*), snowshoe hare (*Lepus americanus*), salamanders, and turtles are just a few of the many species that occupy lower-elevation forests.

In forested habitats, the merlin (*Falco columbarius*), the northern goshawk (*Accipiter gentilis*), and black-backed woodpecker (*Picoides arcticus*) represent some of the sensitive species. Many bird species migrate into or out of this province twice each year, including more than 20 species of warblers, the rose-breasted grosbeak (*Pheucticus ludovicianus*), golden-crowned kinglet (*Regulus satrapa*), and hermit thrush (*Catharus guttatus*). More than 300 total bird species breed in, migrate through, or overwinter in this ecoregion (LePage, 2011). Some bird species (“permanent residents”), most mammal species other than migratory bats, reptiles, and amphibians remain in the province year-round.

#### 1.12.5 VEGETATIVE HABITAT

Northern hardwood-spruce and northeastern spruce-fir forest dominate the vegetative cover within the province. Regionally defined important vegetation communities include highland spruce-fir, lowland spruce-fir, northern hardwood-conifer, alpine krummholz (stunted coniferous trees near the tree line), and alpine meadow habitat. Typically dominant species include sugar maple (*Acer saccharum*) and American beech (*Fagus grandiflora*), with some stands containing Canadian hemlock (*Tsuga canadensis*).

**Sugar maple**



(Cindy Kowalchuk)

Common invasive species of concern include purple loosestrife (*Lythrum salicaria*), hydrilla (*Hydrilla verticillata*), flowering rush (*Butomus umbellatus*), goutweed (*Aegopodium podagraria*), crofton weed (*Ageratina adenophora*), tree of heaven (*Ailanthus altissima*), reed canarygrass (*Phalaris arundinacea*), orange hawkweed (*Hieracium aurantiacum*), garlic mustard



(*Alliaria petiolata*), Oriental bittersweet (*Celastrus orbiculatus*), dodder (*Cuscuta* spp.), curly pondweed (*Potamogeton crispus*), and Eurasian watermilfoil (*Myriophyllum spicatum*), among others.

### 1.12.6 WETLANDS AND WATERWAYS

Wetlands in the study area include approximately: 781,790 acres of forested and scrub-shrub wetlands; 123,175 acres of emergent wetlands; 734,400 acres of lakes; 39,380 acres of ponds; and 365,000 acres of riverine habitats (USDOI, 2010b). This area is too far from the coast for marine and estuarine systems, but lakes and forested wetlands are abundant.

Major rivers in this ecoregion include: the Allagash in Maine; the Androscoggin, Pemigewasset, Saco, Merrimack, and Ammonoosuc in New Hampshire; the Connecticut between New Hampshire and Vermont; the Missisquoi and Passumpsic in Vermont; and the Saranac and St. Regis in New York. Important lakes include: Mooselookmeguntic, Flagstaff, Brassua, and Moosehead in Maine; the Connecticut Lakes, Winnepesaukee, Ossipee, Sunapee, Newfound, and Umbagog in New Hampshire; Saranac and Oneida in New York; and Champlain and Memphremagog in Vermont. Notable wetlands include: the large tertiary peat bogs of Maine; the Hurlbert (Atlantic white cedar) Swamp in New Hampshire (The Nature Conservancy, 2010b); the LaPlatte River Marsh and Gillette Swamp in Vermont; and the Spring Pond Bog in New York (The Nature Conservancy, 2010c).

#### Spring Pond Bog



(Edwin Romanowicz)

### 1.12.7 AQUATIC RESOURCES

The aquatic resources in this province are highly regarded due to the richly diverse fish populations. Large lakes, rivers, and streams constitute important habitat for freshwater fish in this province. Fish species include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), walleye (*Sander vitreus*), northern pike (*Esox lucius*), brook trout (*Salvelinus fontinalis*), and rainbow trout (*Oncorhynchus mykiss*).

Invasive plants and animals alter habitat quality and suitability for a wide variety of native plant and animal species. Some of the invasive aquatic species with the potential for introduction include the giant snakehead (*Channa micropeltes*).

## 2 REFERENCES

- (Abrams, 2003) Abrams, M. 2003. *Where has all the white oak gone?* Bioscience 53 (10): 927–939.
- (Anderson and Loucks, 1979). Anderson, R. C., and O. L. Loucks. 1979. White-tailed deer (*Odocoileus virginianus*) influence on structure and composition of *Tsuga canadensis* forests. *Journal of Applied Ecology* 16:855-861.
- (Bailey, 1995). Bailey, R. G. 1995. *Description of the ecoregions of the United States*. Accessed November 2010 at <http://www.fs.fed.us/land/ecosysmgmt/index.html>.
- (British Columbia Parks, 2010). British Columbia Parks. 2010. *South Okanagan-Similkameen Conservation Program*. Accessed February 2011 at <http://www.env.gov.bc.ca/bcparks/partnership/landAcquisitionMultiPartner.html>.
- (Bryce et al., 1996). Bryce, S.A., J.M. Omernik, D.A. Pater, M. Ulmer, J. Schaar, J. Freeouf, R. Johnson, P. Kuck, and S.H. Azevedo. 1996. *Ecoregions of North Dakota and South Dakota, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000)*. Accessed October 2010 at [http://www.epa.gov/wed/pages/ecoregions/ndsd\\_eco.htm](http://www.epa.gov/wed/pages/ecoregions/ndsd_eco.htm).
- (Center for Invasive Plant Management, 2010). Center for Invasive Plant Management. 2010. *Western States and Provinces Weed Lists*. Accessed November 2010 at [http://www.weedcenter.org/inv\\_plant\\_info/state.html#mt](http://www.weedcenter.org/inv_plant_info/state.html#mt).
- (Cleland et al., 2004). Cleland, D., Crow, T., Saunders, S., Dickmann, D., Maclean, A., Jordan, J., Watson, R., Sloan, A., and K. Brososke. *Characterizing historical and modern fire regimes in Michigan (USA): A landscape ecosystem approach*. *Landscape Ecology* 19: 311–325, 2004.
- (Davis, 1996). Davis, M.D. Ed. *Eastern old-growth forests: prospects for rediscovery and recovery*. Island Press. Washington, DC.
- (Donofrio and Ojima 1997). Donofrio, C., and D. S. Ojima, 1997. *The Great Plains today, in Climate Change Impacts on the Great Plains*. Office of Science and Technology Policy and United States Global Change Research Program Workshop, compiled by D. S. Ojima, W. E. Easterling, and C. Donofrio, Colorado State University, Fort Collins, Colorado, pp. 1-24, 1997.
- (EOE, 2009). Encyclopedia of Earth. 2009. *Eastern Broadleaf forest (Continental) Province (Bailey)*. Accessed November 2010 at [http://www.eoearth.org/article/Eastern\\_Broadleaf\\_Forest\\_%28Continental%29\\_Province\\_%28Bailey%29](http://www.eoearth.org/article/Eastern_Broadleaf_Forest_%28Continental%29_Province_%28Bailey%29).
- (Feierabend, 1992). Feierabend, J. S. 1992. *Endangered species, endangered wetlands: Life on the edge*. National Wildlife Federation, Washington, D.C. 49 pp.

(IDFG, 2010). Idaho Department of Fish and Game. 2010. *Idaho lakes statistics*. Accessed November 2010 at <http://fishandgame.idaho.gov/fish/>.

(Idaho Weed Coordinating Committee, 2005). Idaho Weed Coordinating Committee. 2005. *Idaho's Strategic Plan for Managing Noxious and Invasive Weeds*. Accessed November 2010 at <http://www.agri.state.id.us/Categories/PlantsInsects/NoxiousWeeds/Documents/general/StrategicPlan-10-11-05.pdf>.

(Igl and Johnson, 1998). Igl, L. D., and D. H. Johnson. 1998. *Highlight Box: Wetland Birds in the Northern Great Plains*. Pages 454-455 in M. J. Mac, P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, eds. *Status and Trends of the Nation's Biological Resources*, Vol. 2. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Accessed November 2010 at <http://www.npwr.usgs.gov/resource/2000/grlands/grlands.htm>.

(Knight, 2009). Knight, K. 2009. *Land Use Planning for Salmon, Steelhead and Trout*. Washington Department of Fish and Wildlife. Olympia, Washington. Accessed November 2010 at <http://wdfw.wa.gov/publications/00033/wdfw00033.pdf>.

(Latty et al., 1994). Latty, E. F., Canham, C. D., and P.L. Marks. 1994. *The effects of land-use history on soil properties and nutrient dynamics in northern hardwood forests of the Adirondack Mountains*. *Ecosystems*, Vol. 7(, No. 2):, pp. 193-207.

(LePage, 2011). LePage, D. 2011. *Checklist of birds of Vermont*. Accessed February 2011 at <http://avibase.bsc-eoc.org/checklist.jsp?region=usvt&list=howardmoore>.

(Maine Geological Survey, 2005). Maine Geological Survey. 2005. *Active Coastal Processes*. Accessed November 2010 at [www.maine.gov/doc/nrimc/mgs/explore/marine/sites/aug98.htm](http://www.maine.gov/doc/nrimc/mgs/explore/marine/sites/aug98.htm).

(Maine Natural Areas Program, 2005). Maine Natural Areas Program. 2005. (Updated in 2010). Accessed February 2011: <http://www.maine.gov/doc/nrimc/mnap/>.

(Maryland Department of Environment, 2010). Maryland Department of Environment. 2010. *Wetland disturbance and impact*. Accessed October 2010 at [http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands\\_Waterways/about\\_wetlands/disturbance.asp](http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/about_wetlands/disturbance.asp).

(McNab and Avers, 1994). McNab, W., and P.Avers. 1994. *Ecological Subregions of the United States*. Accessed November 2010 at <http://www.fs.fed.us/land/pubs/ecoregions/index.html>.

(McShea et al., 2007). McShea, W. J., W. M Healy, P. Devers, T. Fearer, F. H. Koch, D. Stauffer, Dean, and J. Waldon. 2007. *Forestry matters: decline of oaks will impact wildlife in hardwood forests*. *Journal of Wildlife Management*. 71(5): 1717 – 1728.

(Medley et al., 2003). Medley, K., Pobocik, C., Okey, B. 2003. *Historical Changes in Forest Cover and Land Ownership in a Midwestern U.S. Landscape*. *Annals of the Association of American Geographers*. 93(1): 104 – 120.

(Mladenoff et al., 1993). Mladenoff, D.J., M. A. White, J. Pastor, and T. R. Crow. 1993. *Comparing spatial pattern in unaltered old-growth and disturbed forest landscapes*. *Ecological Applications* 3(2):294-306.

(MN DNR, 2009). Minnesota Department of Natural Resources. 2009. *Invasive terrestrial plants*. Accessed November 2010 at <http://www.dnr.state.mn.us/invasives/terrestrialplants/index.html>.

(Montana Outdoors, 2006). Montana Outdoors. 2006. *Walleyes in Montana*. Accessed February 2011 at <http://fwp.mt.gov/mtoutdoors/HTML/articles/portraits/walleye.htm>.

(MT FWP, 2002). Montana Fish, Wildlife, and Parks. 2002. *Fort Peck Reservoir Fisheries Management Plan 2002 – 2012*. Accessed November 2010 at <http://fwpiis.mt.gov/content/getItem.aspx?id=7288>.

(MT FWP, 2010). Montana Fish, Wildlife and Parks. 2010. *Species of concern*. Accessed November 2010 at <http://fwp.mt.gov/wildthings/concern/>.

(The Nature Conservancy, 2010a). The Nature Conservancy. 2010c. *Bluestem Prairie*. Accessed February 2011 at <http://www.nature.org/wherewework/northamerica/states/minnesota/preserves/art6940.html>.

(The Nature Conservancy, 2010b). The Nature Conservancy. 2010a. *New Hampshire. Preserve description: Hurlbert Swamp*. Accessed October 2010 at : <http://www.nature.org/wherewework/northamerica/states/newhampshire/preserves/art316.html>.

(The Nature Conservancy, 2010c). The Nature Conservancy. 2010d. *New York Adirondack Region*. Accessed November 2010 at <http://www.nature.org/wherewework/northamerica/states/newyork/preserves/art11878.html>.

(Niering, 1998). Niering, W.A. 1998. *Forces that shaped the forests of the northeastern United States*. *Northeastern Naturalist* 5(2): 99-110.

(NOAA, 2007). National Oceanic and Atmospheric Administration, Fisheries Section. 2007. *Office of Protected Resources*. Maps of Critical Habitat. Accessed November 2010 at <http://www.nmfs.noaa.gov/pr/>.

(North Dakota Game and Fish Department, 2010). North Dakota Game and Fish Department. *Hunting in ND*. Accessed November 2010 at <http://gf.nd.gov/hunting/>.

(NYSOS, 2010). New York State Ornithological Society. 2010. *Checklist of the birds of New York*. Accessed November 2010 at <http://www.nybirds.org/Publications/ChecklistNYS.htm>.

(Pacific Northwest Invasive Plant Council, 2010). Pacific Northwest Invasive Plant Council. 2010. *Overview of invasive plant issues*. Accessed October 2010 at <http://www.pnw-ipc.org/about.shtml>.

(Page and Burr, 1991). Page, L., and B. Burr. 1991. *A field guide to freshwater fishes: North America North of Mexico*. Peterson Field Guide Series. Houghton Mifflin Co. Boston.

(Peet, 1988). Peet, R.K. 1988. Forests of the Rocky Mountains. *Aspen Bibliography*. Paper 3317. Accessed November 2010: [http://digitalcommons.usu.edu/aspen\\_bib/3317](http://digitalcommons.usu.edu/aspen_bib/3317).

(Robinson, 2003). Robinson, M. 2003. *Potential invader - zebra mussel: an exotic aquatic species*. Accessed November 2010 at <http://www.mass.gov/dcr/watersupply/lakepond/factsheet/Zebra%20Mussel.pdf>.

(Schulz et al., 2001). Schulz, K. E., T. Marriage, E. Nauertz, S. Garske, J. Zasada, D. Buckley, and T. R. Crow. 2001. *Response of understory herb species richness and cover to Acer saccharum regeneration thickets*. Presentation at Annual Meeting, Ecological Society of America, Madison, WI, Aug. 5-10, 2001.

(Sheldon et al., 2005). Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, S. Stanley, E. Stockdale. August 2003 Draft. *Freshwater Wetlands in Washington State Volume 1: A Synthesis of the Science*. Washington State Department of Ecology Publication # 03-06-016.

(Simberloff, 1996). Simberloff, D. 1996. *Impacts of introduced species in the United States*. U.S. Global Change Information Office. Consequences. Vol. 2(, No. 2). Accessed November 2010 at <http://www.gcric.org/CONSEQUENCES/vol2no2/article2.html>.

(State of Washington, 2003). State of Washington. 2003. *Washington State Sport Catch Report 2003*. Accessed October 2010 at: <http://wdfw.wa.gov/publications/01050/wdfw01050.pdf>.

(Stewart and Kantrudi, 1972). Stewart, R. E., and H. A. Kantrudi. 1972. *Vegetation of Prairie Potholes, North Dakota, in Relation to Quality of Water and Other Environmental Factors*. Accessed November 2010 at <http://library.ndsu.edu/exhibits/text/potholes/585d.html>.

(Turner, 2010). Turner, M.G. 2010. *Disturbance and landscape dynamics in a changing world*. Ecology 91:2833–2849.

(USDA, 2003a). U.S. Department of Agriculture. 2003. *Invasive and noxious weeds*. Accessed November 2010 at <http://plants.usda.gov/java/noxiousDriver>.

(USDA, 2003b). U.S. Department of Agriculture. 2003. *Invasive animal species*. Accessed November 2010 at <http://www.invasivespeciesinfo.gov/animals/main.shtml>.

(USDA, 2003c). U.S. Department of Agriculture, Forest Service. 2003c. *The forests of Maine*. Accessed November 2010: <http://www.fs.fed.us/ne/fia/states/me/2003highlights.pdf>.

(USDA, 2010). U.S. Department of Agriculture, Natural Resources Conservation Service. 2010. *Invasive plant species*. Accessed November 2010 at <http://plant-materials.nrcs.usda.gov/technical/invasive.html>.

(USDOI, 2004). U. S Department of the Interior. 2004. *Fishing license report*. Accessed February 2011 at <http://wsfrprograms.fws.gov/subpages/LicenseInfo/FishingLicCertHistory.pdf>.



(USDOI, 2009). U. S Department of the Interior, Fish and Wildlife Service. 2009. *Grizzly bear in Continental Divide region*. Accessed December 2010 at <http://www.fws.gov/mountain-prairie/species/mammals/grizzly/continental.htm>.

(USDOI, 2010a). U.S. Department of Interior, Fish and Wildlife Service. 2010. *Grizzly bear recovery zones*. Accessed December 2010 at <http://www.fws.gov/mountain-prairie/species/mammals/grizzly/>.

(USDOI, 2010b). U.S. Department of the Interior, Fish and Wildlife Service. 2010. *USFWS National Wetlands Inventory*. Accessed January 2011 at <http://www.fws.gov/wetlands/>.

(US EPA, 2010). U.S. Environmental Protection Agency. 2010. *Map of Level III Ecoregions of North America*. Accessed September 2010: [ftp://ftp.epa.gov/wed/ecoregions/cec\\_na/NA\\_LEVEL\\_III.pdf](ftp://ftp.epa.gov/wed/ecoregions/cec_na/NA_LEVEL_III.pdf).

(Van Cleve et al., 2009). Van Cleve, F., G. Barmann, M. Culver, and the MPA Work Group. 2009. *Marine Protected Areas of Washington: Recommendations of the Marine Protected Areas Workgroup to the Washington State Legislature*. Olympia, WA: Washington Department of Fish and Wildlife.

(WA DFW, 2008). Washington Department of Fish and Wildlife. 2008. *Priority Habitat and Species List*. Olympia, Washington. 176 pp. Accessed October 2010 at <http://wdfw.wa.gov/publications/00165/wdfw00165.pdf>.

(Washington Natural Heritage Program, 2007). Washington Natural Heritage Program. 2007. *Field Guide to Washington's Ecological Systems*. Accessed October 2010 at [http://www1.dnr.wa.gov/nhp/refdesk/pubs/wa\\_ecological\\_systems.pdf](http://www1.dnr.wa.gov/nhp/refdesk/pubs/wa_ecological_systems.pdf).

(White and Mladenoff, 1994). White, M., and D. Mladenoff. 1994. *Old-growth forest landscape transitions from pre-European settlement to present*. Landscape Ecology vol. 9( no. 3):, pp 191-205. Accessed November 2010 at <http://www.springerlink.com/content/150616626878542v/>.

(WWF, 2001). World Wildlife Fund. 2001. *Terrestrial ecoregions*. Accessed November 2010 at [http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0414\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0414_full.html).

[http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0810\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0810_full.html).

[http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0524\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0524_full.html).

[http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0518\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0518_full.html).

(WWF and TNC, 2008). Worldwide Fund for Nature and The Nature Conservancy. 2008. *Freshwater ecoregions of the world*. Accessed November 2010 at [http://www.feow.org/ecoregion\\_details.php?eco=116](http://www.feow.org/ecoregion_details.php?eco=116).

(Zager et al., 1995). Zager, P., Mills, L. S., Wakkinen, W., and D. Tallmon. 1995. *Woodland Caribou: A Conservation Dilemma*. Accessed October 2010 at <http://www.umich.edu/~esupdate/library/95.10-11/zager.html>.

PAGE INTENTIONALLY LEFT BLANK